TENTH EDITION

PROJECT MANAGEMENT

A SYSTEMS APPROACH TO PLANNING, SCHEDULING AND CONTROLLING

HAROLD KERZNER, PH.D.

PROJECT
MANAGEMENT

Dr. Kerzner's 16 Points to Project Management Maturity

1. Adopt a project management methodology and use it consistently.
2. Implement a philosophy that drives the company toward project management maturity and communicate it to everyone.
3. Commit to developing effective plans at the beginning of each project.
4. Minimize scope changes by committing to realistic objectives.
5. Recognize that cost and schedule management are inseparable.
6. Select the right person as the project manager.
7. Provide executives with project sponsor information, not project management information.
8. Strengthen involvement and support of line management.
9. Focus on deliverables rather than resources.
10. Cultivate effective communication, cooperation, and trust to achieve rapid project management maturity.
11. Share recognition for project success with the entire project team and line management.
12. Eliminate nonproductive meetings.
13. Focus on identifying and solving problems early, quickly, and cost effectively.
14. Measure progress periodically.
15. Use project management software as a tool—not as a substitute for effective planning or interpersonal skills.
16. Institute an all-employee training program with periodic updates based upon documented lessons learned.

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A Systems Approach to Planning, Scheduling, and Controlling

TENTH EDITION

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To
Dr. Herman Krier,
my Friend and Guru,
who taught me well the
meaning of the word “persistence”

Contents

Preface

Project management has evolved from a management philosophy restricted to a few functional areas and regarded as something nice to have to an enterprise project management system affecting every functional unit of the company. Simply stated, project management has evolved into a business process rather than merely a project management process. More and more companies are now regarding project management as being mandatory for the survival of the firm. Organizations that were opponents of project management are now advocates. Management educators of the past, who preached that project management could not work and would be just another fad, are now staunch supporters. Project management is here to stay. Colleges and universities are now offering graduate degrees in project management.

The text discusses the principles of project management. Students who are interested in advanced topics, such as some of the material in Chapters 21 to 24 of this text, may wish to read one of my other texts, *Advanced Project Management: Best Practices in Implementation* (Hoboken, NJ: Wiley, 2004), and *Project Management Best Practices: Achieving Global Excellence* (Hoboken, NJ: Wiley, 2006). John Wiley & Sons will also be introducing a five-book series on project management best practices, co-authored by Frank Saladis and Harold Kerzner, to accompany the above two books.

This book is addressed not only to those undergraduate and graduate students who wish to improve upon their project management skills but also to those functional managers and upper-level executives who serve as project sponsors and must provide continuous support for projects. During the past several years, management's knowledge and understanding of project management has matured to the point where almost every company is using project management in one form or another. These companies have come to the realization that project management

and productivity are related and that we are now managing our business as though it is a series of projects. Project management coursework is now consuming more of training budgets than ever before.

General reference is provided in the text to engineers. However, the reader should not consider project management as strictly engineering related. The engineering examples are the result of the fact that project management first appeared in the engineering disciplines, and we should be willing to learn from their mistakes. Project management now resides in every profession, including information systems, health care, consulting, pharmaceutical, banks, and government agencies.

The text can be used for both undergraduate and graduate courses in business, information systems, and engineering. The structure of the text is based upon my belief that project management is much more behavioral than quantitative since projects are managed by people rather than tools. The first five chapters are part of the basic core of knowledge necessary to understand project management. Chapters 6 through 8 deal with the support functions of managing your time effectively, conflicts, and other special topics. Chapters 9 and 10 describe factors for predicting success and management support. It may seem strange that 10 chapters on organizational behavior and structuring are needed prior to the "hard-core" chapters of planning, scheduling, and controlling. These first 10 chapters are needed to understand the cultural environment for all projects and systems. These chapters are necessary for the reader to understand the difficulties in achieving cross-functional cooperation on projects where team members are working on multiple projects concurrently and why the people involved, all of whom may have different backgrounds, cannot simply be forged into a cohesive work unit without friction. Chapters 11 through 20 are more of the quantitative chapters on planning, scheduling, cost control, estimating, procurement, and quality. Chapters 21 through 24 are advanced topics and future trends. Chapter 25 is a capstone case study that can be related to almost all of the chapters in the text.

The changes that were made in the 10th edition include:

- A chapter on the business of scope changes
- A chapter on managing crises projects
- A chapter on the Iridium Project, which serves as a capstone case
- An appendix on using the book to study for the PMP® exam
- A section on understanding the collective belief on a project
- A section on the need for an exit champion
- A section on project financing
- A section on managing virtual teams
- A section on rewarding project teams
- A section on the need for an enterprise project management system
- A section on kickoff meeting
- A section on breakthrough projects
- A section on project audits
- A section on managing intellectual property

- A section on the problems associated with project scheduling
- A section on schedule compression myths
- A section on human behavior education
- A section on dysfunctional team behavior
- A section on validating project assumptions
- Existing sections from the 9th edition with expanded information include: the new breed of project manager; additional scheduling problems; a discussion on the difference between active and passive involvement by the sponsor; the need for challenging the decisions of the sponsor; information needed for effective estimating; managing stakeholder expectations; the project war room; power and authority; the management reserve; and Six Sigma. The chapters on risk management and procurement were restructured to be in better alignment with the PMBOK® Guide, 4th edition.

The text contains more than 25 case studies, more than 125 multiple choice questions, and nearly 400 discussion questions. In addition, there is a supplemental workbook (*Project Management Workbook to Accompany Project Management*, tenth edition) that contains more than 600 multiple choice questions, additional case studies, challenging problems, and crossword puzzles. There is also a separate book of cases (*Project Management Case Studies*, third edition) that provides additional real-world examples.

This text, the workbook, and the book of cases are ideal as self-study tools for the Project Management Institute's PMP® Certification exam. Because of this, there are tables of cross references on each chapter's opening page in the textbook detailing the sections from the book of cases, the workbook, and the Guide to the Project Management Body of Knowledge (PMBOK® Guide) that apply to that chapter's content. The left-hand margin of the pages in the text has side bars that identify the cross-listing of the material on that page to the appropriate section(s) of the PMBOK® Guide. At the end of most of the chapters is a section on study tips for the PMP® exam, including more than 125 multiple choice questions.

This textbook is currently used in the college market, in the reference market, and for studying for the PMP® Certification exam. Therefore, to satisfy the needs of all markets, a compromise had to be reached on how much of the text would be aligned to the PMBOK® Guide and how much new material would be included without doubling the size of the text. Some colleges and universities use the textbook to teach project management fundamentals without reference to the PMBOK® Guide. The text does not contain all of the material necessary to support each section of the PMBOK® Guide. Therefore, to study for the PMP® Certification exam, the PMBOK® Guide must also be used together with this text. The text covers material for almost all of the PMBOK® Guide knowledge areas but not necessarily in the depth that appears in the PMBOK® Guide.

An instructor's manual is available only to college and university faculty members by contacting your local Wiley sales representative or by visiting

the Wiley website at www.wiley.com/kerzner. This website includes not only the instructor's manual but also 500 PowerPoint slides that follow the content of the book and help organize and execute classroom instruction and group learning. Access to the instructor's material can be provided only through John Wiley & Sons Publishers, not the author.

One-, two-, and three-day seminars on project management and the PMP® Certification Training using the text are offered by contacting Lori Milhaven, Executive Vice President, the International Institute for Learning, at 800-325-1533, extension 5121 (email address: lori.milhaven@iil.com).

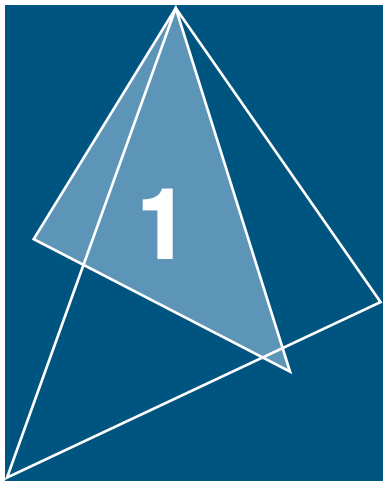
The problems and case studies at the ends of the chapters cover a variety of industries. Almost all of the case studies are real-world situations taken from my consulting practice. Feedback from my colleagues who are using the text has provided me with fruitful criticism, most of which has been incorporated into the tenth edition.

The majority of the articles on project management that have become classics have been referenced in the textbook throughout the first 11 chapters. These articles were the basis for many of the modern developments in project management and are therefore identified throughout the text.

Many colleagues provided valuable criticism. In particular, I am indebted to those industrial/government training managers whose dedication and commitment to quality project management education and training have led to valuable changes in this and previous editions. In particular, I wish to thank Frank Saladis, PMP®, Senior Consultant and Trainer with the International Institute for Learning, for his constructive comments, recommendations, and assistance with the mapping of the text to the PMBOK® Guide as well as recommended changes to many of the chapters. I am indebted to Dr. Edmund Conrow, PMP®, for a decade of assistance with the preparation of the risk management chapters in all of my texts.

To the management team and employees of the International Institute for Learning, thank you all for 20 years of never-ending encouragement, support, and assistance with all of my project management research and writings.

Harold Kerzner
The International Institute for Learning
2009



Overview

Related Case Studies (from Kerzner/*Project Management Case Studies,* 3rd Edition)	Related Workbook Exercises (from Kerzner/*Project Management Workbook and PMP®/CAPM® Exam Study Guide,* 10th Edition)	PMBOK® Guide, 4th Edition, Reference Section for the PMP® Certification Exam
• Kombs Engineering • Williams Machine Tool Company* • Hyten Corporation • Macon, Inc. • Continental Computer Corporation • Jackson Industries	• Multiple Choice Exam	• Integration Management • Scope Management • Human Resource Management

1.0 INTRODUCTION

Executives will be facing increasingly complex challenges during the next decade. These challenges will be the result of high escalation factors for salaries and raw materials, increased union demands, pressure from stockholders, and the possibility of long-term high inflation accompanied by a mild recession and a lack of borrowing power with financial institutions. These environmental conditions have existed before, but not to the degree that they do today.

*Case Study also appears at end of chapter.

In the past, executives have attempted to ease the impact of these environmental conditions by embarking on massive cost-reduction programs. The usual results of these programs have been early retirement, layoffs, and a reduction in manpower through attrition. As jobs become vacant, executives pressure line managers to accomplish the same amount of work with fewer resources, either by improving efficiency or by upgrading performance requirements to a higher position on the learning curve. Because people costs are more inflationary than the cost of equipment or facilities, executives are funding more and more capital equipment projects in an attempt to increase or improve productivity without increasing labor.

Unfortunately, executives are somewhat limited in how far they can go to reduce manpower without running a high risk to corporate profitability. Capital equipment projects are not always the answer. Thus, executives have been forced to look elsewhere for the solutions to their problems.

Almost all of today's executives are in agreement that the solution to the majority of corporate problems involves obtaining better control and use of existing corporate resources, looking internally rather than externally for the solution. As part of the attempt to achieve an internal solution, executives are taking a hard look at the ways corporate activities are managed. Project management is one of the techniques under consideration.

The project management approach is relatively modern. It is characterized by methods of restructuring management and adapting special management techniques, with the purpose of obtaining better control and use of existing resources. Forty years ago project management was confined to U.S. Department of Defense contractors and construction companies. Today, the concept behind project management is being applied in such diverse industries and organizations as defense, construction, pharmaceuticals, chemicals, banking, hospitals, accounting, advertising, law, state and local governments, and the United Nations.

The rapid rate of change in both technology and the marketplace has created enormous strains on existing organizational forms. The traditional structure is highly bureaucratic, and experience has shown that it cannot respond rapidly enough to a changing environment. Thus, the traditional structure must be replaced by project management, or other temporary management structures that are highly organic and can respond very rapidly as situations develop inside and outside the company.

Project management has long been discussed by corporate executives and academics as one of several workable possibilities for organizational forms of the future that could integrate complex efforts and reduce bureaucracy. The acceptance of project management has not been easy, however. Many executives are not willing to accept change and are inflexible when it comes to adapting to a different environment. The project management approach requires a departure from the traditional business organizational form, which is basically vertical and which emphasizes a strong superior–subordinate relationship.

1.1 UNDERSTANDING PROJECT MANAGEMENT

PMBOK® Guide, 4th Edition
1.2 What Is a Project?
1.3 What Is Project Management?

In order to understand project management, one must begin with the definition of a project. A project can be considered to be any series of activities and tasks that:

- Have a specific objective to be completed within certain specifications
- Have defined start and end dates
- Have funding limits (if applicable)
- Consume human and nonhuman resources (i.e., money, people, equipment)
- Are multifunctional (i.e., cut across several functional lines)

Project management, on the other hand, involves five process groups as identified in the PMBOK® Guide, namely:

- Project initiation
    - Selection of the best project given resource limits
    - Recognizing the benefits of the project
    - Preparation of the documents to sanction the project
    - Assigning of the project manager
- Project planning
    - Definition of the work requirements
    - Definition of the quality and quantity of work
    - Definition of the resources needed
    - Scheduling the activities
    - Evaluation of the various risks
- Project execution
    - Negotiating for the project team members
    - Directing and managing the work
    - Working with the team members to help them improve
- Project monitoring and control
    - Tracking progress
    - Comparing actual outcome to predicted outcome
    - Analyzing variances and impacts
    - Making adjustments
- Project closure
    - Verifying that all of the work has been accomplished
    - Contractual closure of the contract
    - Financial closure of the charge numbers
    - Administrative closure of the papework

Successful project management can then be defined as having achieved the project objectives:

- Within time
- Within cost
- At the desired performance/technology level
- While utilizing the assigned resources effectively and efficiently
- Accepted by the customer

The potential benefits from project management are:

- Identification of functional responsibilities to ensure that all activities are accounted for, regardless of personnel turnover
- Minimizing the need for continuous reporting
- Identification of time limits for scheduling
- Identification of a methodology for trade-off analysis
- Measurement of accomplishment against plans

- Early identification of problems so that corrective action may follow
- Improved estimating capability for future planning
- Knowing when objectives cannot be met or will be exceeded

Unfortunately, the benefits cannot be achieved without overcoming obstacles such as:

- Project complexity
- Customer's special requirements and scope changes
- Organizational restructuring
- Project risks
- Changes in technology
- Forward planning and pricing

Project management can mean different things to different people. Quite often, people misunderstand the concept because they have ongoing projects within their company and feel that they are using project management to control these activities. In such a case, the following might be considered an appropriate definition:

> Project management is the art of creating the illusion that any outcome is the result of a series of predetermined, deliberate acts when, in fact, it was dumb luck.

Although this might be the way that some companies are running their projects, this is not project management. Project management is designed to make better use of existing resources by getting work to flow horizontally as well as vertically within the company. This approach does not really destroy the vertical, bureaucratic flow of work but simply requires that line organizations talk to one another horizontally so work will be accomplished more smoothly throughout the organization. The vertical flow of work is still the responsibility of the line managers. The horizontal flow of work is the responsibility of the project managers, and their primary effort is to communicate and coordinate activities horizontally between the line organizations.

PMBOK® Guide, 4th Edition
1.6 Project Management Skills

Figure 1–1 shows how many companies are structured. There are always "class or prestige" gaps between various levels of management. There are also functional gaps between working units of the organization. If we superimpose the management gaps on top of the functional gaps, we find that companies are made up of small operational islands that refuse to communicate with one another for fear that giving up information may strengthen their opponents. The project manager's responsibility is to get these islands to communicate cross-functionally toward common goals and objectives.

The following would be an overview definition of project management:

> Project management is the planning, organizing, directing, and controlling of company resources for a relatively short-term objective that has been established to complete specific goals and objectives. Furthermore, project management utilizes the systems approach to management by having functional personnel (the vertical hierarchy) assigned to a specific project (the horizontal hierarchy).

PMBOK® Guide, 4th Edition
2.4.2 Organizational Structures

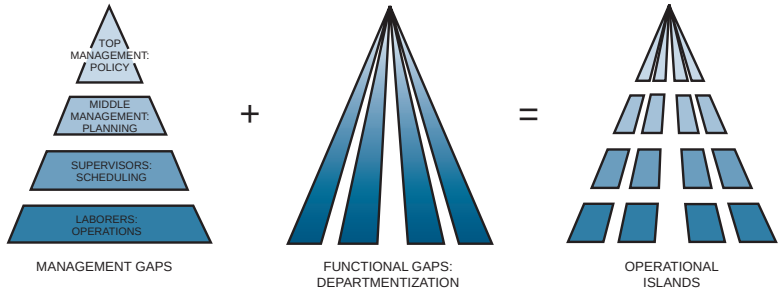


FIGURE 1–1. Why are systems necessary?

The above definition requires further comment. Classical management is usually considered to have five functions or principles:

- Planning
- Organizing
- Staffing
- Controlling
- Directing

You will notice that, in the above definition, the staffing function has been omitted. This was intentional because the project manager does not staff the project. Staffing is a line responsibility. The project manager has the right to request specific resources, but the final decision of what resources will be committed rests with the line managers.

We should also comment on what is meant by a "relatively" short-term project. Not all industries have the same definition for a short-term project. In engineering, the project might be for six months or two years; in construction, three to five years; in nuclear components, ten years; and in insurance, two weeks. Long-term projects, which consume resources full-time, are usually set up as a separate division (if large enough) or simply as a line organization.

Figure 1–2 is a pictorial representation of project management. The objective of the figure is to show that project management is designed to manage or control company resources on a given activity, within time, within cost, and within performance. Time, cost, and performance are the constraints on the project. If the project is to be accomplished for an outside customer, then the project has a fourth constraint: good customer relations. The reader should immediately realize that it is possible to manage a project internally within time, cost, and performance and then alienate the customer to such a degree that no further business will be forthcoming. Executives often select project managers based on who the customer is and what kind of customer relations will be necessary.

Projects exist to produce deliverables. The person ultimately assigned as the project manager may very well be assigned based upon the size, nature, and scope of the deliverables. Deliverables are outputs, or the end result of either the completion of the project or the end of a life-cycle phase of the project. Deliverables are measurable, tangible outputs and can take such form as:

- **Hardware Deliverables:** These are hardware items, such as a table, a prototype, or a piece of equipment.

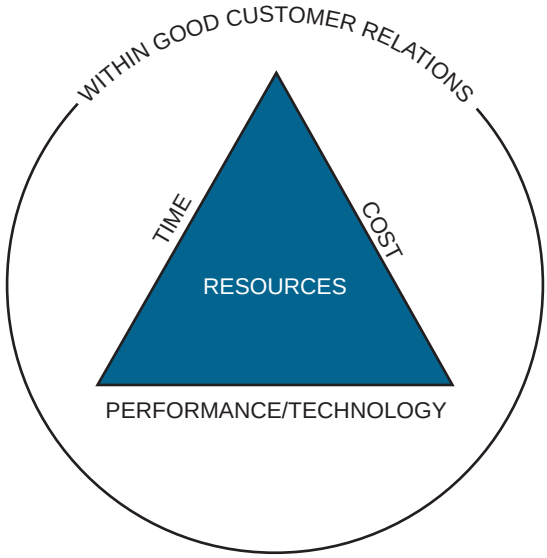


FIGURE 1–2. Overview of project management.

- **Software Deliverables:** These items are similar to hardware deliverables but are usually paper products, such as reports, studies, handouts, or documentation. Some companies do not differentiate between hardware and software deliverables.
- **Interim Deliverables:** These items can be either hardware or software deliverables and progressively evolve as the project proceeds. An example might be a series of interim reports leading up to the final report.

Another factor influencing the selection of the project manager would be the stakeholders. Stakeholders are individuals or organizations that can be favorably or unfavorably impacted by the project. As such, project managers must interface with these stakeholders, and many of the stakeholders can exert their influence or pressure over the direction of the project.

Some stakeholders are referred to as "active" or "key" stakeholders that can possess decision-making authority during the execution of the project. Each stakeholder can have his or her own set of objectives, and this could place the project manager in a position of having to balance a variety of stakeholder interests without creating a conflict-of-interest situation for the project manager.

Each company has its own categorization system for identifying stakeholders. A typical system might be:

- Organizational stakeholders
  - Executive officers
  - Line managers
  - Employees
  - Unions

- Product/market stakeholders
  - Customers
  - Suppliers
  - Local committees
  - Governments (local, state, and federal)
  - General public
- Capital market stakeholders
  - Shareholders
  - Creditors
  - Banks

1.2 DEFINING PROJECT SUCCESS

In the previous section, we defined project success as the completion of an activity within the constraints of time, cost, and performance. This was the definition used for the past twenty years or so. Today, the definition of project success has been modified to include completion:

- Within the allocated time period
- Within the budgeted cost
- At the proper performance or specification level
- With acceptance by the customer/user
- With minimum or mutually agreed upon scope changes
- Without disturbing the main work flow of the organization
- Without changing the corporate culture

The last three elements require further explanation. Very few projects are completed within the original scope of the project. Scope changes are inevitable and have the potential to destroy not only the morale on a project, but the entire project. Scope changes *must* be held to a minimum and those that are required *must* be approved by both the project manager and the customer/user.

Project managers must be willing to manage (and make concessions/trade-offs, if necessary) such that the company's main work flow is not altered. Most project managers view themselves as self-employed entrepreneurs after project go-ahead, and would like to divorce their project from the operations of the parent organization. This is not always possible. The project manager must be willing to manage within the guidelines, policies, procedures, rules, and directives of the parent organization.

All corporations have corporate cultures, and even though each project may be inherently different, the project manager should not expect his assigned personnel to deviate from cultural norms. If the company has a cultural standard of openness and honesty when dealing with customers, then this cultural value should remain in place for all projects, regardless of who the customer/user is or how strong the project manager's desire for success is.

As a final note, it should be understood that simply because a project is a success does not mean that the company as a whole is successful in its project management endeavors. Excellence in project management is defined as a continuous stream of successfully

managed projects. Any project can be driven to success through formal authority and strong executive meddling. But in order for a continuous stream of successful projects to occur, there must exist a strong corporate commitment to project management, and this commitment *must be visible.*

1.3 THE PROJECT MANAGER–LINE MANAGER INTERFACE

PMBOK® Guide, 4th Edition
1.6 Project Management Skills

We have stated that the project manager must control company resources within time, cost, and performance. Most companies have six resources:

- Money
- Manpower
- Equipment
- Facilities
- Materials
- Information/technology

Actually, the project manager does *not* control any of these resources directly, except perhaps money (i.e., the project budget).[1] Resources are controlled by the line managers, functional managers, or, as they are often called, resources managers. Project managers must, therefore, negotiate with line managers for all project resources. When we say that project managers control project resources, we really mean that they control those resources (which are temporarily loaned to them) *through line managers.*

Today, we have a new breed of project manager. Years ago, virtually all project managers were engineers with advanced degrees. These people had a command of technology rather than merely an understanding of technology. If the line manager believed that the project manager did in fact possess a command of technology, then the line manager would allow the assigned functional employees to take direction from the project manager. The result was that project managers were expected to manage people.

Most project managers today have an understanding of technology rather than a command of technology. As a result, the accountability for the success of the project is now viewed as shared accountability between the project manager and all affected line managers. With shared accountability, the line managers must now have a good understanding of project management, which is why more line managers are now becoming PMP®S. Project managers are now expected to focus more so on managing the project's deliverables rather than providing technical direction to the project team. Management of the assigned resources is more often than not a line function.

Another important fact is that project managers are treated as though they are managing part of a business rather than simply a project, and as such are expected to make sound business decisions as well as project decisions. Project managers must understand business principles. In the future, project managers may be expected to become externally certified by PMI® and internally certified by their company on the organization's business processes.

1. Here we are assuming that the line manager and project manager are not the same individual. However, the terms *line manager* and *functional manager* are used interchangeably throughout the text.

In recent years, the rapid acceleration of technology has forced the project manager to become more business oriented. According to Hans Thamhain,

> The new breed of business leaders must deal effectively with a broad spectrum of contemporary challenges that focus on time-to-market pressures, accelerating technologies, innovation, resource limitations, technical complexities, social and ethical issues, operational dynamics, cost, risks, and technology itself as summarized below:

- High task complexities, risks and uncertainties
- Fast-changing markets, technology, regulations
- Intense competition, open global markets
- Resource constraint, tough performance requirements
- Tight, end-date-driven schedules
- Total project life-cycle considerations
- Complex organizations and cross-functional linkages
- Joint ventures, alliances and partnerships, need for dealing with different organizational cultures and values
- Complex business processes and stakeholder communities
- Need for continuous improvements, upgrades and enhancements
- Need for sophisticated people skills, ability to deal with organizational conflict, power, and politics
- Increasing impact of IT and e-business[2]

Dr. Thamhain further believes that there are paradigm shifts in technology-oriented business environments that will affect the business leaders of the future, including project managers. According to Dr. Thamhain, we are shifting from…

- … mostly linear work processes to highly dynamic, organic and integrated management systems
- …efficiency toward effectiveness
- …executing projects to enterprise-wide project management
- …managing information to fully utilizing information technology
- …managerial control to self-direction and accountability
- …managing technology as part of a functional speciality ot management of technology as a distinct skill set and professional
- …status[3]

Another example of the need for the project manager to become more actively involved in business aspects has been identified by Gary Heerkens. Heerkens provides several revelations of why business knowledge has become important, a few of which are[4]:

- It really doesn't matter how well you execute a project, if you're working on the wrong project!

2. H. J. Thamhain, *Management of Technology*, (Hoboken, NJ: Wiley, 2005), pp. 3–4.
3. See note 2; Thamhain; p. 28.
4. G. Heerkens, *The Business-Savvy Project Manager* (New York: McGraw-Hill, 2006), pp. 4–8.

- There are times when spending more money on a project could be smart business—even if you exceed the original budget!
- There are times when spending more money on a project could be smart business—even if the project is delivered after the original deadline!
- Forcing the project team to agree to an unrealistic deadline may not be very smart, from a business standpoint.
- A portfolio of projects that all generate a positive cash flow may not represent an organization's best opportunity for investment.

It should become obvious at this point that successful project management is strongly dependent on:

- A good daily working relationship between the project manager and those line managers who directly assign resources to projects
- The ability of functional employees to report vertically to line managers at the same time that they report horizontally to one or more project managers

These two items become critical. In the first item, functional employees who are assigned to a project manager still take technical direction from their line managers. Second, employees who report to multiple managers will always favor the manager who controls their purse strings. Thus, most project managers appear always to be at the mercy of the line managers.

Classical management has often been defined as a process in which the manager does not necessarily perform things for himself, but accomplishes objectives through others in a group situation. This basic definition also applies to the project manager. In addition, a project manager must help himself. There is nobody else to help him.

If we take a close look at project management, we will see that the project manager actually works for the line managers, not vice versa. Many executives do not realize this. They have a tendency to put a halo around the head of the project manager and give him a bonus at project termination, when, in fact, the credit should go to the line managers, who are continually pressured to make better use of their resources. The project manager is simply the agent through whom this is accomplished. So why do some companies glorify the project management position?

To illustrate the role of the project manager, consider the time, cost, and performance constraints shown in Figure 1–2. Many functional managers, if left alone, would recognize only the performance constraint: "Just give me another $50,000 and two more months, and I'll give you the ideal technology."

The project manager, as part of these communicating, coordinating, and integrating responsibilities, reminds the line managers that there are also time and cost constraints on the project. This is the starting point for better resource control.

Project managers depend on line managers. When the project manager gets in trouble, the only place he can go is to the line manager because additional resources are almost always required to alleviate the problems. When a line manager gets in trouble, he usually goes first to the project manager and requests either additional funding or some type of authorization for scope changes.

To illustrate this working relationship between the project and line managers, consider the following situation:

Project Manager (addressing the line manager): "I have a serious problem. I'm looking at a $150,000 cost overrun on my project and I need your help. I'd like you to do the same amount of work that you are currently scheduled for but in 3,000 fewer man-hours. Since your organization is burdened at $60/hour, this would more than compensate for the cost overrun."

Line Manager: "Even if I could, why should I? You know that good line managers can always make work expand to meet budget. I'll look over my manpower curves and let you know tomorrow."

The following day . . .

Line Manager: "I've looked over my manpower curves and I have enough work to keep my people employed. I'll give you back the 3,000 hours you need, but remember, *you owe me one!*"

Several months later . . .

Line Manager: "I've just seen the planning for your new project that's supposed to start two months from now. You'll need two people from my department. There are two employees that I'd like to use on your project. Unfortunately, these two people are available now. If I don't pick these people up on your charge number right now, some other project might pick them up in the interim period, and they won't be available when your project starts."

Project Manager: "What you're saying is that you want me to let you sandbag against one of my charge numbers, knowing that I really don't need them."

Line Manager: "That's right. I'll try to find other jobs (and charge numbers) for them to work on temporarily so that your project won't be completely burdened. Remember, you owe me one."

Project Manager: "O.K. I know that I owe you one, so I'll do this for you. Does this make us even?"

Line Manager: "Not at all! But you're going in the right direction."

When the project management–line management relationship begins to deteriorate, the project almost always suffers. Executives must promote a good working relationship between line and project management. One of the most common ways of destroying this relationship is by asking, "Who contributes to profits—the line or project manager?" Project managers feel that they control all project profits because they control the budget.

The line managers, on the other hand, argue that they must staff with appropriately budgeted-for personnel, supply the resources at the desired time, and supervise performance. Actually, both the vertical and horizontal lines contribute to profits. These types of conflicts can destroy the entire project management system.

The previous examples should indicate that project management is more behavioral than quantitative. Effective project management requires an understanding of:

- Quantitative tools and techniques
- Organizational structures
- Organizational behavior

Most people understand the quantitative tools for planning, scheduling, and controlling work. It is imperative that project managers understand totally the operations of each line organization. In addition, project managers must understand their own job description, especially where their authority begins and ends. During an in-house seminar on engineering project management, the author asked one of the project engineers to provide a description of his job as a project engineer. During the discussion that followed, several proj-ect managers and line managers said that there was a great deal of overlap between their job descriptions and that of the project engineer.

Organizational behavior is important because the functional employees at the interface position find themselves reporting to more than one boss—a line manager and one project manager for each project they are assigned to. Executives must provide proper training so functional employees can report effectively to multiple managers.

1.4 DEFINING THE PROJECT MANAGER'S ROLE

PMBOK® Guide, 4th Edition
2.3 Stakeholders
2.3.8 Functional Managers
2.3.6 Project Managers
Chapter 4 Project Integration Management

The project manager is responsible for coordinating and integrating activities across multiple, functional lines. The integration activities performed by the project manager include:

- Integrating the activities necessary to develop a project plan
- Integrating the activities necessary to execute the plan
- Integrating the activities necessary to make changes to the plan

These integrative responsibilities are shown in Figure 1–3 where the project manager must convert the inputs (i.e., resources) into outputs of products, services, and ultimately profits. In order to do this, the project manager needs strong communicative and interpersonal skills, must become familiar with the operations of each line organization, and must have knowledge of the technology being used.

An executive with a computer manufacturer stated that his company was looking externally for project managers. When asked if he expected candidates to have a command of computer technology, the executive remarked: "You give me an individual who has

PMBOK® Guide, 4th Edition
Chapter 4 Integration Management

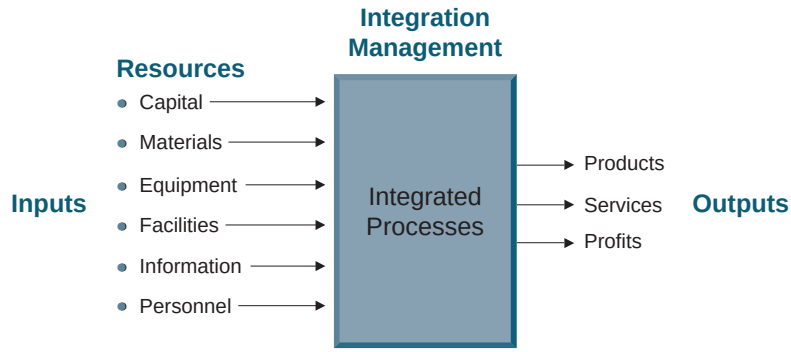


FIGURE 1–3. Integration management.

good communicative skills and interpersonal skills, and I'll give that individual a job. I can teach people the technology and give them technical experts to assist them in decision making. But I cannot teach somebody how to work with people."

The project manager's job is not an easy one. Project managers may have increasing responsibility, but very little authority. This lack of authority can force them to "negotiate" with upper-level management as well as functional management for control of company resources. They may often be treated as outsiders by the formal organization.

In the project environment, everything seems to revolve about the project manager. Although the project organization is a specialized, task-oriented entity, it cannot exist apart from the traditional structure of the organization. The project manager, therefore, must walk the fence between the two organizations. The term *interface management* is often used for this role, which can be described as managing relationships:

- Within the project team
- Between the project team and the functional organizations
- Between the project team and senior management
- Between the project team and the customer's organization, whether an internal or external organization

To be effective as a project manager, an individual must have management as well as technical skills. Because engineers often consider their careers limited in the functional disciplines, they look toward project management and project engineering as career path opportunities. But becoming a manager entails learning about psychology, human behavior, organizational behavior, interpersonal relations, and communications. MBA programs have come to the rescue of individuals desiring the background to be effective project managers.

In the past, executives motivated and retained qualified personnel primarily with financial incentives. Today other ways are being used, such as a change in title or the promise of more challenging work. Perhaps the lowest turnover rates of any professions in the world are in project management and project engineering. In a project environment, the

project managers and project engineers get to see their project through from "birth to death." Being able to see the fruits of one's efforts is highly rewarding. A senior project manager in a construction company commented on why he never accepted a vice presidency that had been offered to him: "I can take my children and grandchildren into ten countries in the world and show them facilities that I have built as the project manager. What do I show my kids as an executive? The size of my office? My bank account? A stockholder's report?"

The project manager is actually a general manager and gets to know the total operation of the company. In fact, project managers get to know more about the total operation of a company than most executives. That is why project management is often used as a training ground to prepare future general managers who will be capable of filling top management positions.

1.5 DEFINING THE FUNCTIONAL MANAGER'S ROLE

PMBOK® Guide, 4th Edition
Chapter 9 Human Resources Management
9.1.2 HR Planning: Tools and Techniques

Assuming that the project and functional managers are not the same person, we can identify a specific role for the functional manager. There are three elements to this role:

- The functional manager has the responsibility to define *how* the task will be done and *where* the task will be done (i.e., the technical criteria).
- The functional manager has the responsibility to provide sufficient resources to accomplish the objective within the project's constraints (i.e., *who* will get the job done).
- The functional manager has the responsibility for the deliverable.

In other words, once the project manager identifies the requirements for the project (i.e., what work has to be done and the constraints), it becomes the line manager's responsibility to identify the technical criteria. Except perhaps in R&D efforts, the line manager should be the recognized technical expert. If the line manager believes that certain technical portions of the project manager's requirements are unsound, then the line manager has the right, by virtue of his expertise, to take exception and plead his case to a higher authority.

In Section 1.1 we stated that all resources (including personnel) are controlled by the line manager. The project manager has the right to request specific staff, but the final appointments rest with line managers. It helps if project managers understand the line manager's problems:

- Unlimited work requests (especially during competitive bidding)
- Predetermined deadlines
- All requests having a high priority
- Limited number of resources
- Limited availability of resources

- Unscheduled changes in the project plan
- Unpredicted lack of progress
- Unplanned absence of resources
- Unplanned breakdown of resources
- Unplanned loss of resources
- Unplanned turnover of personnel

Only in a very few industries will the line manager be able to identify to the project manager in advance exactly what resources will be available when the project is scheduled to begin. It is not important for the project manager to have the best available resources. Functional managers should not commit to certain people's availability. Rather, the functional manager should commit to achieving his portion of the objective within time, cost, and performance even if he has to use average or below-average personnel. If the project manager is unhappy with the assigned functional resources, then the project manager should closely track that portion of the project. Only if and when the project manager is convinced by the evidence that the assigned resources are unacceptable should he confront the line manager and demand better resources.

The fact that a project manager is assigned does not relieve the line manager of his functional responsibility to perform. If a functional manager assigns resources such that the constraints are not met, then *both* the project and functional managers will be blamed. One company is even considering evaluating line managers for merit increases and promotion based on how often they have lived up to their commitments to the project managers. Therefore, it is extremely valuable to everyone concerned to have all project commitments *made visible to all.*

Some companies carry the concept of commitments to extremes. An aircraft components manufacturer has a Commitment Department headed by a second-level manager. The function of the Commitment Department is to track how well the line managers keep their promises to the project managers. The department manager reports directly to the vice president of the division. In this company, line managers are extremely careful and cautious in making commitments, but do everything possible to meet deliverables. This same company has gone so far as to tell both project and line personnel that they run the risk of being discharged from the company for burying a problem rather than bringing the problem to the surface *immediately*.

In one automotive company, the tension between the project and line managers became so combative that it was having a serious impact on the performance and constraints of the project. The project managers argued that the line managers were not fulfilling their promises whereas the line managers were arguing that the project managers' requirements were poorly defined. To alleviate the problem, a new form was created which served as a contractual agreement between the project and the line managers who had to commit to the deliverables. This resulted in "shared accountability" for the project's deliverables.

Project management is designed to have shared authority and responsibility between the project and line managers. Project managers plan, monitor, and control the project, whereas functional managers perform the work. Table 1–1 shows this shared responsibility. The one exception to Table 1–1 occurs when the project and line managers are the same person. This situation, which happens more often than not, creates a conflict of interest.

PMBOK® Guide, 4th Edition
2.4.2 Organizational Structure
Figure 2–7

TABLE 1–1. DUAL RESPONSIBILITY

	Responsibility	
Topic	**Project Manager**	**Line Manager**
Rewards	Give recommendation: Informal	Provide rewards: Formal
Direction	Milestone (summary)	Detailed
Evaluation	Summary	Detailed
Measurement	Summary	Detailed
Control	Summary	Detailed

If a line manager has to assign resources to six projects, one of which is under his direct control, he might save the best resources for his project. In this case, his project will be a success at the expense of all of the other projects.

The exact relationship between project and line managers is of paramount importance in project management where multiple-boss reporting prevails. Table 1–2 shows that the relationship between project and line managers is not always in balance and thus, of course, has a bearing on who exerts more influence over the assigned functional employees.

PMBOK® Guide, 4th Edition
2.4.2 Organizational Structure
Figure 2–7

TABLE 1–2. REPORTING RELATIONSHIPS

		Project Manager (PM)/Line Manager (LM)/Employee Relationship			
Type of Project Manager	**Type of Matrix Structure***	**PM Negotiates For**	**Employees Take Technical Direction From**	**PM Receives Functional Progress From**	**Employee Performance Evaluations Made By**
Lightweight	Weak	Deliverables	LMs	Primarily LMs	LMs only with no input from PM
Heavyweight	Strong	People who report informally to PM but formally to LMs	PM and LMs	Assigned employees who report to LMs	LMs with input from PM
Tiger teams	Very strong	People who report entirely to PM full-time for duration of project	PM only	Assigned employees who now report directly to PM	PM only

*The types of organizational structures are discussed in Chapter 3.

1.6 DEFINING THE FUNCTIONAL EMPLOYEE'S ROLE

Once the line managers commit to the deliverables, it is the responsibility of the assigned functional employees to achieve the functional deliverables. For years the functional employees were called subordinates. Although this term still exists in textbooks, industry prefers to regard the assigned employees as "associates" rather than subordinates. The reason for this is that in project management the associates can be a higher pay grade than the project manager. The associates can even be a higher pay grade than their functional manager.

In most organizations, the assigned employees report on a "solid" line to their functional manager, even though they may be working on several projects simultaneously. The employees are usually a "dotted" line to the project but solid to their function. This places the employees in the often awkward position of reporting to multiple individuals. This situation is further complicated when the project manager has more technical knowledge than the line manager. This occurs during R&D projects.

The functional employee is expected to accomplish the following activities when assigned to projects:

- Accept responsibility for accomplishing the assigned deliverables within the project's constraints
- Complete the work at the earliest possible time
- Periodically inform both the project and line manager of the project's status
- Bring problems to the surface quickly for resolution
- Share information with the rest of the project team

1.7 DEFINING THE EXECUTIVE'S ROLE

In a project environment there are new expectations of and for the executives, as well as a new interfacing role.[5] Executives are expected to interface a project as follows:

- In project planning and objective-setting
- In conflict resolution
- In priority-setting
- As project sponsor[6]

Executives are expected to interface with projects very closely at project initiation and planning, but to remain at a distance during execution unless needed for priority-setting and conflict resolution. One reason why executives "meddle" during project execution is that they are not getting accurate information from the project manager as to project status. If project managers provide executives with meaningful status reports, then the so-called meddling may be reduced or even eliminated.

5. The expectations are discussed in Section 9.3.
6. The role of the project sponsor is discussed in Section 10.1.

PMBOK® Guide, 4th Edition
2.3.2 Sponsor

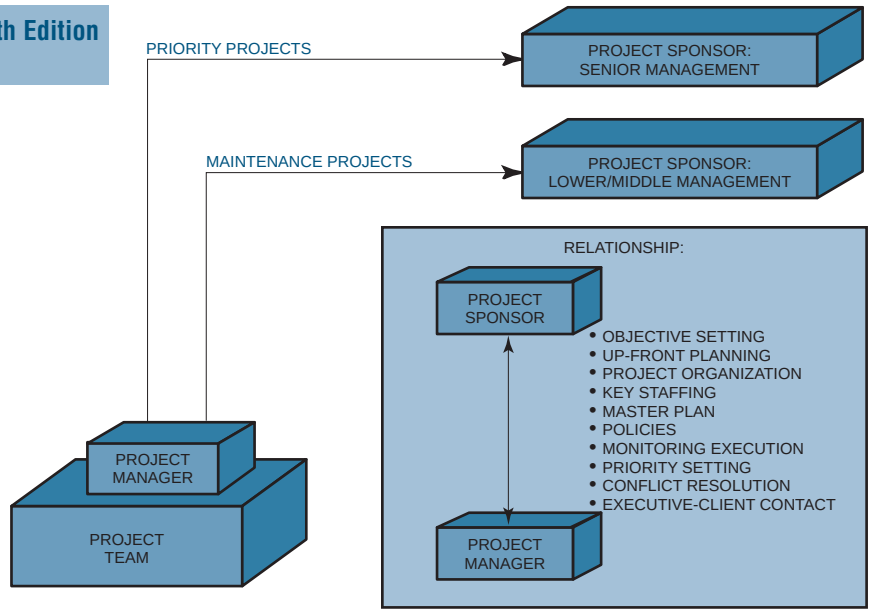


FIGURE 1–4. The project sponsor interface.

1.8 WORKING WITH EXECUTIVES

Success in project management is like a three-legged stool. The first leg is the project manager, the second leg is the line manager, and the third leg is senior management. If any of the three legs fail, then even delicate balancing may not prevent the stool from toppling.

The critical node in project management is the project manager–line manager interface. At this interface, the project and line managers must view each other as equals and be willing to share authority, responsibility, and accountability. In excellently managed companies, project managers do not negotiate for resources but simply ask for the line manager's commitment to executing his portion of the work within time, cost, and performance. Therefore, in excellent companies, it should not matter who the line manager assigns as long as the line manager lives up to his commitments.

Since the project and line managers are "equals," senior management involvement is necessary to provide advice and guidance to the project manager, as well as to provide encouragement to the line managers to keep their promises. When executives act in this capacity, they assume the role of project sponsors, as shown in Figure 1–4,[7] which also shows that sponsorship need not always be at the executive levels. The exact person appointed as the project sponsor is based on the dollar value of the project, the priority of the project, and who the customer is.

7. Section 10.1 describes the role of the project sponsor in more depth.

The ultimate objective of the project sponsor is to provide behind-the-scenes assistance to project personnel for projects both "internal" to the company, as well as "external," as shown in Figure 1–4. Projects can still be successful without this commitment and support, as long as all work flows smoothly. But in time of crisis, having a "big brother" available as a possible sounding board will surely help.

When an executive is required to act as a project sponsor, then the executive has the responsibility to make effective and timely project decisions. To accomplish this, the executive needs timely, accurate, and complete data for such decisions. Keeping management informed serves this purpose, while the all-too-common practice of "stonewalling" prevents an executive from making effective project decisions.

It is not necessary for project sponsorship to remain exclusively at the executive levels. As companies mature in their understanding and implementation of project management, project sponsorship may be pushed down to middle-level management. Committee sponsorship is also possible.

1.9 THE PROJECT MANAGER AS THE PLANNING AGENT

PMBOK® Guide, 4th Edition
Chapter 9 Project Human Resources Management

The major responsibility of the project manager is planning. If project planning is performed correctly, then it is conceivable that the project manager will work himself out of a job because the project can run itself. This rarely happens, however. Few projects are ever completed without some conflict or trade-offs for the project manager to resolve.

In most cases, the project manager provides overall or summary definitions of the work to be accomplished, but the line managers (the true experts) do the detailed planning. Although project managers cannot control or assign line resources, they must make sure that the resources are adequate and scheduled to satisfy the needs of the project, not vice versa. As the architect of the project plan, the project manager must provide:

- Complete task definitions
- Resource requirement definitions (possibly skill levels)
- Major timetable milestones
- Definition of end-item quality and reliability requirements
- The basis for performance measurement

These factors, if properly established, result in:

- Assurance that functional units will understand their total responsibilities toward achieving project needs.
- Assurance that problems resulting from scheduling and allocation of critical resources are known beforehand.
- Early identification of problems that may jeopardize successful project completion so that effective corrective action and replanning can be taken to prevent or resolve the problems.

Project managers are responsible for project administration and, therefore, must have the right to establish their own policies, procedures, rules, guidelines, and directives—provided these policies, guidelines, and so on, conform to overall company policy. Companies with mature project management structures usually have rather loose company guidelines, so project managers have some degree of flexibility in how to control their projects. However, project managers cannot make any promises to a functional employee concerning:

- Promotion
- Grade
- Salary
- Bonus
- Overtime
- Responsibility
- Future work assignments

These seven items can be administered by line managers only, but the project manager can have indirect involvement by telling the line manager how well an employee is doing (and putting it in writing), requesting overtime because the project budget will permit it, and offering individuals the opportunity to perform work above their current pay grade. However, such work above pay grade can cause severe managerial headaches if not coordinated with the line manager, because the individual will expect immediate rewards if he performs well.

Establishing project administrative requirements is part of project planning. Executives must either work with the project managers at project initiation or act as resources later. Improper project administrative planning can create a situation that requires:

- A continuous revision and/or establishment of company and/or project policies, procedures, and directives
- A continuous shifting in organizational responsibility and possible unnecessary restructuring
- A need for staff to acquire new knowledge and skills

If these situations occur simultaneously on several projects, there can be confusion throughout the organization.

1.10 PROJECT CHAMPIONS

Corporations encourage employees to think up new ideas that, if approved by the corporation, will generate monetary and nonmonetary rewards for the idea generator. One such reward is naming the individual the “project champion.” Unfortunately, the project champion often becomes the project manager, and, although the idea was technically sound, the project fails.

TABLE 1–3. PROJECT MANAGERS VERSUS PROJECT CHAMPIONS

Project Managers	Project Champions
• Prefer to work in groups	• Prefer working individually
• Committed to their managerial and technical responsibilities	• Committed to technology
• Committed to the corporation	• Committed to the profession
• Seek to achieve the objective	• Seek to exceed the objective
• Are willing to take risks	• Are unwilling to take risks; try to test everything
• Seek what is possible	• Seek perfection
• Think in terms of short time spans	• Think in terms of long time spans
• Manage people	• Manage things
• Are committed to and pursue material values	• Are committed to and pursue intellectual values

Table 1–3 provides a comparison between project managers and project champions. It shows that the project champions may become so attached to the technical side of the project that they become derelict in their administrative responsibilities. Perhaps the project champion might function best as a project engineer rather than the project manager.

This comparison does not mean that technically oriented project managers-champions will fail. Rather, it implies that the selection of the "proper" project manager should be based on *all* facets of the project.

1.11 THE DOWNSIDE OF PROJECT MANAGEMENT

Project management is often recognized only as a high-salaried, highly challenging position whereby the project manager receives excellent training in general management.

For projects that are done for external sources, the project manager is first viewed as starting out with a pot of gold and then as having to manage the project so that sufficient profits will be made for the stockholders. If the project manager performs well, the project will be successful. But the personal cost may be high for the project manager.

There are severe risks that are not always evident. Some project management positions may require a sixty-hour workweek and extensive time away from home. When a project manager begins to fall in love more with the job than with his family, the result is usually lack of friends, a poor home life, and possibly divorce. During the birth of the missile and space programs, companies estimated that the divorce rate among project managers and project engineers was probably twice the national average. Accepting a project management assignment is not always compatible with raising a young family. Characteristics of the workaholic project manager include:

- Every Friday he thinks that there are only two more working days until Monday.
- At 5:00 P.M. he considers the working day only half over.
- He has no time to rest or relax.
- He always takes work home from the office.
- He takes work with him on vacations.

1.12 PROJECT-DRIVEN VERSUS NON–PROJECT-DRIVEN ORGANIZATIONS

PMBOK® Guide, 4th Edition
2.4.2 Organizational Systems
2.2 Project-Based and Non–Project-Based

On the micro level, virtually all organizations are either marketing-, engineering-, or manufacturing-driven. But on the macro level, organizations are either project- or non–project-driven. The PMBOK® Guide uses the terms *project-based* and *non–project-based*, whereas in this text the terms *project-driven* and *non–project-driven* or *operational-driven* are used. In a project-driven organization, such as construction or aerospace, all work is characterized through projects, with each proj-ect as a separate cost center having its own profit-and-loss statement. The total profit to the corporation is simply the summation of the profits on all projects. In a project-driven organization, everything centers around the projects.

In the non–project-driven organization, such as low-technology manufacturing, profit and loss are measured on vertical or functional lines. In this type of organization, projects exist merely to support the product lines or functional lines. Priority resources are assigned to the revenue-producing functional line activities rather than the projects.

Project management in a non–project-driven organization is generally more difficult for these reasons:

- Projects may be few and far between.
- Not all projects have the same project management requirements, and therefore they cannot be managed identically. This difficulty results from poor understanding of project management and a reluctance of companies to invest in proper training.
- Executives do not have sufficient time to manage projects themselves, yet refuse to delegate authority.
- Projects tend to be delayed because approvals most often follow the vertical chain of command. As a result, project work stays too long in functional departments.
- Because project staffing is on a “local” basis, only a portion of the organization understands project management and sees the system in action.
- There is heavy dependence on subcontractors and outside agencies for project management expertise.

Non–project-driven organizations may also have a steady stream of projects, all of which are usually designed to enhance manufacturing operations. Some projects may be customer-requested, such as:

- The introduction of statistical dimensioning concepts to improve process control
- The introduction of process changes to enhance the final product
- The introduction of process change concepts to enhance product reliability

If these changes are not identified as specific projects, the result can be:

- Poorly defined responsibility areas within the organization
- Poor communications, both internal and external to the organization

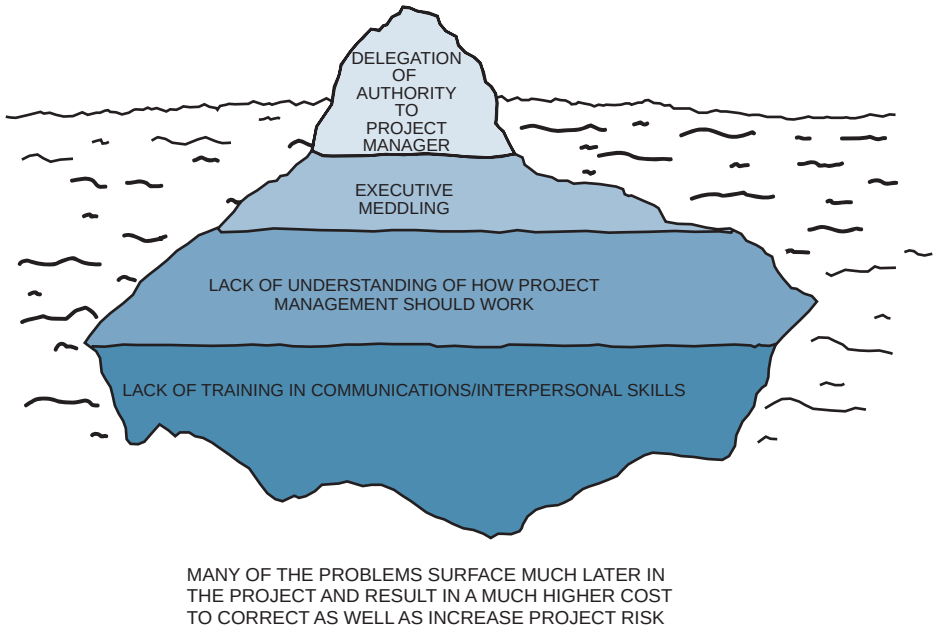


FIGURE 1–5. The tip-of-the-iceberg syndrome for matrix implementation.

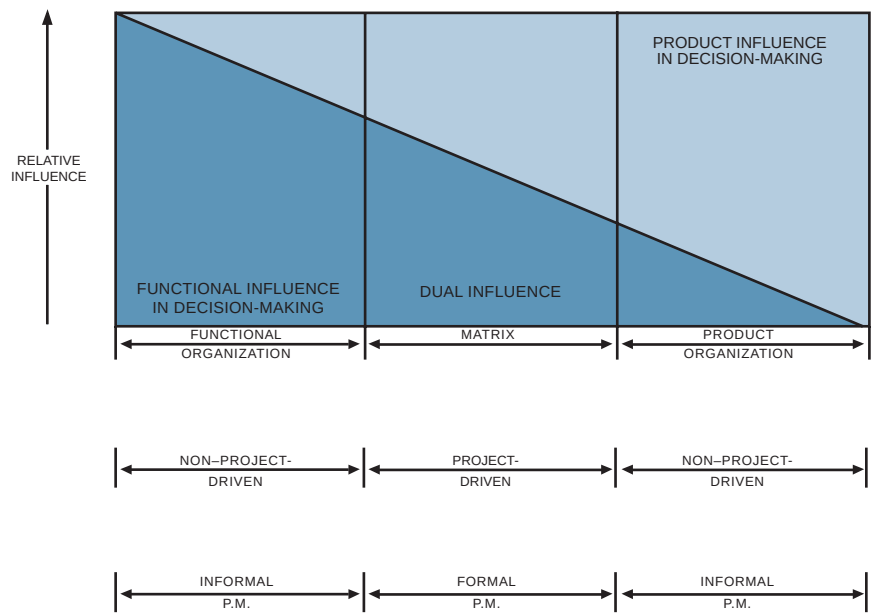


FIGURE 1–6. Decision-making influence.

- Slow implementation
- A lack of a cost-tracking system for implementation
- Poorly defined performance criteria

Figure 1–5 shows the tip-of-the-iceberg syndrome, which can occur in all types of organizations but is most common in non–project-driven organizations. On the surface, all we see is a lack of authority for the project manager. But beneath the surface we see the causes; there is excessive meddling due to lack of understanding of project management, which, in turn, resulted from an inability to recognize the need for proper training.

In the previous sections we stated that project management could be handled on either a formal or an informal basis. As can be seen from Figure 1–6, informal project management most often appears in non–project-driven organizations. It is doubtful that informal project management would work in a project-driven organization where the project manager has profit-and-loss responsibility.

1.13 MARKETING IN THE PROJECT-DRIVEN ORGANIZATION

PMBOK® Guide, 4th Edition
1.4.3 Projects and Strategic Planning

Getting new projects is the lifeblood of any project-oriented business. The practices of the project-oriented company are, however, substantially different from traditional product businesses and require highly specialized and disciplined team efforts among marketing, technical, and operating personnel, plus significant customer involvement. Projects are different from products in many respects, especially marketing. Marketing projects requires the ability to identify, pursue, and capture one-of-a-kind business opportunities, and is characterized by:

- *A systematic effort.* A systematic approach is usually required to develop a new program lead into an actual contract. The project acquisition effort is often highly integrated with ongoing programs and involves key personnel from both the potential customer and the performing organization.
- *Custom design.* While traditional businesses provide standard products and services for a variety of applications and customers, projects are custom-designed items to fit specific requirements of a single-customer community.
- *Project life cycle.* Project-oriented businesses have a well-defined beginning and end and are not self-perpetuating. Business must be generated on a project-by-project basis rather than by creating demand for a standard product or service.
- *Marketing phase.* Long lead times often exist between the product definition, start-up, and completion phases of a project.
- *Risks.* There are risks, especially in the research, design, and production of programs. The program manager not only has to integrate the multidisciplinary tasks and project elements within budget and schedule constraints, but also has to

manage inventions and technology while working with a variety of technically oriented prima donnas.
- *The technical capability to perform.* Technical ability is critical to the successful pursuit and acquisition of a new project.

In spite of the risks and problems, profits on projects are usually very low in comparison with commerical business practices. One may wonder why companies pursue project businesses. Clearly, there are many reasons why projects are good business:

- Although immediate profits (as a percentage of sales) are usually small, the return on capital investment is often very attractive. Progress payment practices keep inventories and receivables to a minimum and enable companies to undertake projects many times larger in value than the assets of the total company.
- Once a contract has been secured and is being managed properly, the project may be of relatively low financial risk to the company. The company has little additional selling expenditure and has a predictable market over the life cycle of the project.
- Project business must be viewed from a broader perspective than motivation for immediate profits. Projects provide an opportunity to develop the company's technical capabilities and build an experience base for future business growth.
- Winning one large project often provides attractive growth potential, such as (1) growth with the project via additions and changes; (2) follow-on work; (3) spare parts, maintenance, and training; and (4) being able to compete effectively in the next project phase, such as nurturing a study program into a development contract and finally a production contract.

Customers come in various forms and sizes. For small and medium businesses particularly, it is a challenge to compete for contracts from large industrial or governmental organizations. Although the contract to a firm may be relatively small, it is often subcontracted via a larger organization. Selling to such a diversified heterogeneous customer is a marketing challenge that requires a highly sophisticated and disciplined approach.

The first step in a new business development effort is to define the market to be pursued. The market segment for a new program opportunity is normally in an area of relevant past experience, technical capability, and customer involvement. Good marketers in the program business have to think as product line managers. They have to understand all dimensions of the business and be able to define and pursue market objectives that are consistent with the capabilities of their organizations.

Program businesses operate in an opportunity-driven market. It is a common mistake, however, to believe that these markets are unpredictable and unmanageable. Market planning and strategizing is important. New project opportunities develop over periods of time, sometimes years for larger projects. These developments must be properly tracked and cultivated to form the bases for management actions such as (1) bid decisions, (2) resource commitment, (3) technical readiness, and (4) effective customer liaison. This strategy of winning new business is supported by systematic, disciplined approaches, which are illustrated in Figure 1–7.

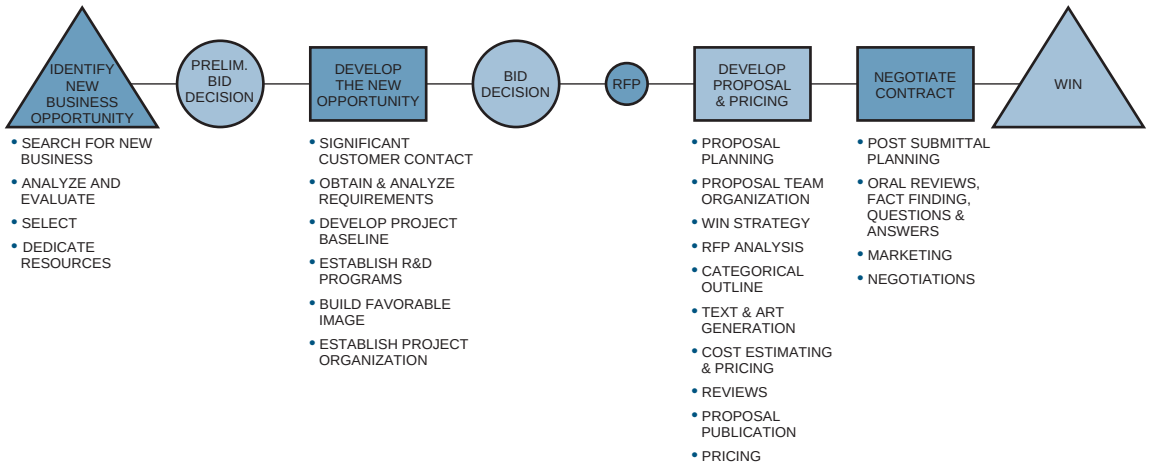


FIGURE 1–7. The phases of winning new contracts in project-oriented businesses.

1.14 CLASSIFICATION OF PROJECTS

The principles of project management can be applied to any type of project and to any industry. However, the relative degree of importance of these principles can vary from project to project and industry to industry. Table 1–4 shows a brief comparison of certain industries/projects.

For those industries that are project-driven, such as aerospace and large construction, the high dollar value of the projects mandates a much more rigorous project management approach. For non–project-driven industries, projects may be managed more informally than formally, especially if no immediate profit is involved. Informal project management is similar to formal project management but paperwork requirements are kept at a minimum.

TABLE 1–4. CLASSIFICATION OF PROJECTS/CHARACTERISTICS

	Type of Project/Industry					
	In-house R&D	**Small Construction**	**Large Construction**	**Aerospace/ Defense**	**MIS**	**Engineering**
Need for interpersonal skills	Low	Low	High	High	High	Low
Importance of organizational structure	Low	Low	Low	Low	High	Low
Time management difficulties	Low	Low	High	High	High	Low
Number of meetings	Excessive	Low	Excessive	Excessive	High	Medium
Project manager's supervisor	Middle management	Top management	Top management	Top management	Middle management	Middle management
Project sponsor present	Yes	No	Yes	Yes	No	No
Conflict intensity	Low	Low	High	High	High	Low
Cost control level	Low	Low	High	High	Low	Low
Level of planning/scheduling	Milestones only	Milestones only	Detailed plan	Detailed plan	Milestones only	Milestones only

1.15 LOCATION OF THE PROJECT MANAGER

The success of project management could easily depend on the location of the project manager within the organization. Two questions must be answered:

- What salary should the project manager earn?
- To whom should the project manager report?

Figure 1–8 shows a typical organizational hierarchy (the numbers represent pay grades). Ideally, the project manager should be at the same pay grade as the individuals with whom he must negotiate on a daily basis. Using this criterion, and assuming that the project manager interfaces at the department manager level, the project manager should earn a salary between grades 20 and 25. A project manager earning substantially more or less money than the line manager will usually create conflict. The ultimate reporting location of the project manager (and perhaps his salary) is heavily dependent on whether the

PMBOK® Guide, 4th Edition
2.4 Organizational Influences

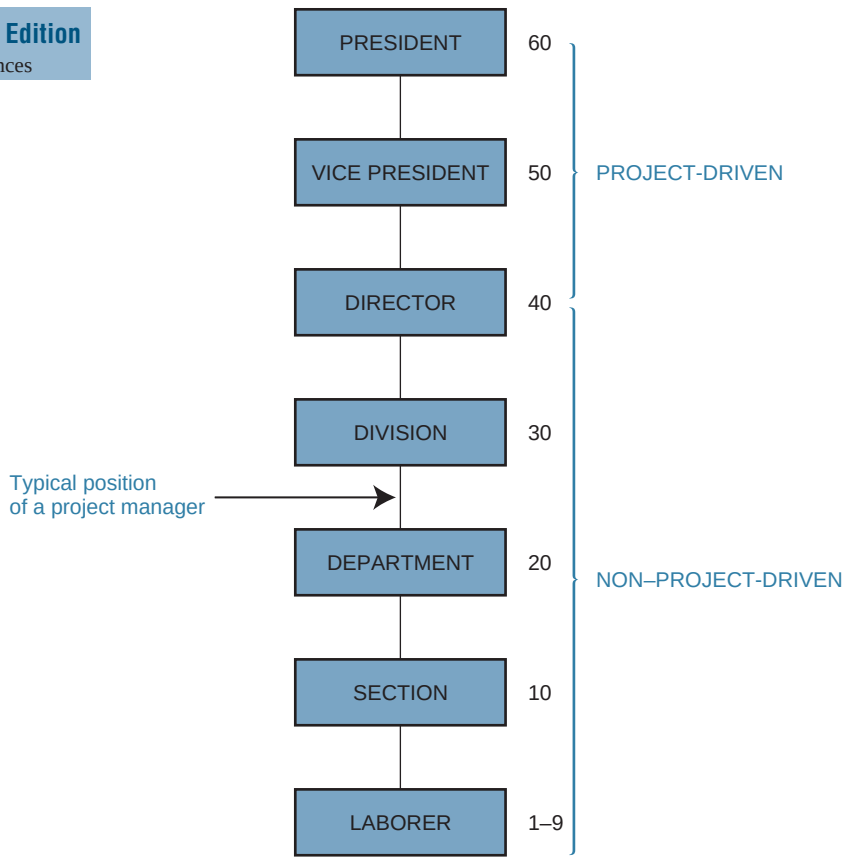


FIGURE 1–8. Organizational hierarchy.

organization is project- or non–project-driven, and whether the project manager is responsible for profit or loss.

Project managers can end up reporting both high and low in an organization during the life cycle of the project. During the planning phase of the project, the project manager may report high, whereas during implementation, he may report low. Likewise, the positioning of the project manager may be dependent on the risk of the project, the size of the project, or the customer.

Finally, it should be noted that even if the project manager reports low, he should still have the right to interface with top executives during project planning although there may be two or more reporting levels between the project manager and executives. At the opposite end of the spectrum, the project manager should have the right to go directly into the depths of the organization instead of having to follow the chain of command downward, especially during planning. As an example, see Figure 1–9. The project manager had two weeks to plan and price out a small project. Most of the work was to be accomplished within one section. The project manager was told that all requests for work, even estimating, had to follow the chain of command from the executive down through the section supervisor. By the time the request was received by the section supervisor, twelve of the fourteen days were gone, and only an order-of-magnitude estimate was possible. The lesson to be learned here is:

The chain of command should be used for approving projects, not planning them.

Forcing the project manager to use the chain of command (in either direction) for project planning can result in a great deal of unproductive time and idle time cost.

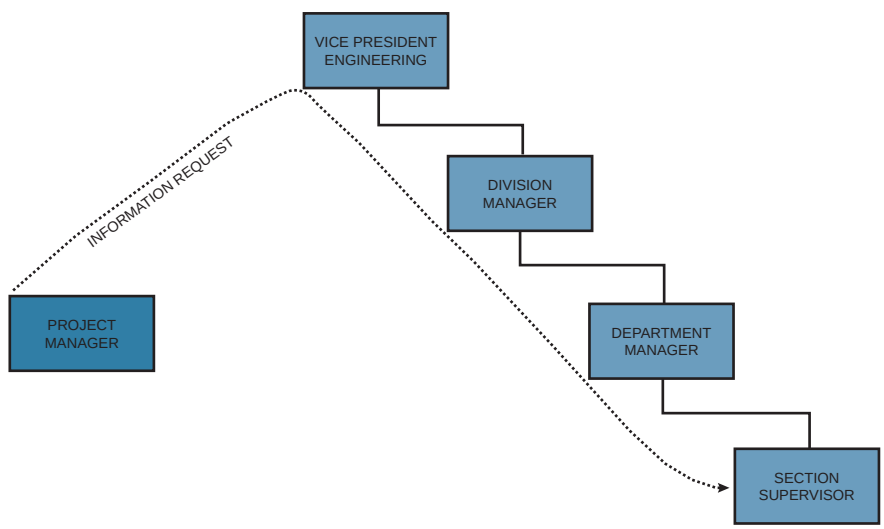


FIGURE 1–9. The organizational hierarchy: for planning and/or approval?

1.16 DIFFERING VIEWS OF PROJECT MANAGEMENT

Many companies, especially those with project-driven organizations, have differing views of project management. Some people view project management as an excellent means to achieving objectives, while others view it as a threat. In project-driven organizations, there are three career paths that lead to executive management:

- Through project management
- Through project engineering
- Through line management

In project-driven organizations, the fast-track position is in project management, whereas in a non–project-driven organization, it would be line management. Even though line managers support the project management approach, they resent the project manager because of his promotions and top-level visibility. In one construction company, a department manager was told that he had no chance for promotion above his present department manager position unless he went into project management or project engineering where he could get to know the operation of the whole company. A second construction company requires that individuals aspiring to become a department manager first spend a "tour of duty" as an assistant project manager or project engineer.

Executives may dislike project managers because more authority and control must be delegated. However, once executives realize that it is a sound business practice, it becomes important, as shown in the following letter[8]:

> In order to sense and react quickly and to insure rapid decision-making, lines of communication should be the shortest possible between all levels of the organization. People with the most knowledge must be available at the source of the problem, and they must have decision-making authority and responsibility. Meaningful data must be available on a timely basis and the organization must be structured to produce this environment.
>
> In the aerospace industry, it is a serious weakness to be tied to fixed organization charts, plans, and procedures. With regard to organization, we successfully married the project concept of management with a central function concept. What we came up with is an organization within an organization—one to ramrod the day-to-day problems; the other to provide support for existing projects and to anticipate the requirements for future projects.
>
> The project system is essential in getting complicated jobs done well and on time, but it solves only part of the management problem. When you have your nose to the project grindstone, you are often not in a position to see much beyond that project. This is where the central functional organization comes in. My experience has been that you need this central organization to give you depth, flexibility, and perspective. Together, the two parts permit you to see both the woods and the trees.
>
> Initiative is essential at all levels of the organization. We try to press the level of decision to the lowest possible rung of the managerial ladder. This type of decision-making provides motivation and permits recognition for the individual and the group at all levels. It stimulates action and breeds dedication.

8. Letter from J. Donald Rath, Vice President of Martin-Marietta Corporation, Denver Division, to J. E. Webb, of NASA, October 18, 1963.

> With this kind of encouragement, the organization can become a live thing—sensitive to problems and able to move in on them with much more speed and understanding than would be normally expected in a large operation. In this way, we can regroup or reorganize easily as situations dictate and can quickly focus on a "crisis." In this industry a company must always be able to reorient itself to meet new objectives. In a more staid, old-line organization, frequent reorientation usually accompanied by a corresponding shift of people's activities, could be most upsetting. However, in the aerospace industry, we must be prepared for change. The entire picture is one of change.

1.17 CONCURRENT ENGINEERING: A PROJECT MANAGEMENT APPROACH

In the past decade, organizations have become more aware of the fact that America's most formidable weapon is its manufacturing ability, and yet more and more work seems to be departing for Southeast Asia and the Far East. If America and other countries are to remain competitive, then survival may depend on the manufacturing of a quality product and a rapid introduction into the marketplace. Today, companies are under tremendous pressure to rapidly introduce new products because product life cycles are becoming shorter. As a result, organizations no longer have the luxury of performing work in series.

Concurrent or simultaneous engineering is an attempt to accomplish work in parallel rather than in series. This requires that marketing, R&D, engineering, and production are all actively involved in the early project phases and making plans even before the product design has been finalized. This concept of current engineering will accelerate product development, but it does come with serious and potentially costly risks, the largest one being the cost of rework.

Almost everyone agrees that the best way to reduce or minimize risks is for the organization to plan better. Since project management is one of the best methodologies to foster better planning, it is little wonder that more organizations are accepting project management as a way of life.

1.18 STUDYING TIPS FOR THE PMI® PROJECT MANAGEMENT CERTIFICATION EXAM

This section is applicable as a review of the principles or to support an understanding of the knowledge areas and domain groups in the PMBOK® Guide. This chapter addresses some material from the PMBOK® Guide knowledge areas:

- Integration Management
- Scope Management
- Human Resources Management

Understanding the following principles is beneficial if the reader is using this textbook together with the PMBOK® Guide to study for the PMP® Certification Exam:

- Definition of a project
- Definition of the triple constraint
- Definition of successful execution of a project
- Benefits of using project management
- Responsibility of the project manager in dealing with stakeholders and how stakeholders can affect the outcome of the project
- Responsibility of the project manager in meeting deliverables
- The fact that the project manager is ultimately accountable for the success of the project
- Responsibilities of the line manager during project management staffing and execution
- Role of the executive sponsor and champion
- Difference between a project-driven and non–project-driven organization

Be sure to review the appropriate sections of the PMBOK® Guide and the glossary of terms at the end of the PMBOK® Guide.

Some multiple-choice questions are provided in this section as a review of the material. There are other sources for practice review questions that are specific for the PMP® Exam, namely:

- *Project Management IQ®* from the International Institute for Learning (iil.com)
- *PMP® Exam Practice Test and Study Guide*, by J. LeRoy Ward, PMP, editor
- *PMP® Exam Prep*, by Rita Mulcahy
- *Q & As for the PMBOK® Guide*, Project Management Institute

The more practice questions reviewed, the better prepared the reader will be for the PMP® Certification Exam.

In Appendix C, there are a series of mini–case studies called Dorale Products that reviews some of the concepts. The minicases can be used as either an introduction to the chapter or as a review of the chapter material. These mini–case studies were placed in Appendix C because they can be used for several chapters in the text. For this chapter, the following are applicable:

- Dorale Products (A) [Integration and Scope Management]
- Dorale Products (B) [Integration and Scope Management]

Answers to the Dorale Products minicases appear in Appendix D.

The following multiple-choice questions will be helpful in reviewing the above principles:

1. The triple constraints on a project are:
A. Time, cost, and profitability
B. Resources required, sponsorship involvement, and funding
C. Time, cost, and quality and/or scope
D. Calendar dates, facilities available, and funding

2. Which of the following is not part of the definition of a project?
   A. Repetitive activities
   B. Constraints
   C. Consumption of resources
   D. A well-defined objective
3. Which of the following is usually not part of the criteria for project success?
   A. Customer satisfaction
   B. Customer acceptance
   C. Meeting at least 75 percent of specification requirements.
   D. Meeting the triple-constraint requirements
4. Which of the following is generally not a benefit achieved from using project management?
   A. Flexibility in the project's end date
   B. Improved risk management
   C. Improved estimating
   D. Tracking of projects
5. The person responsible for assigning the resources to a project is most often:
   A. The project manager
   B. The Human Resources Department
   C. The line manager
   D. The executive sponsor
6. Conflicts between the project and line managers are most often resolved by:
   A. The assistant project manager for conflicts
   B. The project sponsor
   C. The executive steering committee
   D. The Human Resources Department
7. Your company does only projects. If the projects performed by your company are for customers external to your company and a profit criterion exists on the project, then your organization is most likely:
   A. Project-driven
   B. Non–project-driven
   C. A hybrid
   D. All of the above are possible based upon the size of the profit margin.

ANSWERS

1. C
2. A
3. C
4. A
5. C
6. B
7. A

PROBLEMS

1–1 In the project environment, cause-and-effect relationships are almost always readily apparent. Good project management will examine the effect in order to better understand the cause and possibly prevent it from occurring again. Below are causes and effects. For each one of the effects, select the possible cause or causes that may have existed to create this situation:

Effects

1. Late completion of activities
2. Cost overruns
3. Substandard performance
4. High turnover in project staff
5. High turnover in functional staff
6. Two functional departments performing the same activities on one project

Causes

a. Top management not recognizing this activity as a project
b. Too many projects going on at one time
c. Impossible schedule commitments
d. No functional input into the planning phase
e. No one person responsible for the total project
f. Poor control of design changes
g. Poor control of customer changes
h. Poor understanding of the project manager's job
i. Wrong person assigned as project manager
j. No integrated planning and control
k. Company resources are overcommitted
l. Unrealistic planning and scheduling
m. No project cost accounting ability
n. Conflicting project priorities
o. Poorly organized project office

(This problem has been adapted from Russell D. Archibald, *Managing High-Technology Programs and Projects*, New York: John Wiley, 1976, p. 10.)

1–2 Because of the individuality of people, there always exist differing views of what management is all about. Below are lists of possible perspectives and a selected group of organizational members. For each individual select the possible ways that this individual might view project management:

Individuals

1. Upper-level manager
2. Project manager
3. Functional manager
4. Project team member
5. Scientist and consultant

Perspectives

a. A threat to established authority
b. A source for future general managers
c. A cause of unwanted change in ongoing procedures

d. A means to an end
e. A significant market for their services
f. A place to build an empire
g. A necessary evil to traditional management
h. An opportunity for growth and advancement
i. A better way to motivate people toward an objective
j. A source of frustration in authority
k. A way of introducing controlled changes
l. An area of research
m. A vehicle for introducing creativity
n. A means of coordinating functional units
o. A means of deep satisfaction
p. A way of life

1–3 Consider an organization that is composed of upper-level managers, middle- and lower-level managers, and laborers. Which of the groups should have first insight that an organizational restructuring toward project management may be necessary?

1–4 How would you defend the statement that a project manager must help himself?

1–5 Will project management work in all companies? If not, identify those companies in which project management may not be applicable and defend your answers.

1–6 In a project organization, do you think that there might be a conflict in opinions over whether the project managers or functional managers contribute to profits?

1–7 What attributes should a project manager have? Can an individual be trained to become a project manager? If a company were changing over to a project management structure, would it be better to promote and train from within or hire from the outside?

1–8 Do you think that functional managers would make good project managers?

1–9 What types of projects might be more appropriate for functional management rather than project management, and vice versa?

1–10 Do you think that there would be a shift in the relative degree of importance of the following terms in a project management environment as opposed to a traditional management environment?

a. Time management
b. Communications
c. Motivation

1–11 Classical management has often been defined as a process in which the manager does not necessarily perform things for himself, but accomplishes objectives through others in a group situation. Does this definition also apply to project management?

1–12 Which of the following are basic characteristics of project management?

a. Customer problem
b. Responsibility identification
c. Systems approach to decision-making
d. Adaptation to a changing environment

e. Multidisciplinary activity in a finite time duration
f. Horizontal and vertical organizational relationships

1–13 Project managers are usually dedicated and committed to the project. Who should be "looking over the shoulder" of the project manager to make sure that the work and requests are also in the best interest of the company? Does your answer depend on the priority of the project?

1–14 Is project management designed to transfer power from the line managers to the project manager?

1–15 Explain how career paths and career growth can differ between project-driven and non–project-driven organizations. In each organization, is the career path fastest in project management, project engineering, or line management?

1–16 Explain how the following statement can have a bearing on who is ultimately selected as part of the project team:
"There comes a time in the life cycle of all projects when one must shoot the design engineers and begin production."

1–17 How do you handle a situation where the project manager has become a generalist, but still thinks that he is an expert?

CASE STUDY

WILLIAMS MACHINE TOOL COMPANY

For 85 years, the Williams Machine Tool Company had provided quality products to its clients, becoming the third largest U.S.-based machine tool company by 1990. The company was highly profitable and had an extremely low employee turnover rate. Pay and benefits were excellent.

Between 1980 and 1990, the company's profits soared to record levels. The company's success was due to one product line of standard manufacturing machine tools. Williams spent most of its time and effort looking for ways to improve its bread-and-butter product line rather than to develop new products. The product line was so successful that companies were willing to modify their production lines around these machine tools rather than asking Williams for major modifications to the machine tools.

By 1990, Williams Company was extremely complacent, expecting this phenomenal success with one product line to continue for 20 to 25 more years. The recession of the early 1990s forced management to realign their thinking. Cutbacks in production had decreased the demand for the standard machine tools. More and more customers were asking for either major modifications to the standard machine tools or a completely new product design.

The marketplace was changing and senior management recognized that a new strategic focus was necessary. However, lower-level management and the work force, especially engineering, were strongly resisting a change. The employees, many of them with over 20 years of employment at Williams Company, refused to recognize the need for this change in the belief that the glory days of yore would return at the end of the recession.

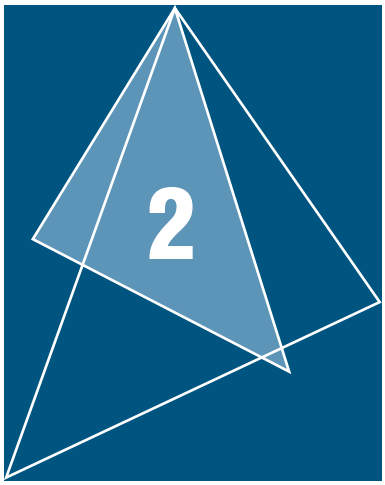
By 1995, the recession had been over for at least two years yet Williams Company had no new product lines. Revenue was down, sales for the standard product (with and without modifications) were decreasing, and the employees were still resisting change. Layoffs were imminent.

In 1996, the company was sold to Crock Engineering. Crock had an experienced machine tool division of its own and understood the machine tool business. Williams Company was allowed to operate as a separate entity from 1995 to 1996. By 1996, red ink had appeared on the Williams Company balance sheet. Crock replaced all of the Williams senior managers with its own personnel. Crock then announced to all employees that Williams would become a specialty machine tool manufacturer and that the "good old days" would never return. Customer demand for specialty products had increased threefold in just the last twelve months alone. Crock made it clear that employees who would not support this new direction would be replaced.

The new senior management at Williams Company recognized that 85 years of traditional management had come to an end for a company now committed to specialty products. The company culture was about to change, spearheaded by project management, concurrent engineering, and total quality management.

Senior management's commitment to product management was apparent by the time and money spent in educating the employees. Unfortunately, the seasoned 20-year-plus veterans still would not support the new culture. Recognizing the problems, management provided continuous and visible support for project management in addition to hiring a project management consultant to work with the people. The consultant worked with Williams from 1996 to 2001.

From 1996 to 2001, the Williams Division of Crock Engineering experienced losses in 24 consecutive quarters. The quarter ending March 31, 2002, was the first profitable quarter in over six years. Much of the credit was given to the performance and maturity of the project management system. In May 2002, the Williams Division was sold. More than 80% of the employees lost their jobs when the company was relocated over 1,500 miles away.



Project Management Growth: Concepts and Definitions

Related Case Studies (from Kerzner/*Project Management Case Studies,* 3rd Edition)	Related Workbook Exercises (from Kerzner/*Project Management Workbook and PMP®/CAPM® Exam Study Guide,* 10th Edition)	PMBOK® Guide, 4th Edition, Reference Section for the PMP® Certification Exam
• Goshe Corporation • MIS Project Management at First National Bank • Cordova Research Group • Cortez Plastics • L. P. Manning Corporation • Project Firecracker • Apache Metals, Inc. • Haller Specialty Manufacturing	• Multiple Choice Exam	• Integration Management • Scope Management

2.0 INTRODUCTION

PMBOK® Guide, 4th Edition
Chapter 4 Integration Management

The growth and acceptance of project management has changed significantly over the past forty years, and these changes are expected to continue well into the twenty-first century, especially in the area of multinational project management. It is interesting to trace the evolution and growth of project management from the early days of systems management to what some people call "modern project management."

The growth of project management can be traced through topics such as roles and responsibilities, organizational structures, delegation of authority and decision-making, and especially corporate profitability. Twenty years ago, companies had the choice of whether or not to accept the project management approach. Today, some companies foolishly think that they still have the choice. Nothing could be further from the truth. The survival of the firm may very well rest upon how well project management is implemented, and how quickly.

2.1 GENERAL SYSTEMS MANAGEMENT

Organizational theory and management philosophies have undergone a dramatic change in recent years with the emergence of the project management approach to management. Because project management is an outgrowth of systems management, it is only fitting that the underlying principles of general systems theory be described. Simply stated, general systems theory can be classified as a management approach that attempts to integrate and unify scientific information across many fields of knowledge. Systems theory attempts to solve problems by looking at the total picture, rather than through an analysis of the individual components.

General systems theory has been in existence for more than four decades. Unfortunately, as is often the case with new theory development, the practitioners require years of study and analysis before implementation. General systems theory is still being taught in graduate programs. Today, project management is viewed as applied systems management.

In 1951, Ludwig von Bertalanffy, a biologist, described so-called open systems using anatomy nomenclature. The body's muscles, skeleton, circulatory system, and so on, were all described as subsystems of the total system (the human being). Dr. von Bertalanffy's contribution was important in that he identified how specialists in each subsystem could be integrated so as to get a better understanding of the interrelationships, thereby contributing to the overall knowledge of the operations of the system. Thus, the foundation was laid for the evolution and outgrowth of project management.

In 1956, Kenneth Boulding identified the communications problems that can occur during systems integration. Professor Boulding was concerned with the fact that subsystem specialists (i.e., physicists, economists, chemists, sociologists, etc.) have their own languages. He advocated that, in order for successful integration to take place, all subsystem specialists must speak a common language, such as mathematics. Today we use the PMBOK® Guide, the Project Management Body of Knowledge, to satisfy this need for project management.

General systems theory implies the creation of a management technique that is able to cut across many organizational disciplines—finance, manufacturing, engineering, marketing, and so on—while still carrying out the functions of management. This technique has come to be called systems management, project management, or matrix management (the terms are used interchangeably).

2.2 PROJECT MANAGEMENT: 1945–1960

During the 1940s, line managers used the concept of over-the-fence management to manage projects. Each line manager, wearing the hat of a project manager, would perform the work necessitated by their line organization, and when completed, would throw the "ball"

over the fence in hopes that someone would catch it. Once the ball was thrown over the fence, the line managers would wash their hands of any responsibility for the project because the ball was no longer in their yard. If a project failed, blame was placed on whichever line manager had the ball at that time.

The problem with over-the-fence management was that the customer had no single contact point for questions. The filtering of information wasted precious time for both the customer and the contractor. Customers who wanted firsthand information had to seek out the manager in possession of the ball. For small projects, this was easy. But as projects grew in size and complexity, this became more difficult.

Following World War II, the United States entered into the Cold War. To win a Cold War, one must compete in the arms race and rapidly build weapons of mass destruction. The victor in a Cold War is the one who can retaliate with such force as to obliterate the enemy.

The arms race made it clear that the traditional use of over-the-fence management would not be acceptable to the Department of Defense (DoD) for projects such as the B52 Bomber, the Minuteman Intercontinental Ballistic Missile, and the Polaris Submarine. The government wanted a single point of contact, namely, a project manager who had total accountability through all project phases. The use of project management was then mandated for some of the smaller weapon systems such as jet fighters and tanks. NASA mandated the use of project management for all activities related to the space program.

Projects in the aerospace and defense industries were having cost overruns in excess of 200 to 300%. Blame was erroneously placed upon improper implementation of project management when, in fact, the real problem was the inability to forecast technology. Forecasting technology is extremely difficult for projects that could last ten to twenty years.

By the late 1950s and early 1960s, the aerospace and defense industries were using project management on virtually all projects, and they were pressuring their suppliers to use it as well. Project management was growing, but at a relatively slow rate except for aerospace and defense.

Because of the vast number of contractors and subcontractors, the government needed standardization, especially in the planning process and the reporting of information. The government established a life-cycle planning and control model and a cost monitoring system, and created a group of project management auditors to make sure that the government's money was being spent as planned. These practices were to be used on all government programs above a certain dollar value. Private industry viewed these practices as an over-management cost and saw no practical value in project management.

2.3 PROJECT MANAGEMENT: 1960–1985

The growth of project management has come about more through necessity than through desire. Its slow growth can be attributed mainly to lack of acceptance of the new management techniques necessary for its successful implementation. An inherent fear of the unknown acted as a deterrent for managers.

Between the middle and late 1960s, more executives began searching for new management techniques and organizational structures that could be quickly adapted to a changing

environment. The table below and Figure 2–1 identify two major variables that executives consider with regard to organizational restructuring.

Type of Industry	Tasks	Environment
A	Simple	Dynamic
B	Simple	Static
C	Complex	Dynamic
D	Complex	Static

Almost all type C and most type D industries have project management–related structures. The key variable appears to be task complexity. Companies that have complex tasks and that also operate in a dynamic environment find project management mandatory. Such industries would include aerospace, defense, construction, high-technology engineering, computers, and electronic instrumentation.

Other than aerospace, defense, and construction, the majority of the companies in the 1960s maintained an informal method for managing projects. In informal project management, just as the words imply, the projects were handled on an informal basis whereby the

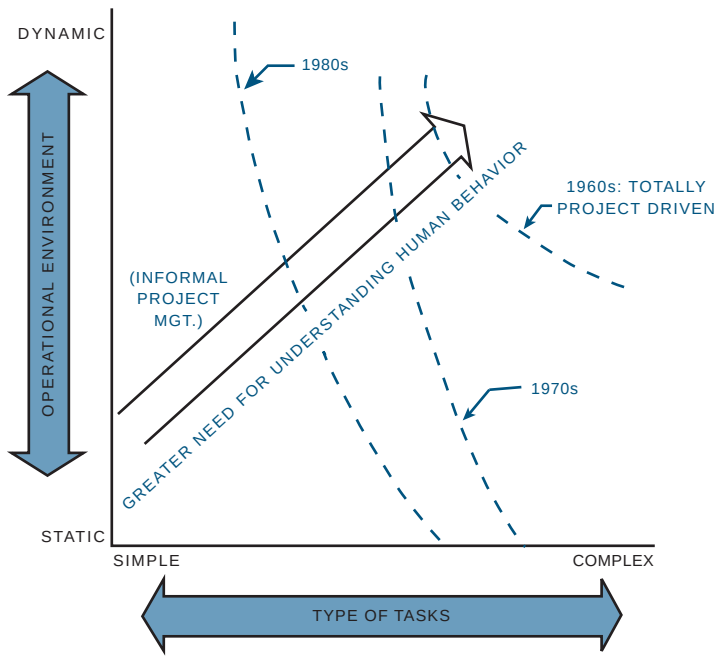


FIGURE 2–1. Matrix implementation scheme.

authority of the project manager was minimized. Most projects were handled by functional managers and stayed in one or two functional lines, and formal communications were either unnecessary or handled informally because of the good working relationships between line managers. Many organizations today, such as low-technology manufacturing, have line managers who have been working side by side for ten or more years. In such situations, informal project management may be effective on capital equipment or facility development projects.

By 1970 and again during the early 1980s, more companies departed from informal project management and restructured to formalize the project management process, mainly because the size and complexity of their activities had grown to a point where they were unmanageable within the current structure. Figure 2–2 shows what happened to one such construction company. The following five questions help determine whether formal project management is necessary:

- Are the jobs complex?
- Are there dynamic environmental considerations?
- Are the constraints tight?
- Are there several activities to be integrated?
- Are there several functional boundaries to be crossed?

If any of these questions are answered yes, then some form of formalized project management may be necessary. It is possible for formalized project management to exist in only one functional department or division, such as for R&D or perhaps just for certain types of projects. Some companies have successfully implemented both formal and informal project management concurrently, but these companies are few and far between. Today we realize that the last two questions may be the most important.

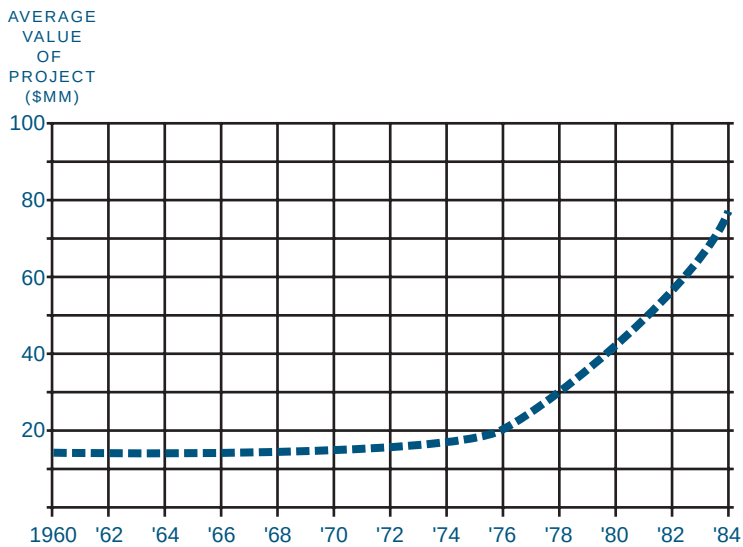


FIGURE 2–2. Average project size capability for a construction company, 1960–1984.

The moral here is that not all industries need project management, and executives must determine whether there is an actual need before making a commitment. Several industries with simple tasks, whether in a static or a dynamic environment, do not need project management. Manufacturing industries with slowly changing technology do not need project management, unless of course they have a requirement for several special projects, such as capital equipment activities, that could interrupt the normal flow of work in the routine manufacturing operations. The slow growth rate and acceptance of project management were related to the fact that the limitations of project management were readily apparent, yet the advantages were not completely recognizable. Project management requires organizational restructuring. The question, of course, is "How much restructuring?" Executives have avoided the subject of project management for fear that "revolutionary" changes must be made in the organization. As will be seen in Chapter 3, project management can be achieved with little departure from the existing traditional structure.

Project management restructuring has permitted companies to:

- Accomplish tasks that could not be effectively handled by the traditional structure
- Accomplish onetime activities with minimum disruption of routine business

The second item implies that project management is a "temporary" management structure and, therefore, causes minimum organizational disruption. The major problems identified by those managers who endeavored to adapt to the new system all revolved around conflicts in authority and resources.

Three major problems were identified by Killian[1]:

- Project priorities and competition for talent may interrupt the stability of the organization and interfere with its long-range interests by upsetting the normal business of the functional organization.
- Long-range planning may suffer as the company gets more involved in meeting schedules and fulfilling the requirements of temporary projects.
- Shifting people from project to project may disrupt the training of new employees and specialists. This may hinder their growth and development within their fields of specialization.

Another major concern was that project management required upper-level managers to relinquish some of their authority through delegation to the middle managers. In several situations, middle managers soon occupied the power positions, even more so than upper-level managers.

Despite these limitations, there were several driving forces behind the project management approach. According to John Kenneth Galbraith, these forces stem from "the imperatives of technology." The six imperatives are[2]:

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1. William P. Killian, "Project Management—Future Organizational Concepts," *Marquette Business Review,* Vol. 2, 1971, pp. 90–107.

2. Excerpt from John Kenneth Galbraith, *The New Industrial State*, 3rd ed. Copyright © 1967, 1971, 1978, by John Kenneth Galbraith. Reprinted by permission of Houghton Mifflin Company. All rights reserved.

- The time span between project initiation and completion appears to be increasing.
- The capital committed to the project prior to the use of the end item appears to be increasing.
- As technology increases, the commitment of time and money appears to become inflexible.
- Technology requires more and more specialized manpower.
- The inevitable counterpart of specialization is organization.
- The above five "imperatives" identify the necessity for more effective planning, scheduling, and control.

As the driving forces overtook the restraining forces, project management began to mature. Executives began to realize that the approach was in the best interest of the company. Project management, if properly implemented, can make it easier for executives to overcome such internal and external obstacles as:

- Unstable economy
- Shortages
- Soaring costs
- Increased complexity
- Heightened competition
- Technological changes
- Societal concerns
- Consumerism
- Ecology
- Quality of work

Project management may not eliminate these problems, but may make it easier for the company to adapt to a changing environment.

If these obstacles are not controlled, the results may be:

- Decreased profits
- Increased manpower needs
- Cost overruns, schedule delays, and penalty payments occurring earlier and earlier
- An inability to cope with new technology
- R&D results too late to benefit existing product lines
- New products introduced into the marketplace too late
- Temptation to make hasty decisions that prove to be costly
- Management insisting on earlier and greater return on investment
- Greater difficulty in establishing on-target objectives in real time
- Problems in relating cost to technical performance and scheduling during the execution of the project

Project management became a necessity for many companies as they expanded into multiple product lines, many of which were dissimilar, and organizational complexities grew. This growth can be attributed to:

- Technology increasing at an astounding rate
- More money invested in R&D

- More information available
- Shortening of project life cycles

To satisfy the requirements imposed by these four factors, management was "forced" into organizational restructuring; the traditional organizational form that had survived for decades was inadequate for integrating activities across functional "empires."

By 1970, the environment began to change rapidly. Companies in aerospace, defense, and construction pioneered in implementing project management, and other industries soon followed, some with great reluctance. NASA and the Department of Defense "forced" subcontractors into accepting project management. The 1970s also brought much more published data on project management. As an example[3]:

> Project teams and task forces will become more common in tackling complexity. There will be more of what some people call temporary management systems as project management systems where the men [and women] who are needed to contribute to the solution meet, make their contribution, and perhaps never become a permanent member of any fixed or permanent management group.

The definition simply states that the purpose of project management is to put together the best possible team to achieve the objective, and, at termination, the team is disbanded. Nowhere in the definition do we see the authority of the project manager or his rank, title, or salary.

Because current organizational structures are unable to accommodate the wide variety of interrelated tasks necessary for successful project completion, the need for project management has become apparent. It is usually first identified by those lower-level and middle managers who find it impossible to control their resources effectively for the diverse activities within their line organization. Quite often middle managers feel the impact of a changing environment more than upper-level executives.

Once the need for change is identified, middle management must convince upper-level management that such a change is actually warranted. If top-level executives cannot recognize the problems with resource control, then project management will not be adopted, at least formally. Informal acceptance, however, is another story.

As project management developed, some essential factors in its successful implementation were recognized. The major factor was the role of the project manager, which became the focal point of integrative responsibility. The need for integrative responsibility was first identified in research and development activities[4]:

> Recently, R&D technology has broken down the boundaries that used to exist between industries. Once-stable markets and distribution channels are now in a state of flux. The industrial environment is turbulent and increasingly hard to predict. Many complex facts

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3. Reprinted from the October 17, 1970, issue of *BusinessWeek* by special permission, © 1970 by McGraw-Hill, Inc., New York, New York 10020. All rights reserved.

4. Reprinted by permission of *Harvard Business Review.* From Paul R. Lawrence and Jay W. Lorsch, "New Management Job: The Integrator," *Harvard Business Review,* November–December 1967, p. 142. Copyright © 1967 by the Harvard Business School Publishing Corporation; all rights reserved.

about markets, production methods, costs and scientific potentials are related to investment decisions.

All of these factors have combined to produce a king-size managerial headache. There are just too many crucial decisions to have them all processed and resolved through regular line hierarchy at the top of the organization. They must be integrated in some other way.

Providing the project manager with integrative responsibility resulted in:

- Total accountability assumed by a single person
- Project rather than functional dedication
- A requirement for coordination across functional interfaces
- Proper utilization of integrated planning and control

Without project management, these four elements have to be accomplished by executives, and it is questionable whether these activities should be part of an executive's job description. An executive in a Fortune 500 corporation stated that he was spending seventy hours a week acting as an executive and as a project manager, and he did not feel that he was performing either job to the best of his abilities. During a presentation to the staff, the executive stated what he expected of the organization after project management implementation:

- Push decision-making down in the organization
- Eliminate the need for committee solutions
- Trust the decisions of peers

Those executives who chose to accept project management soon found the advantages of the new technique:

- Easy adaptation to an ever-changing environment
- Ability to handle a multidisciplinary activity within a specified period of time
- Horizontal as well as vertical work flow
- Better orientation toward customer problems
- Easier identification of activity responsibilities
- A multidisciplinary decision-making process
- Innovation in organizational design

2.4 PROJECT MANAGEMENT: 1985–2009

By the 1990s, companies had begun to realize that implementing project management was a necessity, not a choice. The question was not how to implement project management, but how fast could it be done?

Table 2–1 shows the typical life-cycle phases that an organization goes through to implement project management. In the first phase, the Embryonic Phase, the organization recognizes the apparent need for project management. This recognition normally takes

TABLE 2–1. LIFE-CYCLE PHASES FOR PROJECT MANAGEMENT MATURITY

Embryonic Phase	Executive Management Acceptance Phase	Line Management Acceptance Phase	Growth Phase	Maturity Phase
• Recognize need	• Visible executive support	• Line management support	• Use of life-cycle phases	• Development of a management cost/schedule control system
• Recognize benefits	• Executive understanding of project management	• Line management commitment	• Development of a project management methodology	• Integrating cost and schedule control
• Recognize applications	• Project sponsorship	• Line management education	• Commitment to planning	• Developing an educational program to enhance project management skills
• Recognize what must be done	• Willingness to change way of doing business	• Willingness to release employees for project management training	• Minimization of "creeping scope"	
			• Selection of a project tracking system	

place at the lower and middle levels of management where the project activities actually take place. The executives are then informed of the need and assess the situation.

There are six driving forces that lead executives to recognize the need for project management:

- Capital projects
- Customer expectations
- Competitiveness
- Executive understanding
- New project development
- Efficiency and effectiveness

Manufacturing companies are driven to project management because of large capital projects or a multitude of simultaneous projects. Executives soon realize the impact on cash flow and that slippages in the schedule could end up idling workers.

Companies that sell products or services, including installation, to their clients must have good project management practices. These companies are usually non–project-driven but function as though they were project-driven. These companies now sell solutions to their customers rather than products. It is almost impossible to sell complete solutions to customers without having superior project management practices because what you are actually selling is your project management expertise.

There are two situations where competitiveness becomes the driving force: internal projects and external (outside customer) projects. Internally, companies get into trouble when the organization realizes that much of the work can be outsourced for less than it would cost to perform the work themselves. Externally, companies get into trouble when they are no longer competitive on price or quality, or simply cannot increase their market share.

Executive understanding is the driving force in those organizations that have a rigid traditional structure that performs routine, repetitive activities. These organizations are quite resistant to change unless driven by the executives. This driving force can exist in conjunction with any of the other driving forces.

New product development is the driving force for those organizations that are heavily invested in R&D activities. Given that only a small percentage of R&D projects ever make it into commercialization where the R&D costs can be recovered, project management becomes a necessity. Project management can also be used as an early warning system that a project should be cancelled.

Efficiency and effectiveness, as driving forces, can exist in conjunction with any other driving forces. Efficiency and effectiveness take on paramount importance for small companies experiencing growing pains. Project management can be used to help such companies remain competitive during periods of growth and to assist in determining capacity constraints.

Because of the interrelatedness of these driving forces, some people contend that the only true driving force is survival. This is illustrated in Figure 2–3. When the company recognizes that survival of the firm is at stake, the implementation of project management becomes easier.

The speed by which companies reach some degree of maturity in project management is most often based upon how important they perceive the driving forces to be. This is illustrated generically in Figure 2–4. Non–project-driven and hybrid organizations move quickly to maturity if increased internal efficiencies and effectiveness are needed. Competitiveness is the slowest path because these types of organizations do not recognize that project management affects their competitive position directly. For project-driven organizations, the path is reversed. Competitiveness is the name of the game and the vehicle used is project management.

Once the organization perceives the need for project management, it enters the second life-cycle phase of Table 2–1, Executive Acceptance. Project management cannot be

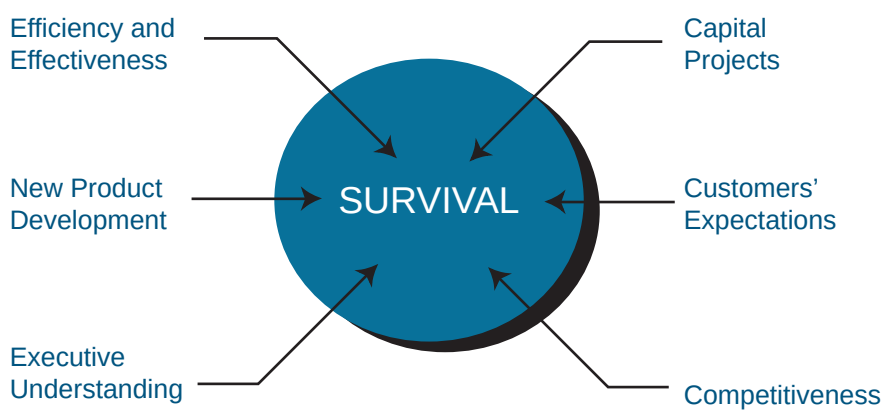

FIGURE 2–3. The components of survival. *Source:* Reprinted from H. Kerzner, *In Search of Excellence in Project Management.* New York: Wiley, 1998, p. 51.

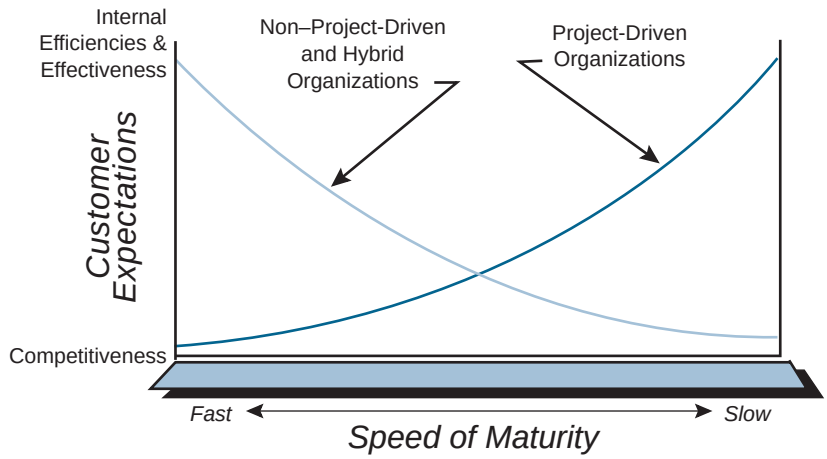

FIGURE 2–4. The speed of maturity.

implemented rapidly in the near term without executive support. Furthermore, the support must be visible to all.

The third life-cycle phase is Line Management Acceptance. It is highly unlikely that any line manager would actively support the implementation of project management without first recognizing the same support coming from above. Even minimal line management support will still cause project management to struggle.

The fourth life-cycle phase is the Growth Phase, where the organization becomes committed to the development of the corporate tools for project management. This includes the project management methodology for planning, scheduling, and controlling, as well as selection of the appropriate supporting software. Portions of this phase can begin during earlier phases.

The fifth life-cycle phase is Maturity. In this phase, the organization begins using the tools developed in the previous phase. Here, the organization must be totally dedicated to project management. The organization must develop a reasonable project management curriculum to provide the appropriate training and education in support of the tools, as well as the expected organizational behavior.

By the 1990s, companies finally began to recognize the benefits of project management. Table 2–2 shows the benefits of project management and how our view of project management has changed.

Recognizing that the organization can benefit from the implementation of project management is just the starting point. The question now becomes, “How long will it take us to achieve these benefits?” This can be partially answered from Figure 2–5. In the beginning of the implementation process, there will be added expenses to develop the project management methodology and establish the support systems for planning, scheduling, and control. Eventually, the cost will level off and become pegged. The question mark in Figure 2–5 is the point at which the benefits equal the cost of implementation. This point can be pushed to the left through training and education.

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1.5 Project Management in Operations Management

TABLE 2–2. BENEFITS OF PROJECT MANAGEMENT

Past View	Present View
• Project management will require more people and add to the overhead costs.	• Project management allows us to accomplish more work in less time, with fewer people.
• Profitability may decrease.	• Profitability will increase.
• Project management will increase the amount of scope changes.	• Project management will provide better control of scope changes.
• Project management creates organizational instability and increases conflicts.	• Project management makes the organization more efficient and effective through better organizational behavior principles.
• Project management is really "eye wash" for the customer's benefit.	• Project management will allow us to work more closely with our customers.
• Project management will create problems.	• Project management provides a means for solving problems.
• Only large projects need project management.	• All projects will benefit from project management.
• Project management will increase quality problems.	• Project management increases quality.
• Project management will create power and authority problems.	• Project management will reduce power struggles.
• Project management focuses on suboptimization by looking at only the project.	• Project management allows people to make good company decisions.
• Project management delivers products to a customer.	• Project management delivers solutions.
• The cost of project management may make us noncompetitive.	• Project management will increase our business.

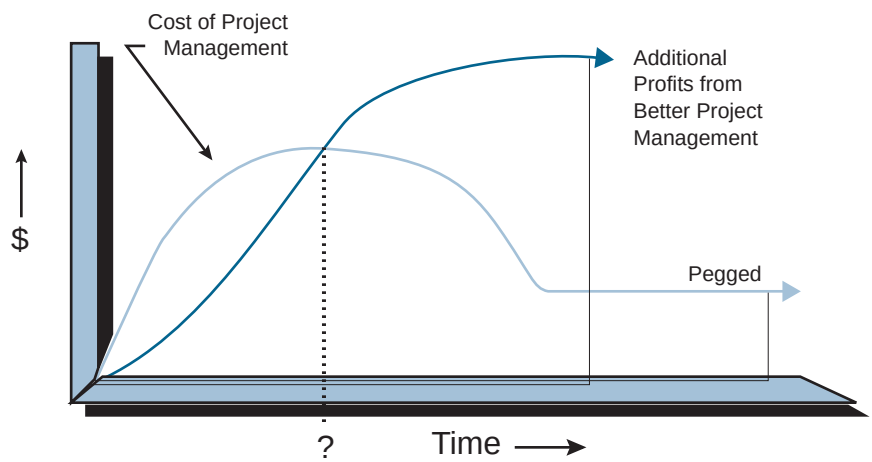

FIGURE 2–5. Project management costs versus benefits.

2.5 RESISTANCE TO CHANGE

Why was project management so difficult for companies to accept and implement? The answer is shown in Figure 2–6. Historically, project management resided only in the project-driven sectors of the marketplace. In these sectors, the project managers were given the responsibility for profit and loss, which virtually forced companies to treat project management as a profession.

In the non–project-driven sectors of the marketplace, corporate survival was based upon products and services, rather than upon a continuous stream of projects. Profitability was identified through marketing and sales, with very few projects having an identifiable P&L. As a result, project management in these firms was never viewed as a profession.

In reality, most firms that believed that they were non–project-driven were actually hybrids. Hybrid organizations are typically non–project-driven firms with one or two divisions that are project-driven. Historically, hybrids have functioned as though they were non–project-driven, as shown in Figure 2–6, but today they are functioning like project-driven firms. Why the change? Management has come to the realization that they can most effectively run their organization on a "management by project" basis, and thereby achieve the benefits of both a project management organization and a traditional organization. The rapid growth and acceptance of project management during the last ten years has taken place in the non–project-driven/hybrid sectors. Now, project management is being promoted by marketing, engineering, and production, rather than only by the project-driven departments (see Figure 2–7).

A second factor contributing to the acceptance of project management was the economy, specifically the recessions of 1979–1983 and 1989–1993. This can be seen from Table 2–3. By the end of the recession of 1979–1983, companies recognized the benefits of using project management but were reluctant to see it implemented. Companies

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2.2 Projects vs. Operational Work

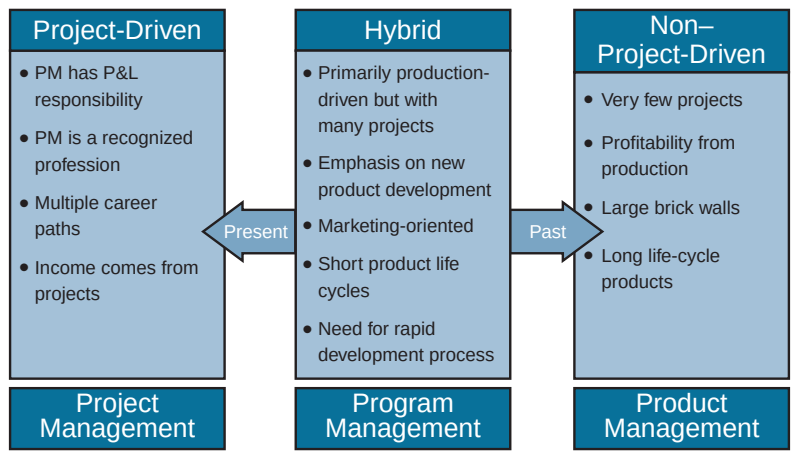


FIGURE 2–6. Industry classification (by project management utilization).

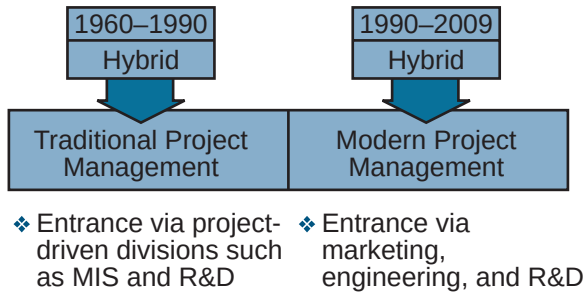


FIGURE 2–7. From hybrid to project-driven.

returned to the "status quo" of traditional management. There were no allies or alternative management techniques that were promoting the use of project management.

The recession of 1989–1993 finally saw the growth of project management in the non–project-driven sector. This recession was characterized by layoffs in the white collar/management ranks. Allies for project management were appearing and emphasis was being placed upon long-term solutions to problems. Project management was here to stay.

The allies for project management began surfacing in 1985 and continued throughout the recession of 1989–1993. This is seen in Figure 2–8.

- *1985:* Companies recognize that they must compete on the basis of quality as well as cost. Companies begin using the principles of project management for the implementation of total quality management (TQM). The first ally for project management surfaces with the "marriage" of project management and TQM.
- *1990:* During the recession of 1989–1993, companies recognize the importance of schedule compression and being the first to market. Advocates of concurrent engineering begin promoting the use of project management to obtain better scheduling techniques. Another ally for project management is born.

TABLE 2–3. RECESSIONARY EFFECTS

	Characteristics				
Recession	**Layoffs**	**R&D**	**Training**	**Solutions Sought**	**Results of the Recessions**
1979–1983	Blue collar	Eliminated	Eliminated	Short-term	• Return to status quo • No project management support • No allies for project management
1989–1993	White collar	Focused	Focused	Long-term	• Change way of doing business • Risk management • Examine lessons learned

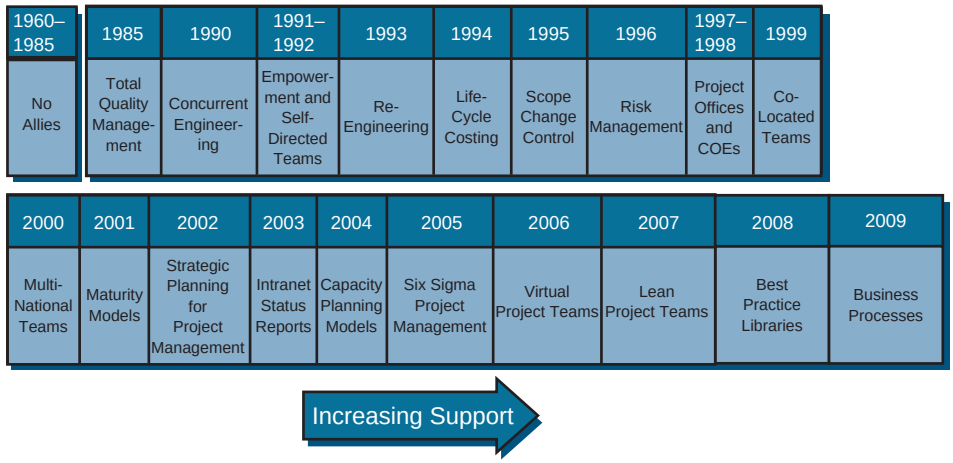


FIGURE 2–8. New processes supporting project management.

- *1991–1992:* Executives realize that project management works best if decision-making and authority are decentralized, but recognize that control can still be achieved at the top by functioning as project sponsors.
- *1993:* As the recession of 1989–1993 comes to an end, companies begin "re-engineering" the organization, which really amounts to elimination of organizational "fat." The organization is now a "lean and mean" machine. People are asked to do more work in less time and with fewer people; executives recognize that being able to do this is a benefit of project management.
- *1994:* Companies recognize that a good project cost control system (i.e., horizontal accounting) allows for improved estimating and a firmer grasp of the real cost of doing work and developing products.
- *1995:* Companies recognize that very few projects are completed within the framework of the original objectives without scope changes. Methodologies are created for effective change management.
- *1996:* Companies recognize that risk management involves more than padding an estimate or a schedule. Risk management plans are now included in the project plans.
- *1997–1998:* The recognition of project management as a professional career path mandates the consolidation of project management knowledge and a centrally located project management group. Benchmarking for best practices forces the creation of centers for excellence in project management.
- *1999:* Companies that recognize the importance of concurrent engineering and rapid product development find that it is best to have dedicated resources for the duration of the project. The cost of overmanagement may be negligible compared to risks of undermanagement. More organizations begin to use colocated teams all housed together.
- *2000:* Mergers and acquisitions create more multinational companies. Multinational project management becomes a major challenge.

- *2001:* Corporations are under pressure to achieve maturity as quickly as possible. Project management maturity models help companies reach this goal.
- *2002:* The maturity models for project management provide corporations with a basis to perform strategic planning for project management. Project management is now viewed as a strategic competency for the corporation.
- *2003:* Intranet status reporting comes of age. This is particularly important for multinational corporations that must exchange information quickly.
- *2004:* Intranet reporting provides corporations with information on how resources are being committed and utilized. Corporations develop capacity planning models to learn how much additional work the organization can take on.
- *2005:* The techniques utilized in Six Sigma are being applied to project management, especially for continuous improvement to the project management methodology. This will result in the establishment of categories of Six Sigma applications some of which are nontraditional.
- *2006:* Virtual project teams and virtual project management offices will become more common. The growth of virtual teams relies heavily upon trust, teamwork, cooperation, and effective communication.
- *2007:* The concepts of lean manufacturing will be applied to project management.
- *2008:* Companies will recognize the value of capturing best practices in project management and creating a best practices library or knowledge repository.
- *2009:* Project management methodologies will include more business processes to support project management.

As project management continues to grow and mature, it will have more allies. In the twenty-first century, second and third world nations will come to recognize the benefits and importance of project management. Worldwide standards for project management will be established.

If a company wishes to achieve excellence in project management, then it must go through a successful implementation process. This is illustrated in Situation 2–1.

Situation 2–1: The aerospace division of a Fortune 500 company had been using project management for more than thirty years. Everyone in the organization had attended courses in the principles of project management. From 1985 to 1994, the division went through a yearly ritual of benchmarking themselves against other aerospace and defense organizations. At the end of the benchmarking period, the staff would hug and kiss one another, believing that they were performing project management as well as could be expected.

In 1995, the picture changed. The company decided to benchmark itself against organizations that were not in the aerospace or defense sector. It soon learned that there were companies that had been using project management for fewer than six years but whose skills at implementation had surpassed the aerospace/defense firms. It was a rude awakening.

Another factor that contributed to resistance to change was senior management's preference for the status quo. Often this preference was based upon what was in the executives'

best interest rather than the best interest of the organization. It was also common for someone to attend basic project management programs and then discover that the organization would not allow full implementation of project management, leading to frustration for those in the lower and middle levels of management. Consider Situation 2–2:

> ***Situation 2–2:*** The largest division of a Fortune 500 company recognized the need for project management. Over a three-year period, 200 people were trained in the basics of project management, and 18 people passed the national certification exam for project management. The company created a project management division and developed a methodology. As project management began to evolve in this division, the project managers quickly realized that the organization would not allow their "illusions of grandeur" to materialize. The executive vice president made it clear that the functional areas, rather than the project management division, would have budgetary control. Project managers would *not* be empowered with authority or critical decision-making opportunities. Simply stated, the project managers were being treated as expediters and coordinators, rather than real project managers.

Even though project management has been in existence for more than forty years, there are still different views and misconceptions about what it really is. Textbooks on operations research or management science still have chapters entitled "Project Management" that discuss only PERT scheduling techniques. A textbook on organizational design recognized project management as simply another organizational form.

All companies sooner or later understand the basics of project management. But companies that have achieved excellence in project management have done so through successful implementation and execution of processes and methodologies.

2.6 SYSTEMS, PROGRAMS, AND PROJECTS: A DEFINITION

In the preceding sections the word "systems" has been used rather loosely. The exact definition of a system depends on the users, environment, and ultimate goal. Business practitioners define a system as:

> A group of elements, either human or nonhuman, that is organized and arranged in such a way that the elements can act as a whole toward achieving some common goal or objective.

Systems are collections of interacting subsystems that, if properly organized, can provide a synergistic output. Systems are characterized by their boundaries or interface conditions. For example, if the business firm system were completely isolated from the environmental system, then a *closed system* would exist, in which case management would have complete control over all system components. If the business system reacts with the environment, then the system is referred to as *open.* All social systems, for example, are categorized as open systems. Open systems must have permeable boundaries.

If a system is significantly dependent on other systems for its survival, then it is an *extended system.* Not all open systems are extended systems. Extended systems are ever-changing and can impose great hardships on individuals who desire to work in a regimented atmosphere.

Military and government organizations were the first to attempt to define the boundaries of systems, programs, and projects. Below are two definitions for systems:

- *Air Force Definition:* A composite of equipment, skills, and techniques capable of performing and/or supporting an operational role. A complete system includes related facilities, equipment, material services, and personnel required for its operation to the degree that it can be considered as a self-sufficient unit in its intended operational and/or support environment.
- *NASA Definition:* One of the principal functioning entities comprising the project hardware within a project or program. The meaning may vary to suit a particular project or program area. Ordinarily a "system" is the first major subdivision of project work (spacecraft systems, launch vehicle systems).

PMBOK® Guide, 4th Edition
1.4.2 Program Management Definition

Programs can be construed as the necessary first-level elements of a system. Two representative definitions of programs are given below:

- *Air Force Definition:* The integrated, time-phased tasks necessary to accomplish a particular purpose.
- *NASA Definition:* A relative series of undertakings that continue over a period of time (normally years) and that are designed to accomplish a broad, scientific or technical goal in the NASA long-range plan (lunar and planetary exploration, manned spacecraft systems).

Programs can be regarded as subsystems. However, programs are generally defined as time-phased efforts, whereas systems exist on a continuous basis.

Projects are also time-phased efforts (much shorter than programs) and are the first level of breakdown of a program. A typical definition would be:

- *NASA/Air Force Definition:* A project is within a program as an undertaking that has a scheduled beginning and end, and that normally involves some primary purpose.

As shown in Table 2–4, the government sector tends to run efforts as programs, headed by a program manager. The majority of the industrial sector, on the other hand, prefers to describe efforts as projects, headed by a project manager. Whether we call our undertaking project management or program management is inconsequential because the same policies, procedures, and guidelines tend to regulate both. For the remainder of this text, programs and projects will be discussed interchangeably. However, the reader should be aware that projects are normally the first-level subdivision of a program and that programs are more ongoing than projects. This breakdown will be discussed in more detail in Chapter 11.

TABLE 2–4. DEFINITION SUMMARY

Level	Sector	Title
System*	—	—
Program	Government	Program managers
Project	Industry	Project managers

*Definitions, as used here, do not include in-house industrial systems such as management information systems or shop floor control systems.

Once a group of tasks is selected and considered to be a project, the next step is to define the kinds of project units. There are four categories of projects:

- *Individual projects:* These are short-duration projects normally assigned to a single individual who may be acting as both a project manager and a functional manager.
- *Staff projects:* These are projects that can be accomplished by one organizational unit, say a department. A staff or task force is developed from each section involved. This works best if only one functional unit is involved.
- *Special projects:* Often special projects occur that require certain primary functions and/or authority to be assigned temporarily to other individuals or units. This works best for short-duration projects. Long-term projects can lead to severe conflicts under this arrangement.
- *Matrix or aggregate projects:* These require input from a large number of functional units and usually control vast resources.

Project management may now be defined as the process of achieving project objectives through the traditional organizational structure and over the specialties of the individuals concerned. Project management is applicable for any ad hoc (unique, one-time, one-of-a-kind) undertaking concerned with a specific end objective. In order to complete a task, a project manager must:

PMBOK® Guide, 4th Edition
1.3 What Is Project Management?

- Set objectives
- Establish plans
- Organize resources
- Provide staffing
- Set up controls
- Issue directives
- Motivate personnel
- Apply innovation for alternative actions
- Remain flexible

The type of project will often dictate which of these functions a project manager will be required to perform.

2.7 PRODUCT VERSUS PROJECT MANAGEMENT: A DEFINITION

PMBOK® Guide, 4th Edition
4.1.1 Inputs to Project Charter
4.1.1.1 Product Scope and Project Scope and Chapter 5 Introduction

For all practical purposes, there is no major difference between a project and a program other than the time duration. Project managers focus on the end date of their project from the day they are assigned as project manager. Program managers usually have a much longer time frame that project managers and never want to see their program come to an end. In the early years of project management with the Department of Defense serving as the primary customer, aerospace and defense project managers were called program managers because the intent was to get follow-on government contracts each year.

But what about the definition of product management or product line management? Product managers function closely like program managers. The product manager wants his or her product to be as long-lived as possible and as profitable as possible. Even when the demand for the product diminishes, the product manager will always look for spin-offs to keep a product alive.

Although the PMBOK® Guide does not differentiate between project and program scope, it does differentiate between project and product scope:

- *Project scope* defines the work that must be accomplished to produce a deliverable with specified features or functions. The deliverable can be a product, service, or other result.
- *Product scope* defines the features or functions that characterize the deliverable.

Figure 2–9 shows the relationship between project and product management. When the project is in the R&D phase, a project manager is involved. Once the product is developed and introduced into the marketplace, the product manager takes control. In some situations, the project manager can become the product manager. Product and project management can, and do, exist concurrently within companies.

Figure 2–9 shows that product management can operate horizontally as well as vertically. When a product is shown horizontally on the organizational chart, the implication is that the product line is not big enough to control its own resources full-time and therefore shares key functional resources. If the product line were large enough to control its own resources full-time, it would be shown as a separate division or a vertical line on the organization chart.

Also shown in Figure 2–9 is the remarkable fact that the project manager (or project engineer) is reporting to a marketing-type person. The reason is that technically oriented project leaders get too involved with the technical details of the project and lose sight of when and how to "kill" a project. Remember, most technical leaders have been trained in an academic rather than a business environment. Their commitment to success often does not take into account such important parameters as return on investment, profitability, competition, and marketability.

To alleviate these problems, project managers and project engineers, especially on R&D-type projects, are now reporting to marketing so that marketing input will be included in all R&D decisions because of the high costs incurred during R&D. Executives must exercise caution with regard to this structure in which both product and project

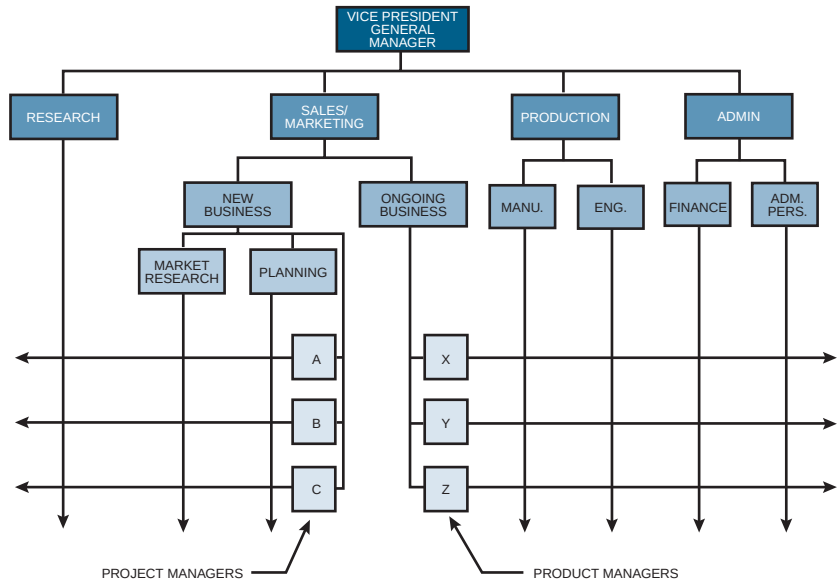


FIGURE 2–9. Organizational chart.

managers report to the marketing function. The marketing executive could become the focal point of the entire organization, with the capability of building a very large empire.

2.8 MATURITY AND EXCELLENCE: A DEFINITION

Some people contend that maturity and excellence in project management are the same. Unfortunately, this is not the case. Consider the following definition:

> Maturity in project management is the implementation of a standard methodology and accompanying processes such that there exists a high likelihood of repeated successes.

This definition is supported by the life-cycle phases shown in Table 2–1. Maturity implies that the proper foundation of tools, techniques, processes, and even culture, exists. When projects come to an end, there is usually a debriefing with senior management to discuss how well the methodology was used and to recommend changes. This debriefing looks at "key performance indicators," which are shared learning topics, and allows the organization to maximize what it does right and to correct what it did wrong.

The definition of excellence can be stated as:

> Organizations excellent in project management are those that create the environment in which there exists a *continuous* stream of successfully managed projects and where success is measured by what is in the best interest of *both* the company and the project (i.e., customer).

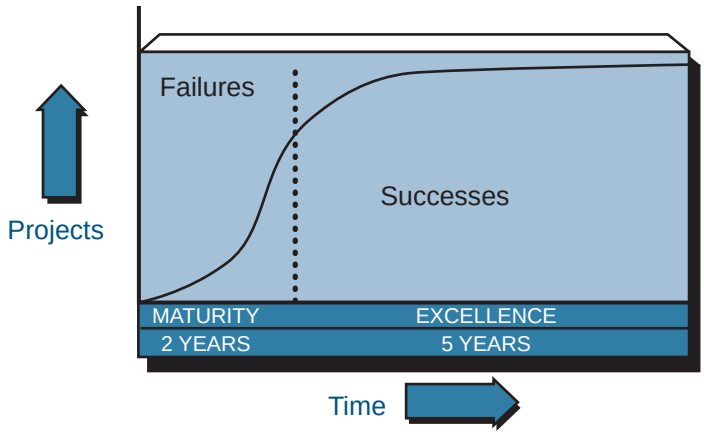


FIGURE 2–10. The growth of excellence.

Excellence goes well beyond maturity. You must have maturity to achieve excellence. Figure 2–10 shows that once the organization completes the first four life-cycle phases in Table 2–1, it may take two years or more to reach some initial levels of maturity. Excellence, if achievable at all, may take an additional five years or more.

Figure 2–10 also brings out another important fact. During maturity, more successes than failures occur. During excellence, we obtain a continuous stream of successful projects. Yet, even after having achieved excellence, there will still be some failures.

> Executives who always make the right decision are not making enough decisions. Likewise, organizations in which all projects are completed successfully are not taking enough risks and are not working on enough projects.

It is unrealistic to believe that all projects will be completed successfully. Some people contend that the only true project failures are the ones from which nothing is learned. Failure can be viewed as success if the failure is identified early enough so that the resources can be reassigned to other more opportunistic activities.

2.9 INFORMAL PROJECT MANAGEMENT: A DEFINITION

Companies today are managing projects more informally than before. Informal project management does have some degree of formality but emphasizes managing the project with a minimum amount of paperwork. Furthermore, informal project management is based upon guidelines rather than the policies and procedures that are the basis for formal project

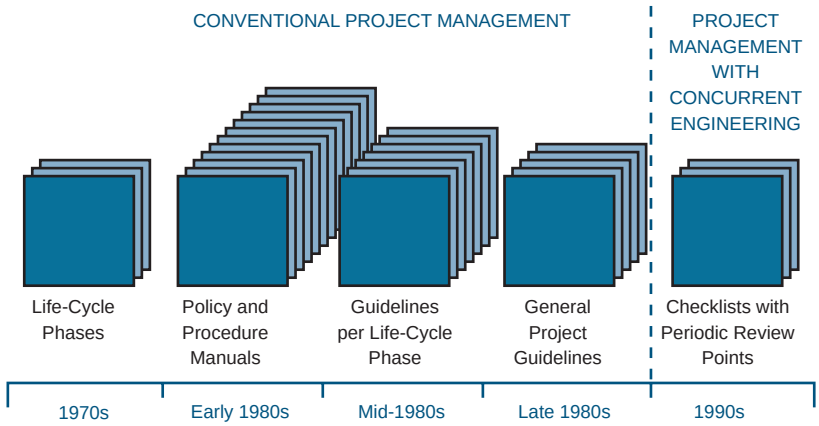


FIGURE 2–11. Evolution of policies, procedures, and guidelines. *Source:* Reprinted from H. Kerzner, *In Search of Excellence in Project Management.* New York: Wiley, 1998, p. 196.

management. This was shown previously to be a characteristic of a good project management methodology. Informal project management mandates:

- Effective communications
- Effective cooperation
- Effective teamwork
- Trust

These four elements are absolutely essential for effective informal project management.

Figure 2–11 shows the evolution of project documentation over the years. As companies become mature in project management, emphasis is on guidelines and checklists. Figure 2–12 shows the critical issues as project management matures toward more informality.

As a final note, not all companies have the luxury of using informal project management. Customers often have a strong voice in whether formal or informal project management will be used.

2.10 THE MANY FACES OF SUCCESS

Historically, the definition of success has been meeting the customer's expectations regardless of whether or not the customer is internal or external. Success also includes getting the job done within the constraints of time, cost, and quality. Using this standard definition, success is defined as a point on the time, cost, quality/performance grid. But how many projects, especially those requiring innovation, are accomplished at this point?

Very few projects are ever completed without trade-offs or scope changes on time, cost, and quality. Therefore, success could still occur without exactly hitting this singular point. In this regard, success could be defined as a cube, such as seen in Figure 2–13. The singular point of time, cost, and quality would be a point within the cube, constituting the convergence of the critical success factors (CSFs) for the project.

Another factor to consider is that there may exist both primary and secondary definitions of success, as shown in Table 2–5. The primary definitions of success are seen through

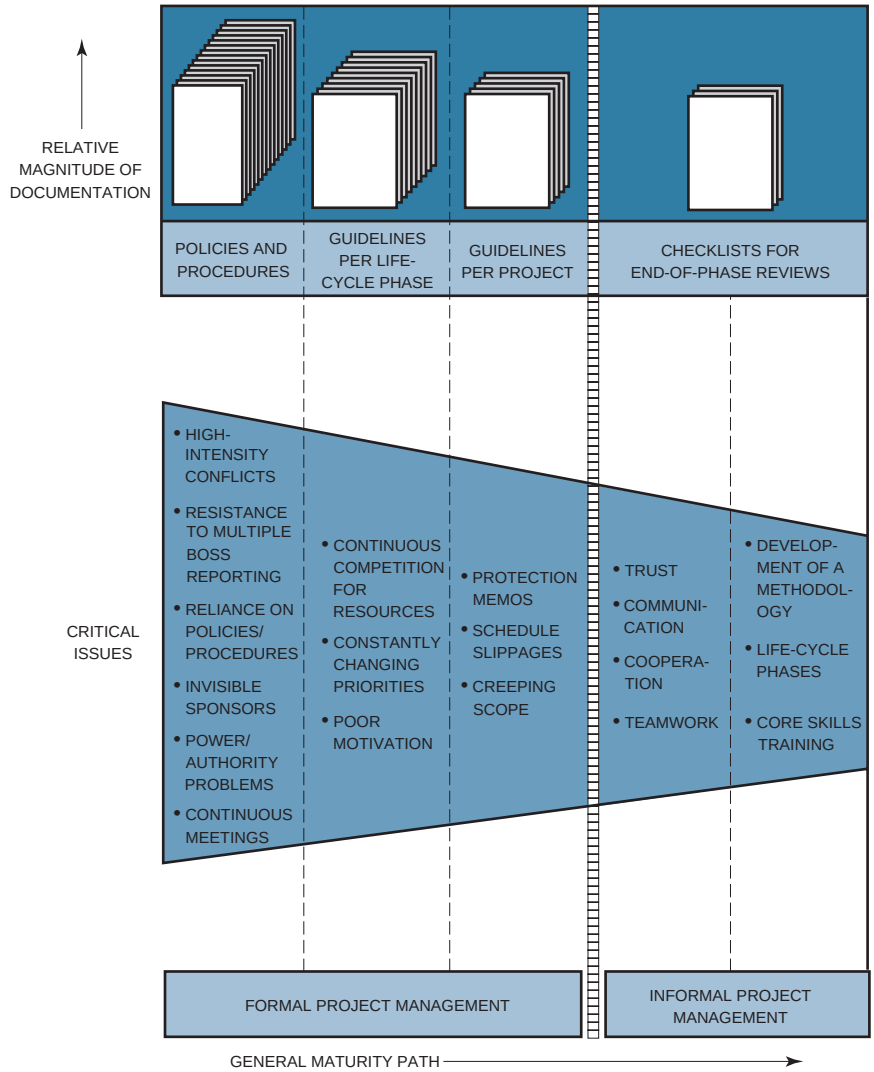


FIGURE 2–12. Maturity path.

the eyes of the customer. The secondary definitions of success are usually internal benefits. If achieving 86 percent of the specification is acceptable to the customer and follow-on work is received, then the original project might very well be considered a success.

The definition of success can also vary according to who the stakeholder is. For example, each of the following can have his or her own definition of success on a project:

- Consumers: safety in its use
- Employees: guaranteed employment
- Management: bonuses
- Stockholders: profitability
- Government agencies: compliance with federal regulations

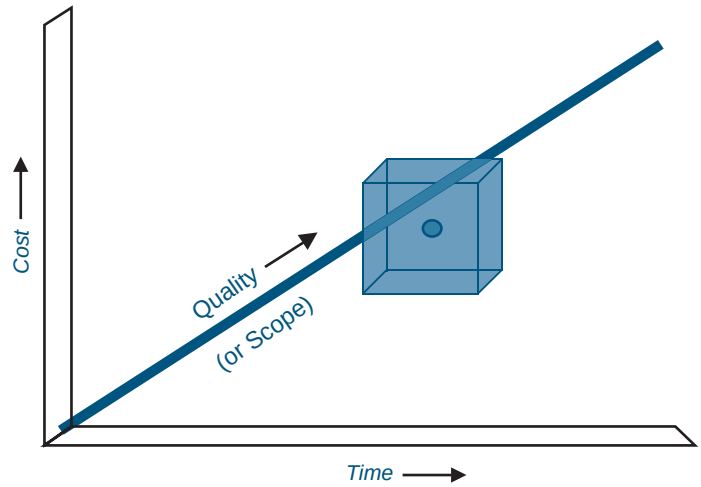


FIGURE 2–13. Success: point or cube?

It is possible for a project management methodology to identify primary and secondary success factors. This could provide guidance to a project manager for the development of a risk management plan and for deciding which risks are worth taking and which are not.

Critical success factors identify what is necessary to meet the desired deliverables of the customer. We can also look at key performance indicators (KPIs), which measure the quality of the process used to achieve the end results. KPIs are internal measures or metrics that can be reviewed on a periodic basis throughout the life cycle of the project. Typical KPIs include:

- Use of the project management methodology
- Establishment of the control processes
- Use of interim metrics
- Quality of resources assigned versus planned for
- Client involvement

TABLE 2–5. SUCCESS FACTORS

Primary	Secondary
• Within time • Within cost • Within quality limits • Accepted by the customer	• Follow-on work from this customer • Using the customer's name as a reference on your literature • Commercialization of a product • With minimum or mutually agreed upon scope changes • Without disturbing the main flow of work • Without changing the corporate culture • Without violating safety requirements • Providing efficiency and effectiveness of operations • Satisfying OSHA/EPA requirements • Maintaining ethical conduct • Providing a strategic alignment • Maintaining a corporate reputation • Maintaining regulatory agency relations

Key performance indicators answer such questions as: Did we use the methodology correctly? Did we keep management informed, and how frequently? Were the proper resources assigned and were they used effectively? Were there lessons learned that could necessitate updating the methodology or its use? Companies excellent in project management measure success both internally and externally using CSFs and KPIs.

2.11 THE MANY FACES OF FAILURE[5]

Previously we stated that success might be a cube rather than a point. If we stay within the cube but miss the point, is that a failure? Probably not! The true definition of failure is when the final results are not what were expected, even though the original expectations may or may not have been reasonable. Sometimes customers and even internal executives set performance targets that are totally unrealistic in hopes of achieving 80–90 percent. For simplicity's sake, let us define failure as unmet expectations.

With unmeetable expectations, failure is virtually assured since we have defined failure as unmet expectations. This is called a *planning failure* and is the difference between what was planned and what was, in fact, achieved. The second component of failure is poor performance or *actual failure*. This is the difference between what was achievable and what was actually accomplished.

Perceived failure is the net sum of *actual failure* and *planning failure*. Figures 2–14 and 2–15 illustrate the components of perceived failure. In Figure 2–14, *project management* has planned a level of accomplishment (C) lower than what is achievable given project circumstances and resources (D). This is a classic underplanning situation. Actual accomplishment (B), however, was less than planned.

A slightly different case is illustrated in Figure 2–15. Here, we have planned to accomplish more than is achievable. Planning failure is again assured even if no actual failure occurs. In both of these situations (overplanning and underplanning), the actual failure is the same, but the perceived failure can vary considerably.

Today, most project management practitioners focus on the *planning failure* term. If this term can be compressed or even eliminated, then the magnitude of the actual failure, should it occur, would be diminished. A good project management methodology helps to reduce this term. We now believe that the existence of this term is largely due to the project manager's inability to perform effective risk management. In the 1980s, we believed that the failure of a project was largely a quantitative failure due to:

- Ineffective planning
- Ineffective scheduling
- Ineffective estimating
- Ineffective cost control
- Project objectives being "moving targets"

5. Adapted from Robert D. Gilbreath, *Winning at Project Management.* New York: Wiley, 1986, pp. 2–6.

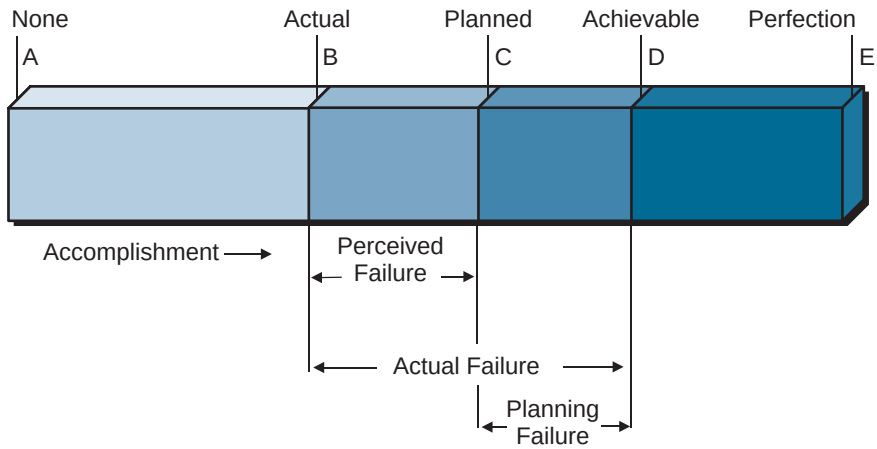


FIGURE 2–14. Components of failure (pessimistic planning).

During the 1990s, we changed our view of failure from being quantitatively oriented to qualitatively oriented. A failure in the 1990s was largely attributed to:

- Poor morale
- Poor motivation
- Poor human relations
- Poor productivity
- No employee commitment

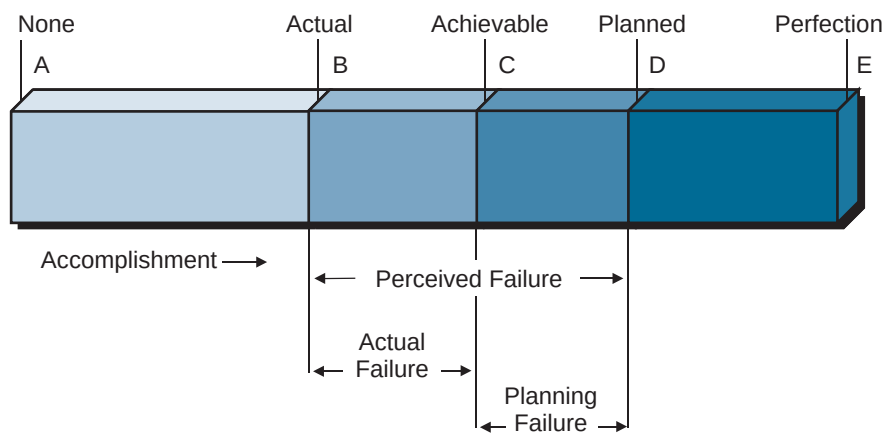


FIGURE 2–15. Components of failure (optimistic planning).

- No functional commitment
- Delays in problem solving
- Too many unresolved policy issues
- Conflicting priorities between executives, line managers, and project managers

Although these quantitative and qualitative approaches still hold true to some degree, today we believe that the major component of planning failure is inappropriate or inadequate risk management, or having a project management methodology that does not provide any guidance for risk management.

Sometimes, the risk management component of failure is not readily identified. For example, look at Figure 2–16. The actual performance delivered by the contractor was significantly less than the customer's expectations. Is the difference due to poor technical ability or a combination of technical inability and poor risk management? Today we believe that it is a combination.

When a project is completed, companies perform a lessons-learned review. Sometimes lessons learned are inappropriately labeled and the true reason for the risk event is not known. Figure 2–17 illustrates the relationship between the marketing personnel and technical personnel when undertaking a project to develop a new product. If the project is completed with actual performance being less than customer expectations, is it because of poor risk management by the technical assessment and forecasting personnel or poor marketing risk assessment? The relationship between marketing and technical risk management is not always clear.

Figure 2–17 also shows that opportunities for trade-offs diminish as we get further downstream on the project. There are numerous opportunities for trade-offs prior to establishing the final objectives for the project. In other words, if the project fails, it may be because of the timing when the risks were analyzed.

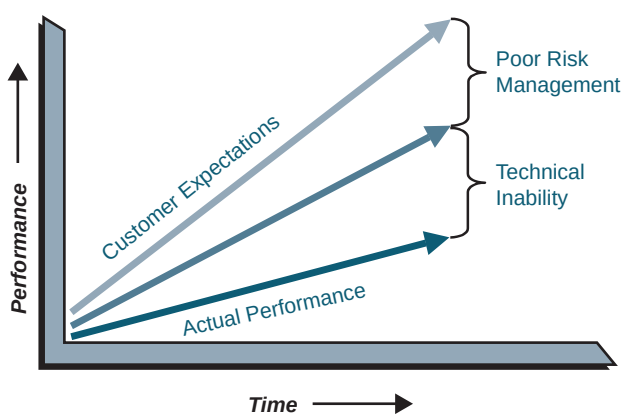


FIGURE 2–16. Risk planning.

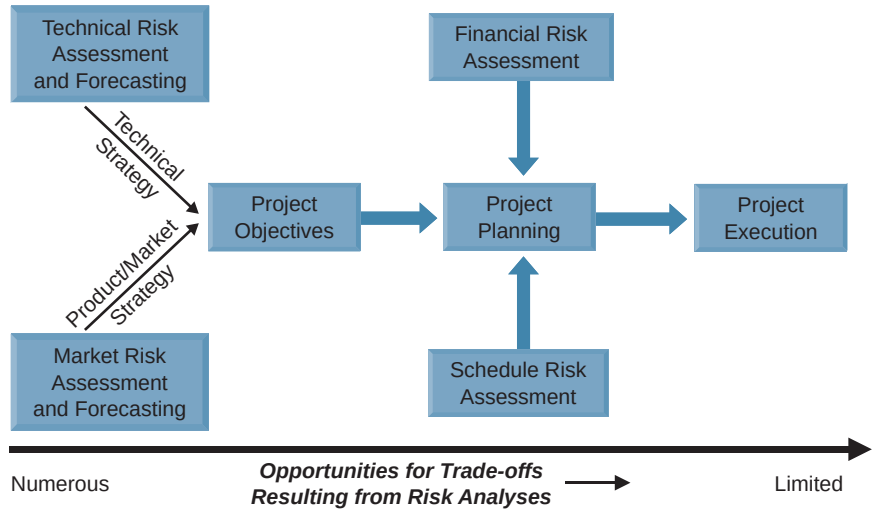


FIGURE 2–17. Mitigation strategies available.

2.12 THE STAGE-GATE PROCESS

PMBOK® Guide, 4th Edition
Chapter 2 Project Life Cycle and Organization
2.1.1 Characteristics of Project Phases

When companies recognize the need to begin developing processes for project management, the starting point is normally the stage-gate process. The stage-gate process was created because the traditional organizational structure was designed primarily for top-down, centralized management, control, and communications, all of which were no longer practical for organizations that use project management and horizontal work flow. The stage-gate process eventually evolved into life-cycle phases.

Just as the words imply, the process is composed of stages and gates. Stages are groups of activities that can be performed either in series or parallel based upon the magnitude of the risks the project team can endure. The stages are managed by cross-functional teams. The gates are structured decision points at the end of each stage. Good project management processes usually have no more than six gates. With more than six gates, the project team focuses too much attention on preparing for the gate reviews rather than on the actual management of the project.

Project management is used to manage the stages between the gates, and can shorten the time between the gates. This is a critical success factor if the stage-gate process is to be used for the development and launch of new products. A good corporate methodology for project management will provide checklists, forms, and guidelines to make sure that critical steps are not omitted.

Checklists for gate reviews are critical. Without these checklists, project managers can waste hours preparing gate review reports. Good checklists focus on answering these questions:

- Where are we today (i.e., time and cost)?
- Where will we end up (i.e., time and cost)?

- What are the present and future risks?
- What assistance is needed from management?

Project managers are never allowed to function as their own gatekeepers. The gatekeepers are either individuals (i.e., sponsors) or groups of individuals designated by senior management and empowered to enforce the structured decision-making process. The gatekeepers are authorized to evaluate the performance to date against predetermined criteria and to provide the project team with additional business and technical information.

Gatekeepers must be willing to make decisions. The four most common decisions are:

- Proceed to the next gate based upon the original objectives
- Proceed to the next gate based upon revised objectives
- Delay making a gate decision until further information is obtained
- Cancel the project

Sponsors must also have the courage to terminate a project. The purpose of the gates is not only to obtain authorization to proceed, but to identify failure early enough so that resources will not be wasted but will be assigned to more promising activities.

We can now identify the three major benefits of the stage-gate process:

- Providing structure to project management
- Providing possible standardization in planning, scheduling, and control (i.e., forms, checklists, and guidelines)
- Allowing for a structured decision-making process

Companies embark upon the stage-gate process with good intentions, but there are pitfalls that may disrupt the process. These include:

- Assigning gatekeepers and not empowering them to make decisions
- Assigning gatekeepers who are afraid to terminate a project
- Denying the project team access to critical information
- Allowing the project team to focus more on the gates than on the stages

It should be recognized that the stage-gate process is neither an end result nor a self-sufficient methodology. Instead, it is just one of several processes that provide structure to the overall project management methodology.

Today, the stage-gate process appears to have been replaced by life-cycle phases. Although there is some truth in this, the stage-gate process is making a comeback. Since the stage-gate process focuses on decision-making more than life-cycle phases, the stage-gate process is being used as an internal, decision-making tool within each of the life-cycle phases. The advantage is that, while life-cycle phases are the same for every project, the stage-gate process can be custom-designed for each project to facilitate decision-making and risk management. The stage-gate process is now an integral part of project management, whereas previously it was used primarily for new product development efforts.

2.13 PROJECT LIFE CYCLES

PMBOK® Guide, 4th Edition
Chapter 2
2.1.2 and 2.1.3

Every program, project, or product has certain phases of development known as life-cycle phases. A clear understanding of these phases permits managers and executives to better control resources to achieve goals.

During the past few years, there has been at least partial agreement about the life-cycle phases of a product. They include:

- Research and development
- Market introduction
- Growth
- Maturity
- Deterioration
- Death

Today, there is no agreement among industries, or even companies within the same industry, about the life-cycle phases of a project. This is understandable because of the complex nature and diversity of projects.

The theoretical definitions of the life-cycle phases of a system can be applied to a project. These phases include:

- Conceptual
- Planning
- Testing
- Implementation
- Closure

The first phase, the conceptual phase, includes the preliminary evaluation of an idea. Most important in this phase is a preliminary analysis of risk and the resulting impact on the time, cost, and performance requirements, together with the potential impact on company resources. The conceptual phase also includes a "first cut" at the feasibility of the effort.

The second phase is the planning phase. It is mainly a refinement of the elements in the conceptual phase and requires a firm identification of the resources required and the establishment of realistic time, cost, and performance parameters. This phase also includes the initial preparation of documentation necessary to support the system. For a project based on competitive bidding, the conceptual phase would include the decision of whether to bid, and the planning phase would include the development of the total bid package (i.e., time, schedule, cost, and performance).

Because of the amount of estimating involved, analyzing system costs during the conceptual and planning phases is not an easy task. As shown in Figure 2–18, most project or system costs can be broken down into operating (recurring) and implementation (nonrecurring) categories. Implementation costs include one-time expenses such as construction of a new facility, purchasing computer hardware, or detailed planning. Operating costs include recurring expenses such as manpower. The operating costs may be reduced as

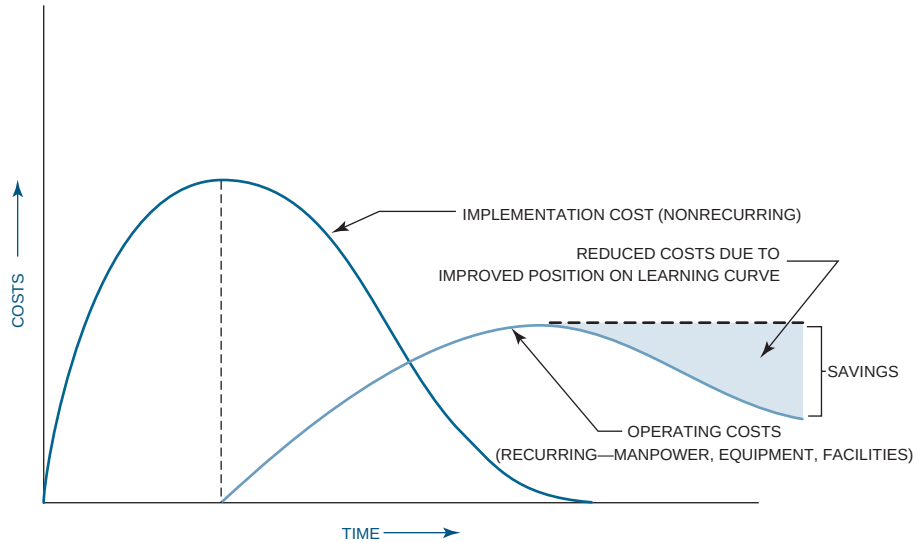


FIGURE 2–18. System costs.

shown in Figure 2–18 if personnel perform at a higher position on the learning curve. The identification of a learning curve position is vitally important during the planning phase when firm cost positions must be established. Of course, it is not always possible to know what individuals will be available or how soon they will perform at a higher learning curve position.

Once the approximate total cost of the project is determined, a cost-benefit analysis should be conducted (see Figure 2–19) to determine if the estimated value of the information obtained from the system exceeds the cost of obtaining the information. This analysis is often included as part of a feasibility study. There are several situations, such as in competitive bidding, where the feasibility study is actually the conceptual and definition phases. Because of the costs that can be incurred during these two phases, top-management approval is almost always necessary before the initiation of such a feasibility study.

The third phase—testing—is predominantly a testing and final standardization effort so that operations can begin. Almost all documentation must be completed in this phase.

The fourth phase is the implementation phase, which integrates the project's product or services into the existing organization. If the project was developed for establishment of a marketable product, then this phase could include the product life-cycle phases of market introduction, growth, maturity, and a portion of deterioration.

The final phase is closure and includes the reallocation of resources. Consider a company that sells products to consumers. As one product begins the deterioration and death phases of its life cycle (i.e., the divestment phase of a system), new products or projects must be established. Such a company would, therefore, require a continuous stream of projects to survive, as shown in Figure 2–20. As projects A and B begin their decline, new

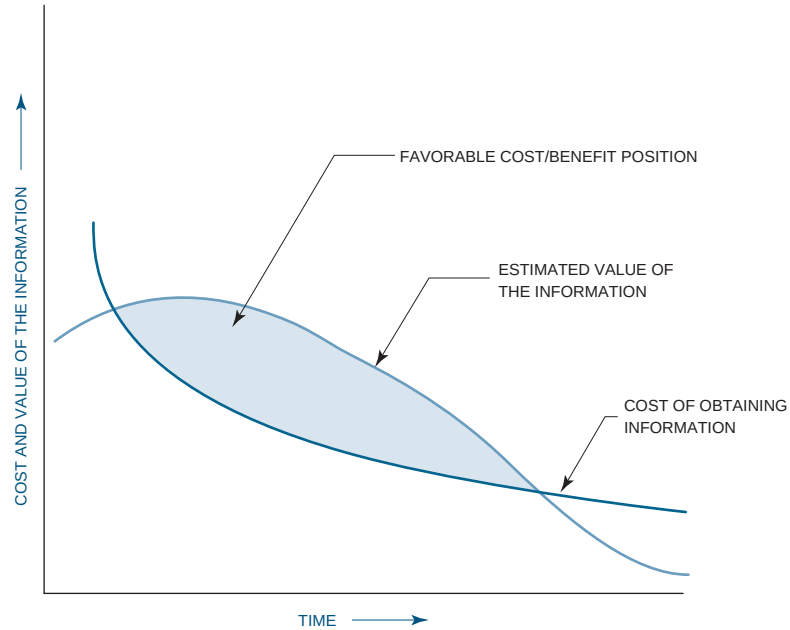


FIGURE 2–19. Cost-benefit analysis.

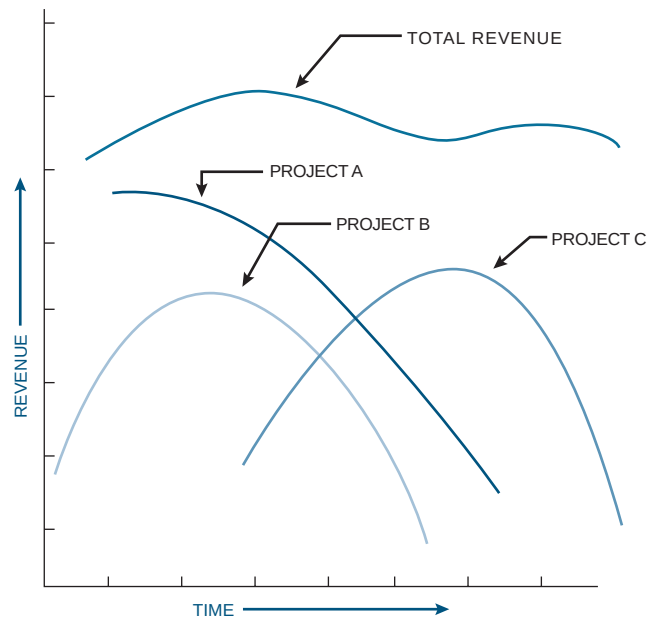


FIGURE 2–20. A stream of projects.

efforts (project C) must be developed for resource reallocation. In the ideal situation these new projects will be established at such a rate that total revenue will increase and company growth will be clearly visible.

The closure phase evaluates the efforts of the total system and serves as input to the conceptual phases for new projects and systems. This final phase also has an impact on other ongoing projects with regard to identifying priorities.

Thus far no attempt has been made to identify the size of a project or system. Large projects generally require full-time staffs, whereas small projects, although they undergo the same system life-cycle phases, may require only part-time people. This implies that an individual can be responsible for multiple projects, possibly with each project existing in a different life-cycle phase. The following questions must be considered in multiproject management:

- Are the project objectives the same?
  - For the good of the project?
  - For the good of the company?
- Is there a distinction between large and small projects?
- How do we handle conflicting priorities?
  - Critical versus critical projects
  - Critical versus noncritical projects
  - Noncritical versus noncritical projects

Later chapters discuss methods of resolving conflicts and establishing priorities.

The phases of a project and those of a product are compared in Figure 2–21. Notice that the life-cycle phases of a product generally do not overlap, whereas the phases of a project can and often do overlap.

Table 2–6 identifies the various life-cycle phases that are commonly used. Even in mature project management industries such as construction, one could survey ten different construction companies and find ten different definitions for the life-cycle phases.

The life-cycle phases for computer programming, as listed in Table 2–6, are also shown in Figure 2–22, which illustrates how manpower resources can build up and decline during a project. In Figure 2–22, PMO stands for the present method of operations, and PMO′ will be the "new" present method of operations after conversion. This life cycle would probably be representative of a twelve-month activity. Most executives prefer short data processing life cycles because computer technology changes rapidly. An executive of a major utility commented that his company was having trouble determining how to terminate a computer programming project to improve customer service because, by the time a package is ready for full implementation, an updated version appears on the scene. Should the original project be canceled and a new project begun? The solution appears to lie in establishing short data processing project life-cycle phases, perhaps through segmented implementation.

Top management is responsible for the periodic review of major projects. This should be accomplished, at a minimum, at the completion of each life-cycle phase.

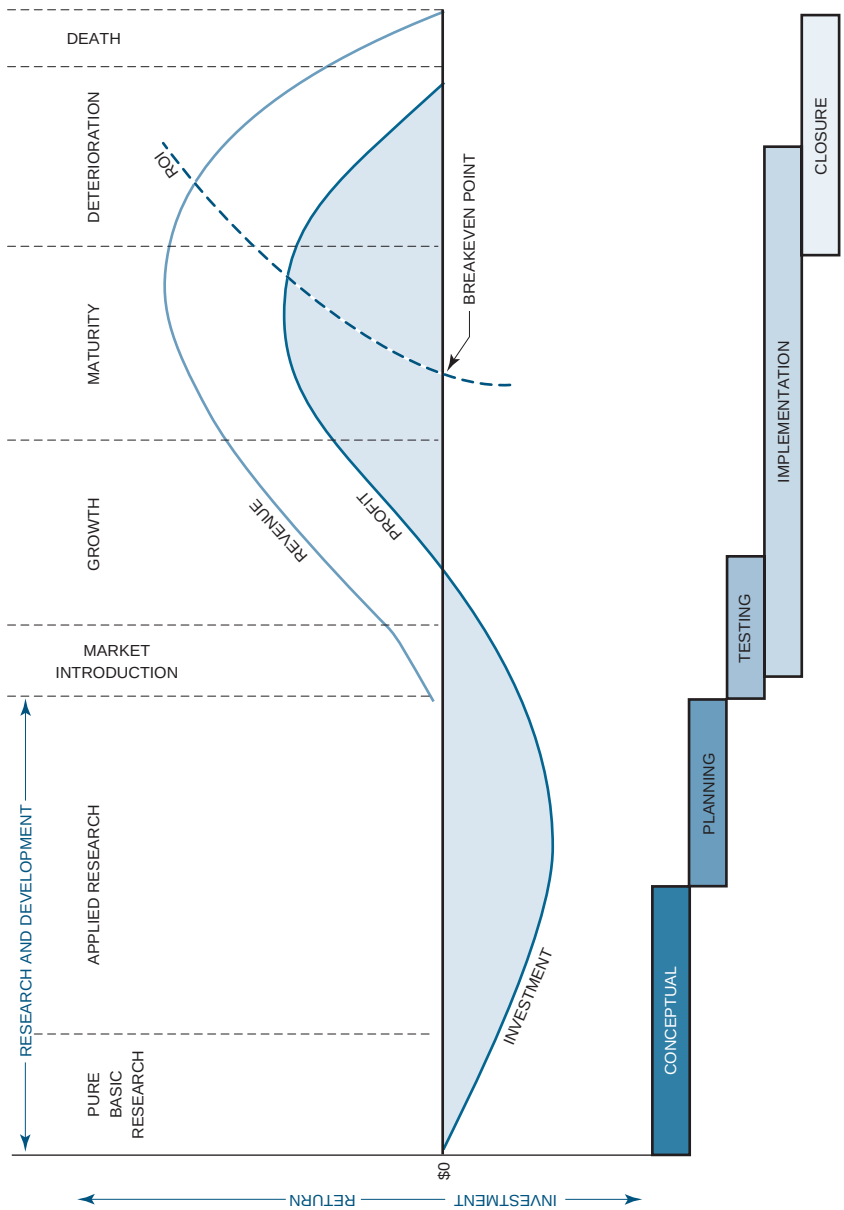


FIGURE 2–21. System/product life cycles.

TABLE 2–6. LIFE-CYCLE PHASE DEFINITIONS

Engineering	Manufacturing	Computer Programming	Construction
• Start-up • Definition • Main • Termination	• Formation • Buildup • Production • Phase-out • Final audit	• Conceptual • Planning • Definition and design • Implementation • Conversion	• Planning, data gathering, and procedures • Studies and basic engineering • Major review • Detail engineering • Detail engineering/ construction overlap • Construction • Testing and commissioning

More companies are preparing procedural manuals for project management and for structuring work using life-cycle phases. There are several reasons for this trend:

- Clear delineation of the work to be accomplished in each phase may be possible.
- Pricing and estimating may be easier if well-structured work definitions exist.
- Key decision points exist at the end of each life-cycle phase so that incremental funding is possible.

As a final note, the reader should be aware that not all projects can be simply transposed into life-cycle phases (e.g., R&D). It might be possible (even in the same company) for different definitions of life-cycle phases to exist because of schedule length, complexity, or just the difficulty of managing the phases.

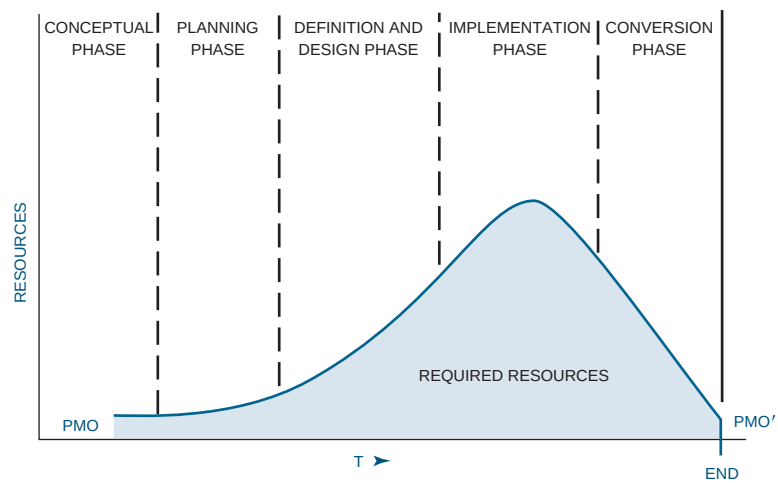


FIGURE 2–22. Definition of a project life cycle.

2.14 GATE REVIEW MEETINGS (PROJECT CLOSURE)

Gate review meetings are a form of project closure. Gate review meetings could result in the closure of a life-cycle phase or the closure of the entire project. Gate review meetings must be planned for, and this includes the gathering, analysis, and dissemination of pertinent information. This can be done effectively with the use of forms, templates, and checklists.

There are two forms of closure pertinent to gate review meetings: contractual closure and administrative closure. Contractual closure precedes administrative closure. Contractual closure is the verification and signoff that all deliverables required for this phase have been completed and all action items have been fulfilled. Contractual closure is the responsibility of both the project manager and the contract administrator.

Administrative closure is the updating of all pertinent records required for both the customer and the contractor. Customers are particularly interested in documentation on any as-built or as-installed changes or deviations from the specifications. Also required is an archived trail of all scope changes agreed to during the life of the project. Contractors are interested in archived data that include project records, minutes, memos, newsletters, change management documentation, project acceptance documentation, and the history of audits for lessons learned and continuous improvement.

A subset of administrative closure is financial closure, which is the closing out of all charge numbers for the work completed. Even though contractual closure may have taken place, there may still exist open charge numbers for the repair of defects or to complete archived paperwork. Closure must be planned for, and this includes setting up a timetable and budget.

2.15 PROJECT MANAGEMENT METHODOLOGIES: A DEFINITION

PMBOK® Guide, 4th Edition
Chapter 4 Integration Management
4.2.1.4 Project Management Methodology
2.4.3 Organizational Process Assets

Achieving project management excellence, or maturity, is more likely with a repetitive process that can be used on each and every project. This repetitive process is referred to as the project management methodology.

If possible, companies should maintain and support a single methodology for project management. Good methodologies integrate other processes into the project management methodology, as shown in Figure 2–23. Companies such as Nortel, Ericsson, and Johnson Controls Automotive have all five of these processes integrated into their project management methodology.

During the 1990s, the following processes were integrated into a single methodology:

- *Project Management:* The basic principles of planning, scheduling, and controlling work
- *Total Quality Management:* The process of ensuring that the end result will meet the quality expectations of the customer

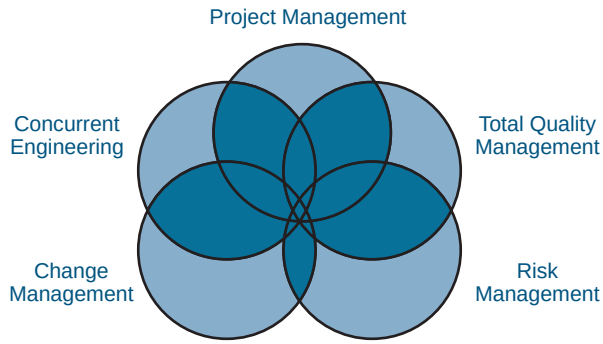


FIGURE 2–23. Integrated processes for the twenty-first century.

- *Concurrent Engineering:* The process of performing work in parallel rather than series in order to compress the schedule without incurring serious risks
- *Scope Change Control:* The process of controlling the configuration of the end result such that value added is provided to the customer
- *Risk Management:* The process of identifying, quantifying, and responding to the risks of the project without any material impact on the project's objectives

In the coming years, companies can be expected to integrate more of their business processes in the project management methodology. This is shown in Figure 2–24.

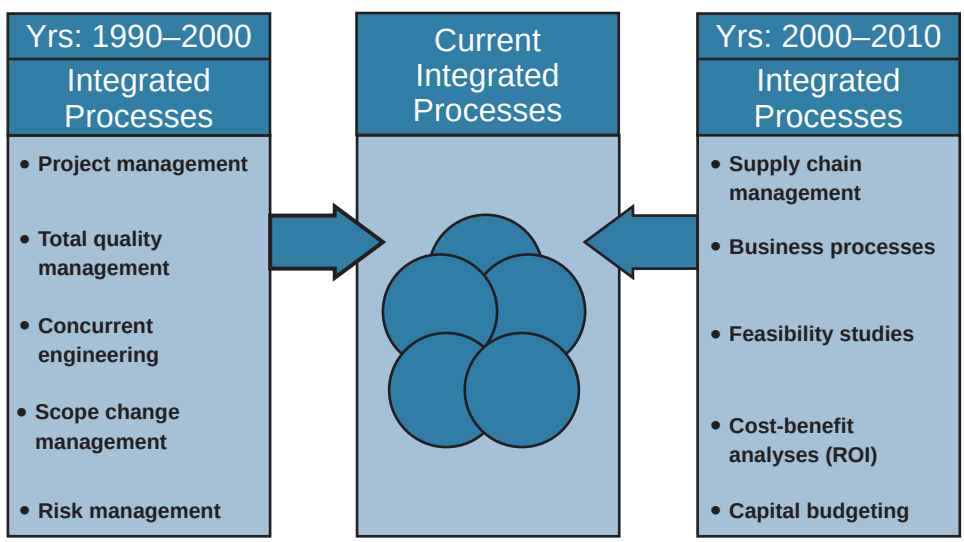


FIGURE 2–24. Integrated processes (past, present, and future).

Managing off of a single methodology lowers cost, reduces resource requirements for support, minimizes paperwork, and eliminates duplicated efforts.

The characteristics of a good methodology based upon integrated processes include:

- A recommended level of detail
- Use of templates
- Standardized planning, scheduling, and cost control techniques
- Standardized reporting format for both in-house and customer use
- Flexibility for application to all projects
- Flexibility for rapid improvements
- Easy for the customer to understand and follow
- Readily accepted and used throughout the entire company
- Use of standardized life-cycle phases (which can overlap) and end of phase reviews (Section 2.13)
- Based upon guidelines rather than policies and procedures (Section 2.9)
- Based upon a good work ethic

Methodologies do not manage projects; people do. It is the corporate culture that executes the methodology. Senior management must create a corporate culture that supports project management and demonstrates faith in the methodology. If this is done successfully, then the following benefits can be expected:

- Faster "time to market" through better control of the project's scope
- Lower overall project risk
- Better decision-making process
- Greater customer satisfaction, which leads to increased business
- More time available for value-added efforts, rather than internal politics and internal competition

One company found that its customers liked its methodology so much and that the projects were so successful, that the relationship between the contractor and the customer improved to the point where the customers began treating the contractor as a partner rather than as a supplier.

2.16 ORGANIZATIONAL CHANGE MANAGEMENT AND CORPORATE CULTURES

PMBOK® Guide, 4th Edition
Chapter 4 Integration Management
4.5 Integrated Change Control
2.4.1 Organizational Culture

It has often been said that the most difficult projects to manage are those that involve the management of change. Figure 2–25 shows the four basic inputs needed to develop a project management methodology. Each has a "human" side that may require that people change.

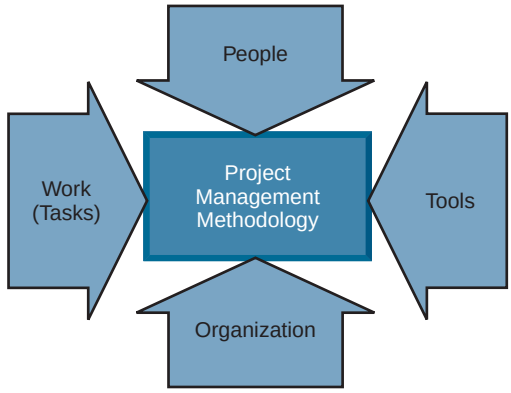


FIGURE 2–25. Methodology inputs.

Successful development and implementation of a project management methodology requires:

- Identification of the most common reasons for change in project management
- Identification of the ways to overcome the resistance to change
- Application of the principles of organizational change management to ensure that the desired project management environment will be created and sustained

For simplicity's sake, resistance can be classified as professional resistance and personal resistance to change. Professional resistance occurs when each functional unit as a whole feels threatened by project management. This is shown in Figure 2–26. Examples include:

- *Sales:* The sales staff's resistance to change arises from fear that project management will take credit for corporate profits, thus reducing the year-end bonuses for the sales force. Sales personnel fear that project managers may become involved in the sales effort, thus diminishing the power of the sales force.
- *Marketing:* Marketing people fear that project managers will end up working so closely with customers that project managers may eventually be given some of the marketing and sales functions. This fear is not without merit because customers often want to communicate with the personnel managing the project rather than those who may disappear after the sale is closed.
- *Finance (and Accounting):* These departments fear that project management will require the development of a project accounting system (such as earned value measurement) that will increase the workload in accounting and finance, and that they will have to perform accounting both horizontally (i.e., in projects) and vertically (i.e., in line groups).

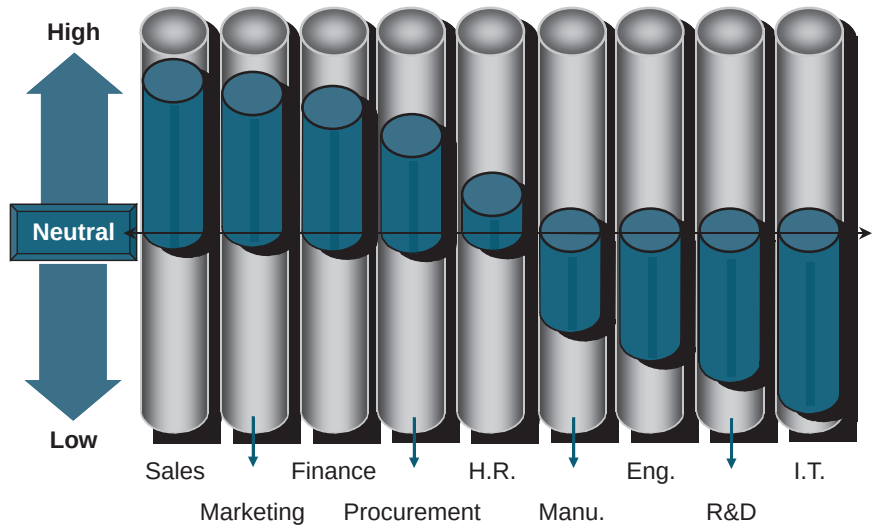


FIGURE 2–26. Resistance to change.

- *Procurement:* The fear in this group is that a project procurement system will be implemented in parallel with the corporate procurement system, and that the project managers will perform their own procurement, thus bypassing the procurement department.
- *Human Resources Management:* The HR department may fear that a project management career path ladder will be created, requiring new training programs. This will increase their workloads.
- *Manufacturing:* Little resistance is found here because, although the manufacturing segment is not project-driven, there are numerous capital installation and maintenance projects which will have required the use of project management.
- *Engineering, R&D, and Information Technology:* These departments are almost entirely project-driven with very little resistance to project management.

Getting the support of and partnership with functional management can usually overcome the functional resistance. However, the individual resistance is usually more complex and more difficult to overcome. Individual resistance can stem from:

- Potential changes in work habits
- Potential changes in the social groups
- Embedded fears
- Potential changes in the wage and salary administration program

Tables 2–7 through 2–10 show the causes of resistance and possible solutions. Workers tend to seek constancy and often fear that new initiatives will push them outside their comfort zones. Most workers are already pressed for time in their current jobs and fear that new programs will require more time and energy.

TABLE 2–7. RESISTANCE: WORK HABITS

Cause of Resistance	Ways to Overcome
• New guidelines/processes • Need to share "power" information • Creation of a fragmented work environment • Need to give up established work patterns (learn new skills) • Change in comfort zones	• Dictate mandatory conformance from above • Create new comfort zones at an acceptable pace • Identify tangible/intangible individual benefits

Some companies feel compelled to continually undertake new initiatives, and people may become skeptical of these programs, especially if previous initiatives have not been successful. The worst case scenario is when employees are asked to undertake new initiatives, procedures, and processes that they do not understand.

It is imperative that we understand resistance to change. If individuals are happy with their current environment, there will be resistance to change. But what if people are unhappy? There will still be resistance to change unless (1) people believe that the change is possible, and (2) people believe that they will somehow benefit from the change.

Management is the architect of the change process and must develop the appropriate strategies so the organization can change. This is done best by developing a shared understanding with employees by doing the following:

- Explaining the reasons for the change and soliciting feedback
- Explaining the desired outcomes and rationale
- Championing the change process
- Empowering the appropriate individuals to institutionalize the changes
- Investing in training necessary to support the changes

For most companies, the change management process will follow the pattern shown in Figure 2–27. Employees initially refuse to admit the need for change. As management begins pursuing the change, the support for the change diminishes and pockets of resistance crop up. Continuous support for the change by management encourages employees to explore the potential opportunities that will result from the change about to take place. Unfortunately, this exploration often causes additional negative information to surface, thus reinforcing the resistance to change. As pressure by management increases, and employees begin to recognize the benefits of the proposed change, support begins to grow.

TABLE 2–8. RESISTANCE: SOCIAL GROUPS

Cause of Resistance	Ways to Overcome
• Unknown new relationships • Multiple bosses • Multiple, temporary assignments • Severing of established ties	• Maintain existing relationships • Avoid cultural shock • Find an acceptable pace for rate of change

TABLE 2–9. RESISTANCE: EMBEDDED FEARS

Cause of Resistance	Ways to Overcome
• Fear of failure • Fear of termination • Fear of added workload • Fear or dislike of uncertainty/unknowns • Fear of embarrassment • Fear of a "we/they" organization	• Educate workforce on benefits of changes to the individual/corporation • Show willingness to admit/accept mistakes • Show willingness to pitch in • Transform unknowns into opportunities • Share information

TABLE 2–10. RESISTANCE: WAGE AND SALARY ADMINISTRATION

Causes of Resistance	Ways to Overcome
• Shifts in authority and power • Lack of recognition after the changes • Unknown rewards and punishment • Improper evaluation of personal performance • Multiple bosses	• Link incentives to change • Identify future advancement opportunities/career path

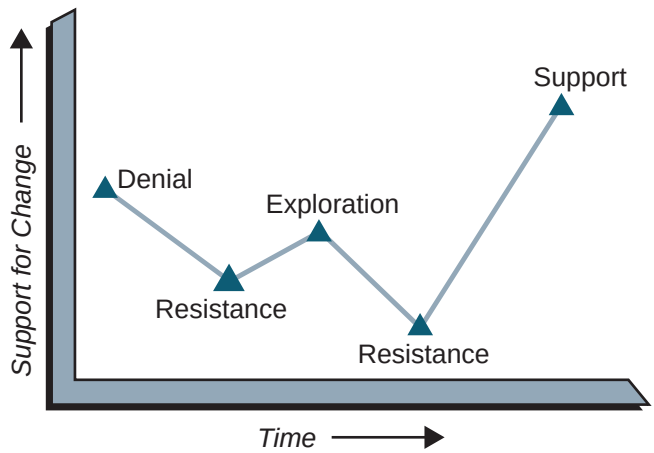


FIGURE 2–27. Change process.

The ideal purpose of change management is to create a superior culture. There are different types of project management cultures based upon the nature of the business, the amount of trust and cooperation, and the competitive environment. Typical types of cultures include:

- *Cooperative cultures:* These are based upon trust and effective communications, internally and externally.
- *Noncooperative cultures:* In these cultures, mistrust prevails. Employees worry more about themselves and their personal interests than what's best for the team, company, or customer.

- *Competitive cultures:* These cultures force project teams to compete with one another for valuable corporate resources. In these cultures, project managers often demand that the employees demonstrate more loyalty to the project than to their line managers. This can be disastrous when employees are working on many projects at the same time.
- *Isolated cultures:* These occur when a large organization allows functional units to develop their own project management cultures and can result in a culture-within-a-culture environment.
- *Fragmented cultures:* These occur when part of the team is geographically separated from the rest of the team. Fragmented cultures also occur on multinational projects, where the home office or corporate team may have a strong culture for project management but the foreign team has no sustainable project management culture.

Cooperative cultures thrive on effective communication, trust, and cooperation. Decisions are based upon the best interest of all of the stakeholders. Executive sponsorship is passive, and very few problems go to the executive levels for resolution. Projects are managed informally and with minimal documentation and few meetings. This culture takes years to achieve and functions well during favorable and unfavorable economic conditions.

Noncooperative cultures are reflections of senior management's inability to cooperate among themselves and with the workforce. Respect is nonexistent. These cultures are not as successful as a cooperative culture.

Competitive cultures can be healthy in the short term, especially if there is abundant work. Long-term effects are usually not favorable. In one instance, an electronics firm regularly bid on projects that required the cooperation of three departments. Management then implemented the unhealthy decision of allowing each of the three departments to bid on every job. The two "losing" departments would be treated as subcontractors.

Management believed that this competitiveness was healthy. Unfortunately, the long-term results were disastrous. The three departments refused to talk to one another and stopped sharing information. In order to get the job done for the price quoted, the departments began outsourcing small amounts of work rather than using the other departments that were more expensive. As more work was outsourced, layoffs occurred. Management then realized the disadvantages of the competitive culture it had fostered.

2.17 PROJECT MANAGEMENT INTELLECTUAL PROPERTY

We believe today that we are managing our business by projects. As such, project managers are expected to make business decisions as well as project decisions. This also implies that we must capture not only project-related best practices, but business best practices as well.

For the past decade, whenever we would capture project management best practices, they would be placed in a project management best practices library. But as we capture business best practices, we begin replacing the project management best practices library with a knowledge repository that includes both project management and business-related best practices. This is shown in Figure 2–28.

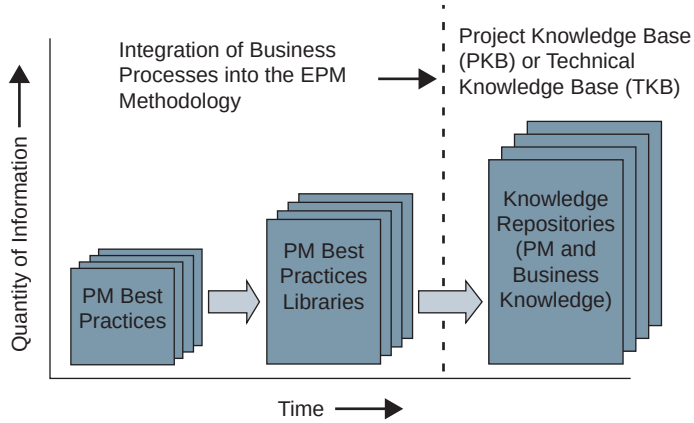


Figure 2–28. Growth of knowledge management.

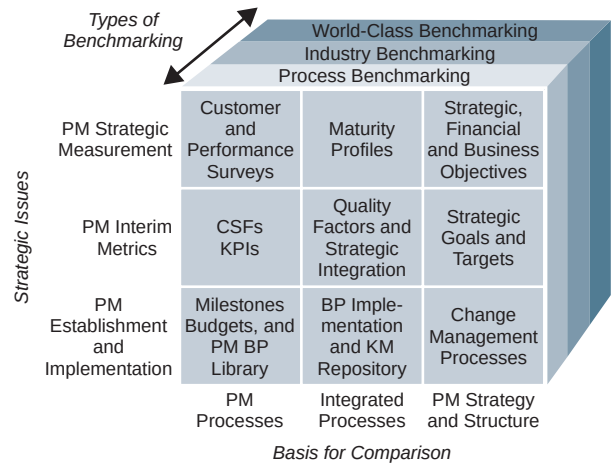


Figure 2–29. PM benchmarking and knowledge management (KM).

Another reason for the growth in intellectual property is because of the benchmarking activities that companies are performing, most likely using the project management office. Figure 2–29 shows typical benchmarking activities and the types of information being sought.

2.18 SYSTEMS THINKING

Ultimately, all decisions and policies are made on the basis of judgments; there is no other way, and there never will be. In the end, analysis is but an aid to the judgment and intuition

of the decision maker. These principles hold true for project management as well as for systems management.

The systems approach may be defined as a logical and disciplined process of problem-solving. The word *process* indicates an active ongoing system that is fed by input from its parts.

The systems approach:

- Forces review of the relationship of the various subsystems
- Is a dynamic process that integrates all activities into a meaningful total system
- Systematically assembles and matches the parts of the system into a unified whole
- Seeks an optimal solution or strategy in solving a problem

The systems approach to problem-solving has phases of development similar to the life-cycle phases shown in Figure 2–21. These phases are defined as follows:

- *Translation:* Terminology, problem objective, and criteria and constraints are defined and accepted by all participants.
- *Analysis:* All possible approaches to or alternatives to the solution of the problem are stated.
- *Trade-off:* Selection criteria and constraints are applied to the alternatives to meet the objective.
- *Synthesis:* The best solution in reaching the objective of the system is the result of the combination of analysis and trade-off phases.

Other terms essential to the systems approach are:

- *Objective:* The function of the system or the strategy that must be achieved.
- *Requirement:* A partial need to satisfy the objective.
- *Alternative:* One of the selected ways to implement and satisfy a requirement.
- *Selection criteria:* Performance factors used in evaluating the alternatives to select a preferable alternative.
- *Constraint:* An absolute factor that describes conditions that the alternatives *must* meet.

A common error by potential decision makers (those dissatisfied individuals with authority to act) who base their thinking solely on subjective experience, judgment, and intuition is that they fail to recognize the existence of alternatives. Subjective thinking is inhibited or affected by personal bias.

Objective thinking, on the other hand, is a fundamental characteristic of the systems approach and is exhibited or characterized by emphasis on the tendency to view events, phenomena, and ideas as external and apart from self-consciousness. Objective thinking is unprejudiced.

The systems analysis process, as shown in Figure 2–30, begins with systematic examination and comparison of those alternative actions that are related to the accomplishment of the desired objective. The alternatives are then compared on the basis of the resource costs and the associated benefits. The loop is then completed using feedback to determine how compatible each alternative is with the objectives of the organization.

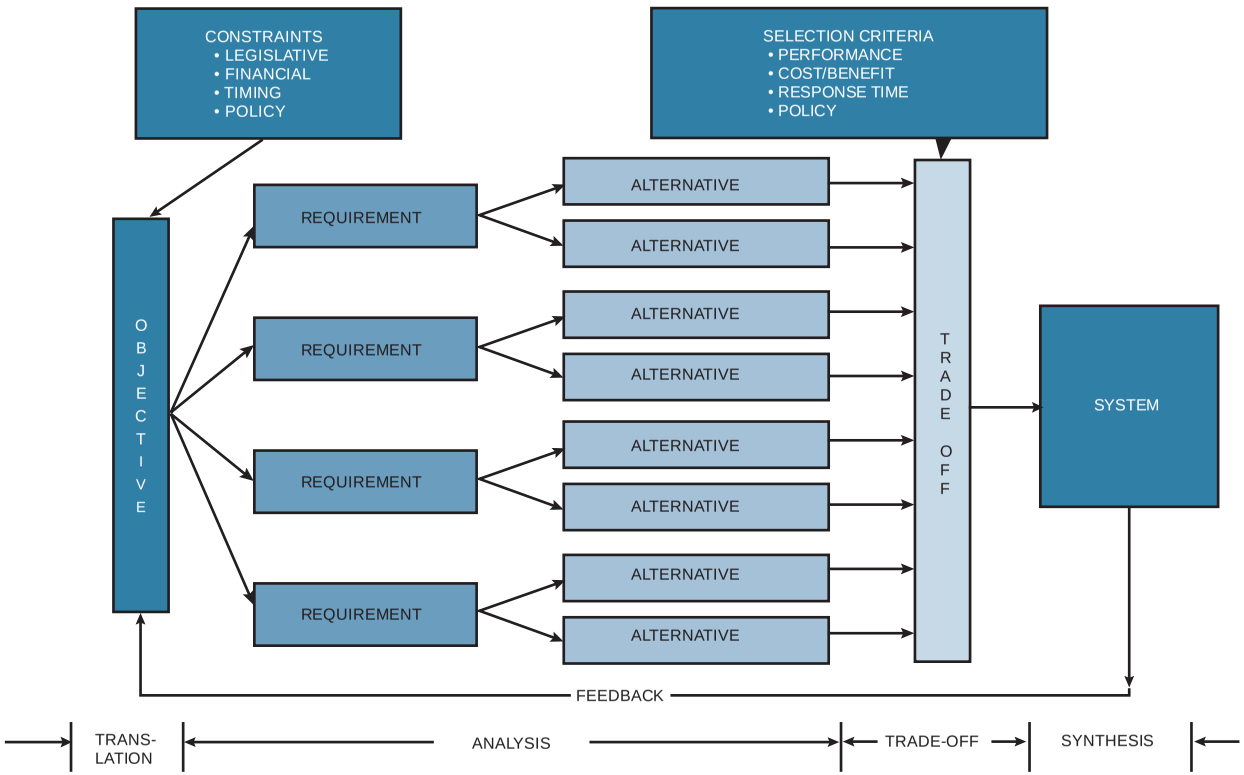


FIGURE 2–30. The systems approach.

The above analysis can be arranged in steps:

- Input data to mental process
- Analyze data
- Predict outcomes
- Evaluate outcomes and compare alternatives
- Choose the best alternative
- Take action
- Measure results and compare them with predictions

The systems approach is most effective if individuals can be trained to be ready with alternative actions that directly tie in with the prediction of outcomes. The basic tool is the outcome array, which represents the matrix of all possible circumstances. This outcome array can be developed only if the decision maker thinks in terms of the wide scope of possible outcomes. Outcome descriptions force the decision maker to spell out clearly just what he is trying to achieve (i.e., his objectives).

Systems thinking is vital for the success of a project. Project management systems urgently need new ways of strategically viewing, questioning, and analyzing project needs for alternative nontechnical and technical solutions. The ability to analyze the total project, rather than the individual parts, is essential for successful project management.

2.19 STUDYING TIPS FOR THE PMI® PROJECT MANAGEMENT CERTIFICATION EXAM

This section is applicable as a review of the principles to support the knowledge areas and domain groups in the PMBOK® Guide. This chapter addresses:

- Integration Management
- Scope Management
- Closure

Understanding the following principles is beneficial if the reader is using this text to study for the PMP® Certification Exam:

- Brief historical background of project management
- That, early on, project managers were assigned from engineering
- Benefits of project management
- Barriers to project management implementation and how to overcome them
- Differences between a program and a project
- What is meant by informal project management
- How to identify success and failure in project management
- Project life-cycle phases
- What is meant by closure to a life-cycle phase or to the entire project

- What is meant by a project management methodology
- What is meant by critical success factors (CSFs) and key performance indicators (KPIs)

In Appendix C, the following Dorale Products mini–case studies are applicable:

- Dorale Products (A) [Integration and Scope Management]
- Dorale Products (B) [Integration and Scope Management]
- Dorale Products (C) [Integration and Scope Management]
- Dorale Products (D) [Integration and Scope Management]
- Dorale Products (E) [Integration and Scope Management]
- Dorale Products (F) [Integration and Scope Management]

The following multiple-choice questions will be helpful in reviewing the principles of this chapter:

1. A structured process for managing a multitude of projects is most commonly referred to as:
   A. Project management policies
   B. Project management guidelines
   C. Industrywide templates
   D. A project management methodology
2. The most common terminology for a reusable project management methodology is:
   A. Template
   B. Concurrent scheduling technique
   C. Concurrent planning technique
   D. Skeleton framework document
3. The major behavioral issue in getting an organization to accept and use a project management methodology effectively is:
   A. Lack of executive sponsorship
   B. Multiple boss reporting
   C. Inadequate policies and procedures
   D. Limited project management applications
4. The major difference between a project and a program is usually:
   A. The role of the sponsor
   B. The role of the line manager
   C. The timeframe
   D. The specifications
5. Projects that remain almost entirely within one functional area are best managed by the:
   A. Project manager
   B. Project sponsor
   C. Functional manager
   D. Assigned functional employees
6. Large projects are managed by:
   A. The executive sponsor
   B. The project or program office for that project

C. The manager of project managers
D. The director of marketing

7. The most common threshold limits on when to use the project management methodology are:
A. The importance of the customer and potential profitability
B. The size of the project (i.e., $) and duration
C. The reporting requirements and position of the sponsor
D. The desires of management and functional boundaries crossed

8. A grouping of projects is called a:
A. Program
B. Project template
C. Business template
D. Business plan

9. Project management methodologies often work best if they are structured around:
A. Rigid policies
B. Rigid procedures
C. Minimal forms and checklists
D. Life-cycle phases

10. One way to validate the successful implementation of project management is by looking at the number and magnitude of the conflicts requiring:
A. Executive involvement
B. Customer involvement
C. Line management involvement
D. Project manager involvement

11. Standardization and control are benefits usually attributed to:
A. Laissez-faire management
B. Project management on R&D efforts
C. Use of life cycle-phases
D. An organization with weak executive sponsorship

12. The most difficult decision for an executive sponsor to make at the end-of-phase review meeting is to:
A. Allow the project to proceed to the next phase based upon the original objective
B. Allow the project to proceed to the next phase based upon a revised objective
C. Postpone making a decision until more information is processed
D. Cancel the project

13. Having too many life-cycle phases may be detrimental because:
A. Executive sponsors will micromanage.
B. Executive sponsors will become "invisible."
C. The project manager will spend too much time planning for gate review meetings rather than managing the phases.
D. The project manager will need to develop many different plans for each phase.

14. A project is terminated early because the technology cannot be developed, and the resources are applied to another project that ends up being successful. Which of the following is true concerning the first project?
A. The first project is regarded as a failure.
B. The first project is a success if the termination is done early enough before additional resources are squandered.

C. The first project is a success if the project manager gets promoted.
D. The first project is a failure if the project manager gets reassigned to a less important project.

15. Which of the following would *not* be regarded as a secondary definition of project success?
A. The customer is unhappy with the deliverable, but follow-on business is awarded based on effective customer relations.
B. The deliverables are met but OSHA and EPA laws are violated.
C. The customer is displeased with the performance, but you have developed a new technology that could generate many new products.
D. The project's costs were overrun by 40 percent, but the customer funds an enhancement project.

ANSWERS

1. D
2. A
3. B
4. C
5. C
6. B
7. B
8. A
9. D
10. A
11. C
12. D
13. C
14. B
15. B

PROBLEMS

2–1 Can the organizational chart of a company be considered as a systems model? If so, what kind of systems model?

2–2 Do you think that someone could be a good systems manager but a poor project manager? What about the reverse situation? State any assumptions that you may have to make.

2–3 Can we consider R&D as a system? If so, under what circumstances?

2–4 For each of the following projects, state whether we are discussing an open, closed, or extended system:

a. A high-technology project
b. New product R&D

c. An on-line computer system for a bank
d. Construction of a chemical plant
e. Developing an in-house cost accounting reporting system

2–5 Can an entire organization be considered as a model? If so, what type?

2–6 Systems can be defined as a combination or interrelationship of subsystems. Does a project have subsystems?

2–7 If a system can, in fact, be broken down into subsystems, what problems can occur during integration?

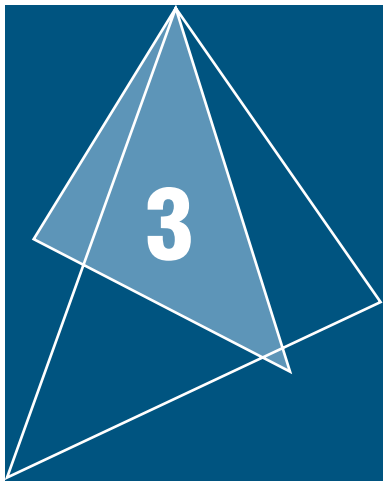
2–8 How could suboptimization occur during systems thinking and analysis?

2–9 Would a cost-benefit analysis be easier or harder to perform in a traditional or project management organizational structure?

2–10 What impact could the product life cycle have on the selection of the project organizational structure?

2–11 In the development of a system, what criteria should be used to determine where one phase begins and another ends and where overlap can occur?

2–12 Consider the following expression: “Damn the torpedoes: full-speed ahead.” Is it possible that this military philosophy can be applied to project management and lead to project success?



Organizational Structures

Related Case Studies (from Kerzner/*Project Management Case Studies,* 3rd Edition)	Related Workbook Exercises (from Kerzner/*Project Management Workbook and PMP®/CAPM® Exam Study Guide,* 10th Edition)	PMBOK® Guide, 4th Edition, Reference Section for the PMP® Certification Exam
• Quasar Communications, Inc. • Jones and Shephard Accountants, Inc.* • Fargo Foods • Mohawk National Bank	• The Struggle with Implementation • Multiple Choice Exam	• Human Resource Management

3.0 INTRODUCTION

PMBOK® Guide, 4th Edition
2.4.2 Organizational Structure
Chapter 9 Human Resource Management

During the past thirty years there has been a so-called hidden revolution in the introduction and development of new organizational structures. Management has come to realize that organizations must be dynamic in nature; that is, they must be capable of rapid restructuring should environmental conditions so dictate. These environmental factors evolved

* Case Study also appears at end of chapter.

from the increasing competitiveness of the market, changes in technology, and a requirement for better control of resources for multiproduct firms. More than forty years ago, Wallace identified four major factors that caused the onset of the organizational revolution[1]:

- The technology revolution (complexity and variety of products, new materials and processes, and the effects of massive research)
- Competition and the profit squeeze (saturated markets, inflation of wage and material costs, and production efficiency)
- The high cost of marketing
- The unpredictability of consumer demands (due to high income, wide range of choices available, and shifting tastes)

Much has been written about how to identify and interpret those signs that indicate that a new organizational form may be necessary. According to Grinnell and Apple, there are five general indications that the traditional structure may not be adequate for managing projects[2]:

- Management is satisfied with its technical skills, but projects are not meeting time, cost, and other project requirements.
- There is a high commitment to getting project work done, but great fluctuations in how well performance specifications are met.
- Highly talented specialists involved in the project feel exploited and misused.
- Particular technical groups or individuals constantly blame each other for failure to meet specifications or delivery dates.
- Projects are on time and to specifications, but groups and individuals aren't satisfied with the achievement.

Unfortunately, many companies do not realize the necessity for organizational change until it is too late. Management looks externally (i.e., to the environment) rather than internally for solutions to problems. A typical example would be that new product costs are rising while the product life cycle may be decreasing. Should emphasis be placed on lowering costs or developing new products?

If we assume that an organizational system is composed of both human and nonhuman resources, then we must analyze the sociotechnical subsystem whenever organizational changes are being considered. The social system is represented by the organization's personnel and their group behavior. The technical system includes the technology, materials, and machines necessary to perform the required tasks.

Behavioralists contend that there is no one best structure to meet the challenges of tomorrow's organizations. The structure used, however, must be one that optimizes company performance by achieving a balance between the social and the technical requirements. According to Sadler[3]:

> Since the relative influence of these (sociotechnical) factors change from situation to situation, there can be no such thing as an ideal structure making for effectiveness in organizations of all kinds, or even appropriate to a single type of organization at different stages in its development.

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1. W. L. Wallace, "The Winchester-Western Division Concept of Product Planning" (New Haven: Olin Mathieson Corporation, January 1963), pp. 2–3.

2. S. K. Grinnell and H. P. Apple, "When Two Bosses Are Better Than One," *Machine Design*, January 1975, pp. 84–87.

3. Philip Sadler, "Designing an Organizational Structure," *Management International Review*, Vol. 11, No. 6, 1971, pp. 19–33.

> There are often real and important conflicts between the type of organizational structure called for if the tasks are to be achieved with minimum cost, and the structure that will be required if human beings are to have their needs satisfied. Considerable management judgment is called for when decisions are made as to the allocation of work activities to individuals and groups. High standardization of performance, high manpower utilization and other economic advantages associated with a high level of specialization and routinization of work have to be balanced against the possible effects of extreme specialization in lowering employee attitudes and motivation.

Organizations can be defined as groups of people who must coordinate their activities in order to meet organizational objectives. The coordination function requires strong communications and a clear understanding of the relationships and interdependencies among people. Organizational structures are dictated by such factors as technology and its rate of change, complexity, resource availability, products and/or services, competition, and decision-making requirements. The reader must keep in mind that *there is no such thing as a good or bad organizational structure; there are only appropriate or inappropriate ones*.

Even the simplest type of organizational change can induce major conflicts. The creation of a new position, the need for better planning, the lengthening or shortening of the span of control, the need for additional technology (knowledge), and centralization or decentralization can result in major changes in the sociotechnical subsystem. Argyris has defined five conditions that form the basis for organizational change requirements[4]:

> These requirements . . . depend upon (1) continuous and open access between individuals and groups, (2) free, reliable communication, where (3) independence is the foundation for individual and departmental cohesiveness and (4) trust, risk-taking and helping each other is prevalent so that (5) conflict is identified and managed in such a way that the destructive win-lose stances with their accompanying polarization of views are minimized. . . . Unfortunately these conditions are difficult to create. . . . There is a tendency toward conformity, mistrust and lack of risk-taking among the peers that results in focusing upon individual survival, requiring the seeking out of the scarce rewards, identifying one's self with a successful venture (be a hero) and being careful to avoid being blamed for or identified with a failure, thereby becoming a "bum." All these adaptive behaviors tend to induce low interpersonal competence and can lead the organization, over the long-run, to become rigid, sticky, and less innovative, resulting in less than effective decisions with even less internal commitment to the decision on the part of those involved.

Organizational restructuring is a compromise between the traditional (classical) and the behavioral schools of thought; management must consider the needs of individuals as well as the needs of the company. Is the organization structured to manage people or to manage work?

There is a wide variety of organizational forms for restructuring management. The exact method depends on the people in the organization, the company's product lines, and management's philosophy. A poorly restructured organization can sever communication channels that may have taken months or years to cultivate; cause a restructuring of the informal organization, thus creating new power, status, and political positions; and eliminate job satisfaction and motivational factors to such a degree that complete discontent results.

Sadler defines three tasks that must be considered because of the varied nature of organizations: control, integration, and external relationships.[5] If the company's position is very sensitive to the environment, then management may be most concerned with the control task. For an organization with multiple products, each requiring a high degree of engineering and technology, the integration task can become primary. Finally, for

4. Chris Argyris, "Today's Problems with Tomorrow's Organizations," *The Journal of Management Studies*, February 1967, pp. 31–55.

5. See note 3.

situations with strong labor unions and repetitive tasks, external relations can predominate, especially in strong technological and scientific environments where strict government regulations must be adhered to.

In the sections that follow, a variety of organizational forms will be presented. Obviously, it is an impossible task to describe all possible organizational structures. Each form describes how the project management organization evolved from the classical theories of management. Advantages and disadvantages are listed for technology and social systems. Sadler has prepared a six-question checklist that explores a company's tasks, social climate, and relationship to the environment.[6]

- To what extent does the task of organization call for close control if it is to be performed efficiently?
- What are the needs and attitudes of the people performing the tasks? What are the likely effects of control mechanisms on their motivation and performance?
- What are the natural social groupings with which people identify themselves? To what extent are satisfying social relationships important in relation to motivation and performance?
- What aspect of the organization's activities needs to be closely integrated if the overall task is to be achieved?
- What organizational measures can be developed that will provide an appropriate measure of control and integration of work activities, while at the same time meeting the needs of people and providing adequate motivation?
- What environmental changes are likely to affect the future trend of company operations? What organizational measures can be taken to insure that the enterprise responds to these effectively?

The answers to these questions are not easy. For the most part, they are a matter of the judgment exercised by organizational and behavioral managers.

3.1 ORGANIZATIONAL WORK FLOW

Organizations are continually restructured to meet the demands imposed by the environment. Restructuring can change the role of individuals in the formal and the informal organization. Many researchers believe that the greatest usefulness of behavioralists lies in their ability to help the informal organization adapt to changes and resolve the resulting conflicts. Unfortunately, behavioralists cannot be totally effective unless they have input into the formal organization as well. Whatever organizational form is finally selected, formal channels must be developed so that each individual has a clear description of the authority, responsibility, and accountability necessary for the work to proceed.

In the discussion of organizational structures, the following definitions will be used:

- *Authority* is the power granted to individuals (possibly by their position) so that they can make final decisions.
- *Responsibility* is the obligation incurred by individuals in their roles in the formal organization to effectively perform assignments.

6. See note 3.

- *Accountability* is being answerable for the satisfactory completion of a specific assignment. (Accountability = authority + responsibility.)

Authority and responsibility can be delegated to lower levels in the organization, whereas accountability usually rests with the individual. Yet many executives refuse to delegate and argue that an individual can have total accountability just through responsibility.

Even with these clearly definable divisions of authority, responsibility, and accountability, establishing good relationships between project and functional managers can take a great deal of time, especially during the conversion from a traditional to a project organizational form. Trust is the key to success here. The normal progression in the growth of trust is as follows:

- Even though a problem exists, both the project and functional managers deny that any problem exists.
- When the problem finally surfaces, each manager blames the other.
- As trust develops, both managers readily admit responsibility for the problems.
- The project and functional managers meet face-to-face to work out the problem.
- The project and functional managers begin to formally and informally anticipate problems.

For each of the organizational structures described in the following sections, advantages and disadvantages are listed. Many of the disadvantages stem from possible conflicts arising from problems in authority, responsibility, and accountability.

3.2 TRADITIONAL (CLASSICAL) ORGANIZATION

The traditional management structure has survived for more than two centuries. However, recent business developments, such as the rapid rate of change in technology and increased stockholder demands, have created strains on existing organizational forms. Fifty years ago companies could survive with only one or two product lines. The classical management organization, as shown in Figure 3–1, was satisfactory for control, and conflicts were minimal.[7]

However, with the passing of time, companies found that survival depended on multiple product lines (i.e., diversification) and vigorous integration of technology into the existing organization. As organizations grew and matured, managers found that company activities were not being integrated effectively, and that new conflicts were arising in the well-established formal and informal channels. Managers began searching for more innovative organizational forms that would alleviate these problems.

7. Many authors refer to classical organizations as pure functional organizations. This can be seen from Figure 3–1. Also note that the department level is below the division level. In some organizations these titles are reversed.

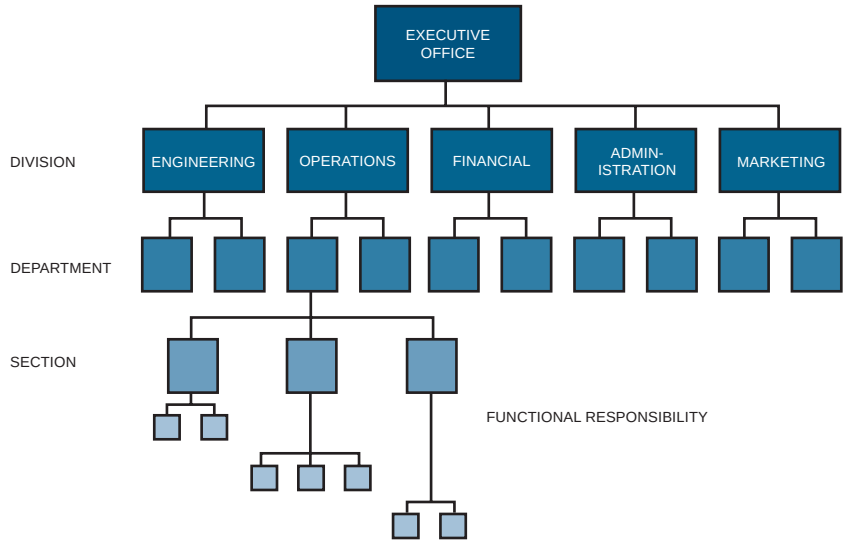

FIGURE 3–1. The traditional management structure.

Before a valid comparison can be made with the newer forms, the advantages and disadvantages of the traditional structure must be shown. Table 3–1 lists the advantages of the traditional organization. As seen in Figure 3–1, the general manager has all of the functional entities necessary to perform R&D or develop and manufacture a product. All activities are performed within the functional groups and are headed by a department (or, in some cases, a division) head. Each department maintains a strong concentration of technical expertise. Since all projects must flow through the functional departments, each project can benefit from the most advanced technology, thus making this organizational form well suited to mass production. Functional managers can hire a wide variety of specialists and provide them with easily definable paths for career progression.

TABLE 3–1. ADVANTAGES OF THE TRADITIONAL (CLASSICAL) ORGANIZATION

- Easier budgeting and cost control are possible.
- Better technical control is possible.
  - Specialists can be grouped to share knowledge and responsibility.
  - Personnel can be used on many different projects.
  - All projects will benefit from the most advanced technology (better utilization of scarce personnel).
- Flexibility in the use of manpower.
- A broad manpower base to work with.
- Continuity in the functional disciplines; policies, procedures, and lines of responsibility are easily defined and understandable.
- Admits mass production activities within established specifications.
- Good control over personnel, since each employee has one and only one person to report to.
- Communication channels are vertical and well established.
- Quick reaction capability exists, but may be dependent upon the priorities of the functional managers.

TABLE 3–2. DISADVANTAGES OF THE TRADITIONAL (CLASSICAL) ORGANIZATION

- No one individual is directly responsible for the total project (i.e., no formal authority; committee solutions).
- Does not provide the project-oriented emphasis necessary to accomplish the project tasks.
- Coordination becomes complex, and additional lead time is required for approval of decisions.
- Decisions normally favor the strongest functional groups.
- No customer focal point.
- Response to customer needs is slow.
- Difficulty in pinpointing responsibility; this is the result of little or no direct project reporting, very little project-oriented planning, and no project authority.
- Motivation and innovation are decreased.
- Ideas tend to be functionally oriented with little regard for ongoing projects.

The functional managers maintain absolute control over the budget. They establish their own budgets, on approval from above, and specify requirements for additional personnel. Because the functional manager has manpower flexibility and a broad base from which to work, most projects are normally completed within cost.

Both the formal and informal organizations are well established, and levels of authority and responsibility are clearly defined. Because each person reports to only one individual, communication channels are well structured. If a structure has this many advantages, then why are we looking for other structures?

For each advantage, there is almost always a corresponding disadvantage (see Table 3–2). The majority of these disadvantages are related to the absence of a strong central authority or individual responsible for the total project. As a result, integration of activities that cross functional lines becomes difficult, and top-level executives must get involved with the daily routine. Conflicts occur as each functional group struggles for power. Ideas may remain functionally oriented with very little regard for ongoing projects, and the decision-making process will be slow and tedious.

Because there is no customer focal point, all communications must be channeled through upper-level management. Upper-level managers then act in a customer-relations capacity and refer all complex problems down through the vertical chain of command to the functional managers. The response to the customer's needs therefore becomes a slow and aggravating process.

Projects have a tendency to fall behind schedule in the classical organizational structure. Incredibly large lead times are required. Functional managers attend to those tasks that provide better benefits to themselves and their subordinates first.

With the growth of project management in the late 1960s, executives began to realize that many of the problems were the result of weaknesses in the traditional structure. William Goggin identified the problems that faced Dow Corning[8]:

> Although Dow Corning was a healthy corporation in 1967, it showed difficulties that troubled many of us in top management. These symptoms were, and still are, common ones in

8. Reprinted by permission of *Harvard Business Review.* From William C. Goggin, "How the Multidimensional Structure Works at Dow Corning," *Harvard Business Review,* January–February 1974, p. 54. Copyright © 1973 by the Harvard Business School Publishing Corporation; all rights reserved.

U.S. business and have been described countless times in reports, audits, articles and speeches. Our symptoms took such form as:

- Executives did not have adequate financial information and control of their operations. Marketing managers, for example, did not know how much it cost to produce a product. Prices and margins were set by division managers.
- Cumbersome communications channels existed between key functions, especially manufacturing and marketing.
- In the face of stiffening competition, the corporation remained too internalized in its thinking and organizational structure. It was insufficiently oriented to the outside world.
- Lack of communications between divisions not only created the antithesis of a corporate team effort but also was wasteful of a precious resource—people.
- Long-range corporate planning was sporadic and superficial; this was leading to overstaffing, duplicated effort and inefficiency.

3.3 DEVELOPING WORK INTEGRATION POSITIONS

As companies grew in size, more emphasis was placed on multiple ongoing programs with high-technology requirements. Organizational pitfalls soon appeared, especially in the integration of the flow of work. As management discovered that the critical point in any program is the interface between functional units, the new theories of "interface management" developed.

Because of the interfacing problems, management began searching for innovative methods to coordinate the flow of work between functional units without modification to the existing organizational structure. This coordination was achieved through several integrating mechanisms[9]:

- Rules and procedures
- Planning processes
- Hierarchical referral
- Direct contact

By specifying and documenting management policies and procedures, management attempted to eliminate conflicts between functional departments. Management felt that, even though many of the projects were different, the actions required by the functional personnel were repetitive and predictable. The behavior of the individuals should therefore be easily integrated into the flow of work with minimum communication between individuals or functional groups.

9. Jay R. Galbraith, "Matrix Organization Designs." Reprinted with permission from *Business Horizons*, February 1971, pp. 29–40. Copyright © 1971 by the Board of Trustees at Indiana University. Galbraith defines a fifth mechanism, liaison departments, that will be discussed later in this section.

Another means of reducing conflicts and minimizing the need for communication was detailed planning. Functional representation would be present at all planning, scheduling, and budget meetings. This method worked best for nonrepetitive tasks and projects.

In the traditional organization, one of the most important responsibilities of upper-level management was the resolution of conflicts through "hierarchical referral." The continuous conflicts and struggle for power between the functional units consistently required that upper-level personnel resolve those problems resulting from situations that were either nonroutine or unpredictable and for which no policies or procedures existed.

The fourth method is direct contact and interactions by the functional managers. The rules and procedures, as well as the planning process method, were designed to minimize ongoing communications between functional groups. The quantity of conflicts that executives had to resolve forced key personnel to spend a great percentage of their time as arbitrators, rather than as managers. To alleviate problems of hierarchical referral, upper-level management requested that all conflicts be resolved at the lowest possible levels. This required that functional managers meet face-to-face to resolve conflicts.

In many organizations, these new methods proved ineffective, primarily because there still existed a need for a focal point for the project to ensure that all activities would be properly integrated.

When the need for project managers was acknowledged, the next logical question was where in the organization to place them. Executives preferred to keep project managers low in the organization. After all, if they reported to someone high up, they would have to be paid more and would pose a continuous threat to management.

The first attempt to resolve this problem was to develop project leaders or coordinators within each functional department, as shown in Figure 3–2. Section-level personnel were temporarily assigned as project leaders and would return to their former positions at project termination. This is why the term "project leader" is used rather than "project manager," as the word "manager" implies a permanent relationship. This arrangement proved effective for coordinating and integrating work within one department, provided that the correct project leader was selected. Some employees considered this position an increase in power and status, and conflicts occurred about whether assignments should be based on experience, seniority, or capability. Furthermore, the project leaders had almost no authority, and section-level managers refused to take directions from them, fearing that the project leaders might be next in line for the department manager's position.

When the activities required efforts that crossed more than one functional boundary, conflicts arose. The project leader in one department did not have the authority to coordinate activities in any other department. Furthermore, the creation of this new position caused internal conflicts within each department. As a result, many employees refused to become dedicated to project management and were anxious to return to their "secure" jobs. Quite often, especially when cross-functional integration was required, the division manager was forced to act as the project manager. If the employee enjoyed the assignment of project leader, he would try to "stretch out" the project as long as possible.

Even though we have criticized this organizational form, it does not mean that it cannot work. Any organizational form will work if the employees want it to work. As an example, a computer manufacturer has a midwestern division with three departments, as in Figure 3–2, and approximately fourteen people per department. When a project comes

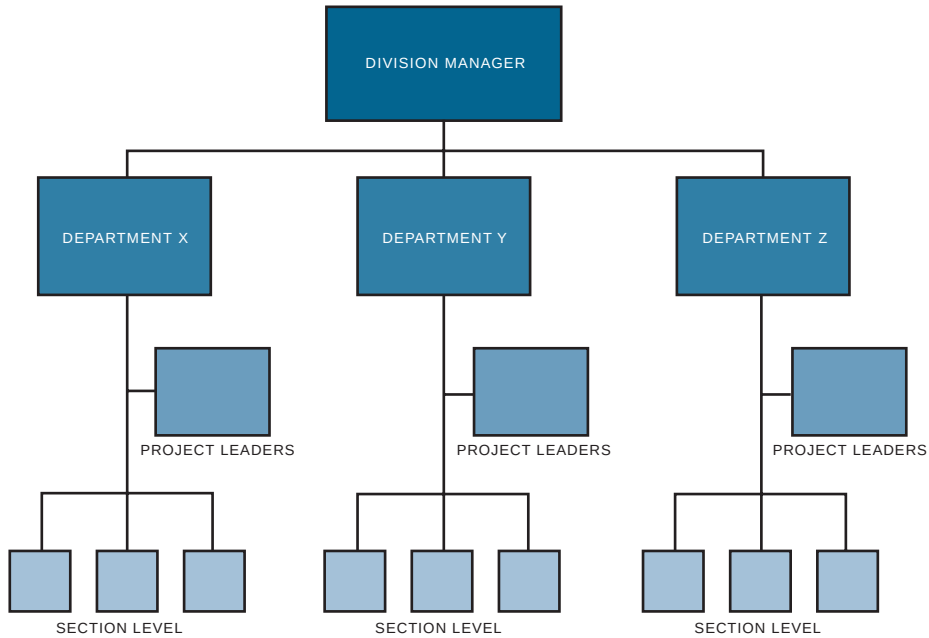

FIGURE 3–2. Departmental project management.

in, the division manager determines which department will handle most of the work. Let us say that the work load is 60 percent department X, 30 percent department Y, and 10 percent department Z. Since most of the effort is in department X, the project leader is selected from that department. When the project leader goes into the other two departments to get resources, he will almost always get the resources he wants. This organizational form works in this case because:

- The other department managers know that they may have to supply the project leader on the next activity.
- There are only three functional boundaries or departments involved (i.e., a small organization).

The next step in the evolution of project management was the task force concept. The rationale behind the task force concept was that integration could be achieved if each functional unit placed a representative on the task force. The group could then jointly solve problems as they occurred, provided that budget limitations were still adhered to. Theoretically, decisions could now be made at the lowest possible levels, thus expediting information and reducing, or even eliminating, delay time.

The task force was composed of both part-time and full-time personnel from each department involved. Daily meetings were held to review activities and discuss potential problems. Functional managers soon found that their task force employees were spending

more time in unproductive meetings than in performing functional activities. In addition, the nature of the task force position caused many individuals to shift membership within the informal organization. Many functional managers then placed nonqualified and inexperienced individuals on task forces. The result was that the group soon became ineffective because they either did not have the information necessary to make the decisions, or lacked the authority (delegated by the functional managers) to allocate resources and assign work.

Development of the task force concept was a giant step toward conflict resolution: Work was being accomplished on time, schedules were being maintained, and costs were usually within budget. But integration and coordination were still problems because there were no specified authority relationships or individuals to oversee the entire project through completion. Attempts were made to overcome this by placing various people in charge of the task force: Functional managers, division heads, and even upper-level management had opportunities to direct task forces. However, without formal project authority relationships, task force members remained loyal to their functional organizations, and when conflicts came about between the project and functional organization, the project always suffered.

Although the task force concept was a step in the right direction, the disadvantages strongly outweighed the advantages. A strength of the approach was that it could be established very rapidly and with very little paperwork. Integration, however, was complicated; work flow was difficult to control; and functional support was difficult to obtain because it was almost always strictly controlled by the functional manager. In addition, task forces were found to be grossly ineffective on long-range projects.

The next step in the evolution of work integration was the establishment of liaison departments, particularly in engineering divisions that perform multiple projects involving a high level of technology (see Figure 3–3). The purpose of the liaison department was to

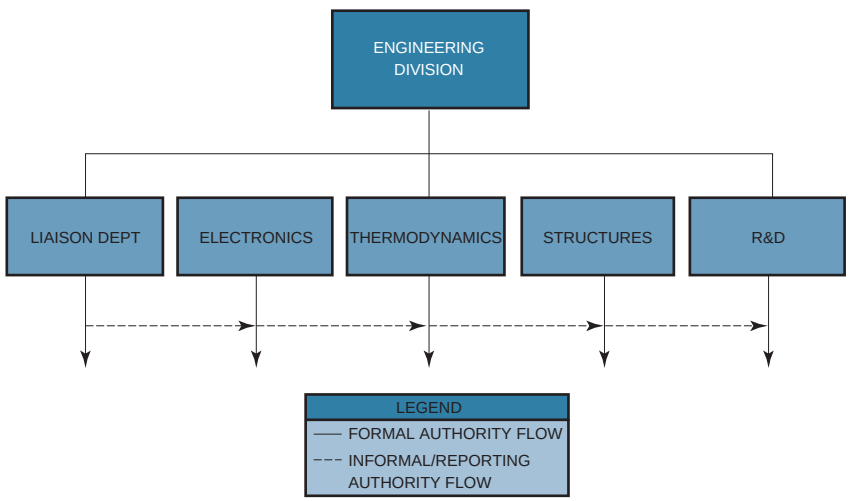

FIGURE 3–3. Engineering division with liaison department (The Expeditor).

handle transactions between functional units within the (engineering) division. The liaison personnel received their authority through the division head. The liaison department did not actually resolve conflicts. Their prime function was to assure that all departments worked toward the same requirements and goals. Liaison departments are still in existence in many large companies and typically handle engineering changes and design problems.

Unfortunately, the liaison department is simply a scaleup of the project coordinator within the department. The authority given to the liaison department extends only to the outer boundaries of the division. If a conflict arose between the manufacturing and engineering divisions, for example, it would still be referred to upper management for resolution. Today, liaison departments are synonymous with project engineering and systems engineering departments, and the individuals in these departments have the authority to span the entire organization.

3.4 LINE–STAFF ORGANIZATION (PROJECT COORDINATOR)

It soon became obvious that control of a project must be given to personnel whose first loyalty is directed toward the completion of the project. Thus the project management position must not be controlled by the functional managers. Figure 3–4 shows a typical line–staff organization.

Two possible situations can exist with this form of line–staff project control. In the first, the project manager serves only as the focal point for activity control, that is, a center for information. The prime responsibility of the project manager is to keep the division manager informed of the status of the project and to "harass" or attempt to "influence" managers into completing activities on time. Referring to such early project managers, Galbraith stated, "Since these men had no formal authority, they had to resort to their technical competence and their interpersonal skills in order to be effective."[10]

The project manager in the first situation maintained monitoring authority only, despite the fact that both he and the functional manager reported to the same individual. Both work assignments and merit reviews were made by the functional managers. Department managers refused to take direction from the project managers because to do so would seem an admission that the project manager was next in line to be the division manager.

The amount of authority given to the project manager posed serious problems. Almost all upper-level and division managers were from the classical management schools and therefore maintained serious reservations about how much authority to relinquish. Many of these managers considered it a demotion if they had to give up any of their long-established powers.

In the second situation, the project manager is given more authority; using the authority vested in him by the division manager, he can assign work to individuals in the functional organizations. The functional manager, however, still maintains the authority to

10. Jay R. Galbraith, "Matrix Organization Designs." *Business Horizons*, February 1971, pp. 29–40.

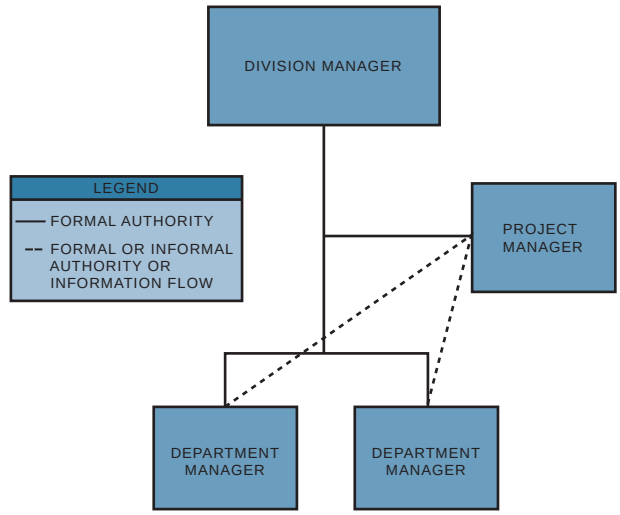

FIGURE 3–4. Line–staff organization (Project Coordinator).

perform merit reviews, but cannot enforce both professional and organizational standards in the completion of an activity. The individual performing the work is now caught in a web of authority relationships, and additional conflicts develop because functional managers are forced to share their authority with the project manager.

Although this second situation did occur during the early stages of matrix project management, it did not last because:

- Upper-level management was not ready to cope with the problems arising from shared authority.
- Upper-level management was reluctant to relinquish any of its power and authority to project managers.
- Line–staff project managers who reported to a division head did not have any authority or control over those portions of a project in other divisions; that is, the project manager in the engineering division could not direct activities in the manufacturing division.

3.5 PURE PRODUCT (PROJECTIZED) ORGANIZATION

The pure product organization, as shown in Figure 3–5, develops as a division within a division. As long as there exists a continuous flow of projects, work is stable and conflicts are at a minimum. The major advantage of this organizational flow is that one individual, the program manager, maintains complete line authority over the entire project. Not only does he assign work, but he also conducts merit reviews. Because each individual reports

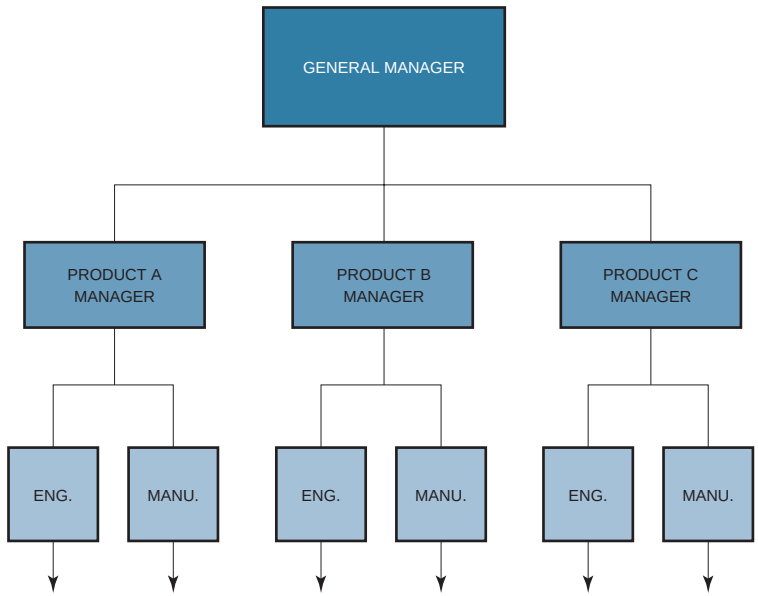

FIGURE 3–5. Pure product or projectized structure.

to only one person, strong communication channels develop that result in a very rapid reaction time.

In pure product organizations, long lead times became a thing of the past. Trade-off studies could be conducted as fast as time would permit without the need to look at the impact on other projects (unless, of course, identical facilities or equipment were required). Functional managers were able to maintain qualified staffs for new product development without sharing personnel with other programs and projects.

The responsibilities attributed to the project manager were entirely new. First, his authority was now granted by the vice president and general manager. The program manager handled all conflicts, both those within his organization and those involving other projects. Interface management was conducted at the program manager level. Upper-level management was now able to spend more time on executive decision-making than on conflict arbitration.

The major disadvantage with the pure project form is the cost of maintaining the organization. There is no chance for sharing an individual with another project in order to reduce costs. Personnel are usually attached to these projects long after they are needed because once an employee is given up, the project manager might not be able to get him back. Motivating personnel becomes a problem. At project completion, functional personnel do not “have a home” to return to. Many organizations place these individuals into an overhead labor pool from which selection can be made during new project development. People remaining in the labor pool may be laid off. As each project comes to a close,

TABLE 3–3. ADVANTAGES OF THE PRODUCT ORGANIZATIONAL FORM

- Provides complete line authority over the project (i.e., strong control through a single project authority).
- Participants work directly for the project manager. Unprofitable product lines are easily identified and can be eliminated.
- Strong communications channels.
- Staffs can maintain expertise on a given project without sharing key personnel.
- Very rapid reaction time is provided.
- Personnel demonstrate loyalty to the project; better morale with product identification.
- A focal point develops for out-of-company customer relations.
- Flexibility in determining time (schedule), cost, and performance trade-offs.
- Interface management becomes easier as unit size is decreased.
- Upper-level management maintains more free time for executive decision-making.

people become uneasy and often strive to prove their worth to the company by overachieving, a condition that is only temporary. It is very difficult for management to convince key functional personnel that they do, in fact, have career opportunities in this type of organization.

In pure functional (traditional) structures, technologies are well developed, but project schedules often fall behind. In the pure project structure, the fast reaction time keeps activities on schedule, but technology suffers because without strong functional groups, which maintain interactive technical communication, the company's outlook for meeting the competition may be severely hampered. The engineering department for one project might not communicate with its counterpart on other projects, resulting in duplication of efforts.

The last major disadvantage of this organizational form lies in the control of facilities and equipment. The most frequent conflict occurs when two projects require use of the same piece of equipment or facilities at the same time. Upper-level management must then assign priorities to these projects. This is normally accomplished by defining certain projects as strategic, tactical, or operational—the same definitions usually given to plans.

Tables 3–3 and 3–4 summarize the advantages and disadvantages of this organizational form.

TABLE 3–4. DISADVANTAGES OF THE PRODUCT ORGANIZATIONAL FORM

- Cost of maintaining this form in a multiproduct company would be prohibitive due to duplication of effort, facilities, and personnel; inefficient usage.
- A tendency to retain personnel on a project long after they are needed. Upper-level management must balance workloads as projects start up and are phased out.
- Technology suffers because, without strong functional groups, outlook of the future to improve company's capabilities for new programs would be hampered (i.e., no perpetuation of technology).
- Control of functional (i.e., organizational) specialists requires top-level coordination.
- Lack of opportunities for technical interchange between projects.
- Lack of career continuity and opportunities for project personnel.

3.6 MATRIX ORGANIZATIONAL FORM

PMBOK® Guide, 4th Edition
Matrix Organizational Structures
Figures 2–8, 2–9, 2–10

The matrix organizational form is an attempt to combine the advantages of the pure functional structure and the product organizational structure. This form is ideally suited for companies, such as construction, that are "project-driven." Figure 3–6 shows a typical matrix structure. Each project manager reports directly to the vice president and general manager. Since each project represents a potential profit center, the power and authority used by the project manager come directly from the general manager. The project manager has total responsibility and accountability for project success. The functional departments, on the other hand, have functional responsibility to maintain technical excellence on the project. Each functional unit is headed by a department manager whose prime responsibility is to ensure that a unified technical base is maintained and that all available information can be exchanged for each project. Department managers must also keep their people aware of the latest technical accomplishments in the industry.

Project management is a "coordinative" function, whereas matrix management is a collaborative function division of project management. In the coordinative or project organization, work is generally assigned to specific people or units who "do their own thing." In the collaborative or matrix organization, information sharing may be mandatory, and several people may be required for the same piece of work. In a project organization, authority for decision-making and direction rests with the project leader, whereas in a matrix it rests with the team.

Certain ground rules exist for matrix development:

- Participants must spend full time on the project; this ensures a degree of loyalty.
- Horizontal as well as vertical channels must exist for making commitments.
- There must be quick and effective methods for conflict resolution.

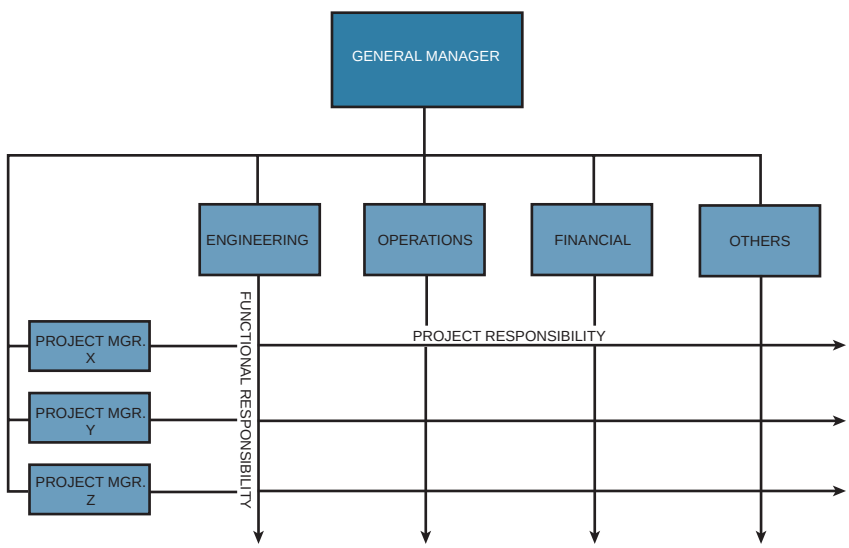

FIGURE 3–6. Typical matrix structure.

- There must be good communication channels and free access between managers.
- All managers must have input into the planning process.
- Both horizontally and vertically oriented managers must be willing to negotiate for resources.
- The horizontal line must be permitted to operate as a separate entity except for administrative purposes.

Before describing the advantages and disadvantages of this structure, the organization concepts must be introduced. The basis for the matrix approach is an attempt to create synergism through shared responsibility between project and functional management. Yet this is easier said than done. *No two working environments are the same, and, therefore, no two companies will have the same matrix design.* The following questions must be answered before a matrix structure can be successful:

- If each functional unit is responsible for one aspect of a project, and other parts are conducted elsewhere (possibly subcontracted to other companies), how can a synergistic environment be created?
- Who decides which element of a project is most important?
- How can a functional unit (operating in a vertical structure) answer questions and achieve project goals and objectives that are compatible with other projects?

The answers to these questions depend on mutual understanding between the project and functional managers. Since both individuals maintain some degree of authority, responsibility, and accountability on each project, they must continuously negotiate. Unfortunately, the program manager might only consider what is best for his project (disregarding all others), whereas the functional manager might consider his organization more important than each project.

In order to get the job done, project managers need organizational status and authority. A corporate executive contends that the organization chart shown in Figure 3–6 can be modified to show that the project managers have adequate organizational authority by placing the department manager boxes at the tip of the functional responsibility arrowheads. With this approach, the project managers appear to be higher in the organization than their departmental counterparts but are actually equal in status. Executives who prefer this method must exercise caution because the line and project managers may not feel that there is still a balance of power.

Problem-solving in this environment is fragmented and diffused. The project manager acts as a unifying agent for project control of resources and technology. He must maintain open channels of communication to prevent suboptimization of individual projects.

In many situations, functional managers have the power to make a project manager look good, if they can be motivated to think about what is best for the project. Unfortunately, this is not always accomplished. As stated by Mantell[11]:

> There exists an inevitable tendency for hierarchically arrayed units to seek solutions and to identify problems in terms of scope of duties of particular units rather than looking

11. Leroy H. Mantell, "The Systems Approach and Good Management." Reprinted with permission from *Business Horizons,* October 1972 (p. 50). Copyright © 1972 by the Board of Trustees at Indiana University.

> beyond them. This phenomenon exists without regard for the competence of the executive concerned. It comes about because of authority delegation and functionalism.

The project environment and functional environment cannot be separated; they must interact. The location of the project and functional unit interface is the focal point for all activities.

The functional manager controls departmental resources (i.e., people). This poses a problem because, although the project manager maintains the maximum control (through the line managers) over all resources including cost and personnel, the functional manager must provide staff for the project's requirements. It is therefore inevitable that conflicts occur between functional and project managers[12]:

> These conflicts revolve about items such as project priority, manpower costs, and the assignment of functional personnel to the project manager. Each project manager will, of course, want the best functional operators assigned to his program. In addition to these problems, the accountability for profit and loss is much more difficult in a matrix organization than in a project organization. Project managers have a tendency to blame overruns on functional managers, stating that the cost of the function was excessive. Whereas functional managers have a tendency to blame excessive costs on project managers with the argument that there were too many changes, more work required than defined initially and other such arguments.

The individual placed at the interface position has two bosses: He must take direction from both the project manager and the functional manager. The merit review and hiring and firing responsibilities still rest with the department manager. Merit reviews are normally made by the functional manager after discussions with the program manager. The functional manager may not have the time to measure the progress of this individual continuously. He must rely on the word of the program manager for merit review and promotion. The interface members generally give loyalty to the person signing their merit review. This poses a problem, especially if conflicting orders are given by the functional and project managers. The simplest solution is for the individual at the interface to ask the functional and project managers to communicate with each other to resolve the problem. This type of situation poses a problem for project managers:

- How does a project manager motivate an individual working on a project (either part-time or full-time) so that his loyalties are with the project?
- How does a project manager convince an individual to perform work according to project direction and specifications when these requests may be in conflict with department policy, especially if the individual feels that his functional boss may not regard him favorably?

There are many advantages to matrix structures, as shown in Table 3–5. Functional units exist primarily to support a project. Because of this, key people can be shared and

12. William P. Killian, "Project Management—Future Organizational Concepts," *Marquette Business Review,* Vol. 2, 1971, pp. 90–107.

TABLE 3–5. ADVANTAGES OF A PURE MATRIX ORGANIZATIONAL FORM

- The project manager maintains maximum project control (through the line managers) over all resources, including cost and personnel.
- Policies and procedures can be set up independently for each project, provided that they do not contradict company policies and procedures.
- The project manager has the authority to commit company resources, provided that scheduling does not cause conflicts with other projects.
- Rapid responses are possible to changes, conflict resolution, and project needs (as technology or schedule).
- The functional organizations exist primarily as support for the project.
- Each person has a "home" after project completion. People are susceptible to motivation and end-item identification. Each person can be shown a career path.
- Because key people can be shared, the program cost is minimized. People can work on a variety of problems; that is, better people control is possible.
- A strong technical base can be developed, and much more time can be devoted to complex problem-solving. Knowledge is available for all projects on an equal basis.
- Conflicts are minimal, and those requiring hierarchical referrals are more easily resolved.
- There is a better balance among time, cost, and performance.
- Rapid development of specialists and generalists occurs.
- Authority and responsibility are shared.
- Stress is distributed among the team (and the functional managers).

costs can be minimized. People can be assigned to a variety of challenging problems. Each person, therefore, has a "home" after project completion and a career path. People in these organizations are especially responsive to motivation and end-item identification. Functional managers find it easy to develop and maintain a strong technical base and can, therefore, spend more time on complex problem-solving. Knowledge can be shared for all projects.

The matrix structure can provide a rapid response to changes, conflicts, and other project needs. Conflicts are normally minimal, but those requiring resolution are easily resolved using hierarchical referral.

This rapid response is a result of the project manager's authority to commit company resources, provided that scheduling conflicts with other projects can be eliminated. Furthermore, the project manager has the authority independently to establish his own project policies and procedures, provided that they do not conflict with company policies. This can do away with red tape and permit a better balance among time, cost, and performance.

The matrix structure provides us with the best of two worlds: the traditional structure and the matrix structure. The advantages of the matrix structure eliminate almost all of the disadvantages of the traditional structure. The word "matrix" often brings fear to the hearts of executives because it implies radical change, or at least they think that it does. If we take a close look at Figure 3–6, we can see that the traditional structure is still there. The matrix is simply horizontal lines superimposed over the traditional structure. The horizontal lines will come and go as projects start up and terminate, but the traditional structure will remain.

Matrix structures are not without their disadvantages, as shown in Table 3–6. The first three elements are due to the horizontal and vertical work flow requirements of a matrix. Actually the flow may even be multidimensional if the project manager has to report to

TABLE 3–6. DISADVANTAGES OF A PURE MATRIX ORGANIZATIONAL FORM

- Multidimensional information flow.
- Multidimensional work flow.
- Dual reporting.
- Continuously changing priorities.
- Management goals different from project goals.
- Potential for continuous conflict and conflict resolution.
- Difficulty in monitoring and control.
- Company-wide, the organizational structure is not cost-effective because more people than necessary are required, primarily administrative.
- Each project organization operates independently. Care must be taken that duplication of efforts does not occur.
- More effort and time are needed initially to define policies and procedures, compared to traditional form.
- Functional managers may be biased according to their own set of priorities.
- Balance of power between functional and project organizations must be watched.
- Balance of time, cost, and performance must be monitored.
- Although rapid response time is possible for individual problem resolution, the reaction time can become quite slow.
- Employees and managers are more susceptible to role ambiguity than in traditional form.
- Conflicts and their resolution may be a continuous process (possibly requiring support of an organizational development specialist).
- People do not feel that they have any control over their own destiny when continuously reporting to multiple managers.

customers or corporate or other personnel in addition to his superior and the functional line managers.

Most companies believe that if they have enough resources to staff all of the projects that come along, then the company is "overstaffed." As a result of this philosophy, priorities may change continuously, perhaps even daily. Management's goals for a project may be drastically different from the project's goals, especially if executive involvement is lacking during the definition of a project's requirements in the planning phase. In a matrix, conflicts and their resolution may be a continuous process, especially if priorities change continuously. Regardless of how mature an organization becomes, there will always exist difficulty in monitoring and control because of the complex, multidirectional work flow. Another disadvantage of the matrix organization is that more administrative personnel are needed to develop policies and procedures, and therefore both direct and indirect administrative costs will increase. In addition, it is impossible to manage projects with a matrix if there are steep horizontal or vertical pyramids for supervision and reporting, because each manager in the pyramid will want to reduce the authority of the managers operating within the matrix. Each project organization operates independently. Duplication of effort can easily occur; for example, two projects might be developing the same cost accounting procedure, or functional personnel may be doing similar R&D efforts on different projects. Both vertical and horizontal communication is a must in a project matrix organization.

One of the advantages of the matrix is a rapid response time for problem resolution. This rapid response generally applies to slow-moving projects where problems occur within each functional unit. On fast-moving projects, the reaction time can become quite slow, especially if the problem spans more than one functional unit. This slow reaction

time exists because the functional employees assigned to the project do not have the authority to make decisions, allocate functional resources, or change schedules. Only the line managers have this authority. Therefore, in times of crisis, functional managers must be actively brought into the "big picture" and invited to team meetings.

Middleton has listed four additional undesirable results of matrix organizations, results that can affect company capabilities[13]:

- Project priorities and competition for talent may interrupt the stability of the organization and interfere with its long-range interests by upsetting the traditional business of functional organizations.
- Long-range plans may suffer as the company gets more involved in meeting schedules and fulfilling the requirements of temporary projects.
- Shifting people from project to project may disrupt the training of employees and specialists, thereby hindering the growth and development within their fields of specialization.
- Lessons learned on one project may not be communicated to other projects.

Davis and Lawrence have identified nine additional matrix pathologies[14]:

- Power struggles: The horizontal versus vertical hierarchy.
- Anarchy: Formation of organizational islands during periods of stress.
- Groupitis: Confusing the matrix as being synonymous with group decision making.
- Collapse during economic crunch: Flourishing during periods of growth and collapsing during lean times.
- Excessive overhead: How much matrix supervision is actually necessary?
- Decision strangulation: Too many people involved in decision-making.
- Sinking: Pushing the matrix down into the depths of the organization.
- Layering: A matrix within a matrix.
- Navel gazing: Becoming overly involved in the internal relationships of the organization.

The matrix structure therefore becomes a compromise in an attempt to obtain the best of two worlds. In pure product management, technology suffered because there wasn't a single group for planning and integration. In the pure functional organization, time and schedule were sacrificed. Matrix project management is an attempt to obtain maximum technology and performance in a cost-effective manner and within time and schedule constraints.

We should note that with proper executive-level planning and control, all of the disadvantages can be eliminated. This is the only organizational form where such control is possible. But companies must resist creating more positions in executive management than are

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13. Reprinted by permission of *Harvard Business Review.* From C. J. Middleton, "How to Set Up a Project Organization," *Harvard Business Review,* March–April 1967. Copyright © 1967 by the Harvard Business School Publishing Corporation; all rights reserved.

14. Stanley M. Davis and Paul R. Lawrence, *Matrix* (adapted from pp. 129–144), © 1977. Adapted by permission of Pearson Education, Inc., Upper Saddle River, NJ.

actually necessary as this will drive up overhead rates. However, there is a point where the matrix will become mature and fewer people will be required at the top levels of management.

Previously we identified the necessity for the project manager to be able to establish his own policies, procedures, rules, and guidelines. Obviously, with personnel reporting in two directions and to multiple managers, conflicts over administration can easily occur.

Most practitioners consider the matrix to be a two-dimensional system where each project represents a potential profit center and each functional department represents a cost center. (This interpretation can also create conflict because functional departments may feel that they no longer have an input into corporate profits.) For large corporations with multiple divisions, the matrix is no longer two-dimensional, but multidimensional.

William C. Goggin has described geographical area and space and time as the third and fourth dimensions of the Dow Corning matrix[15]:

> Geographical areas . . . business development varied widely from area to area, and the profit-center and cost-center dimensions could not be carried out everywhere in the same manner. . . . Dow Corning area organizations are patterned after our major U.S. organizations. Although somewhat autonomous in their operation, they subscribe to the overall corporate objectives, operating guidelines, and planning criteria. During the annual planning cycle, for example, there is a mutual exchange of sales, expense, and profit projections between the functional and business managers headquartered in the United States and the area managers around the world.
>
> Space and time. . . . A fourth dimension of the organization denotes fluidity and movement through time. . . . The multidimensional organization is far from rigid; it is constantly changing. Unlike centralized or decentralized systems that are too often rooted deep in the past, the multidimensional organization is geared toward the future: Long-term planning is an inherent part of its operation.

Goggin then went on to describe the advantages that Dow Corning expected to gain from the multidimensional organization:

- Higher profit generation even in an industry (silicones) price-squeezed by competition. (Much of our favorable profit picture seems due to a better overall understanding and practice of expense controls through the company.)
- Increased competitive ability based on technological innovation and product quality without a sacrifice in profitability.
- Sound, fast decision-making at all levels in the organization, facilitated by stratified but open channels of communications, and by a totally participative working environment.
- A healthy and effective balance of authority among the businesses, functions, and areas.
- Progress in developing short- and long-range planning with the support of all employees.

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15. Reprinted by permission of *Harvard Business Review.* From William C. Goggin, "How the Multidimensional Structure Works at Dow Corning," *Harvard Business Review,* January–February 1974, pp. 56–57. Copyright © 1973 by the Harvard Business School Publishing Corporation; all rights reserved.

- Resource allocations that are proportional to expected results.
- More stimulating and effective on-the-job training.
- Accountability that is more closely related to responsibility and authority.
- Results that are visible and measurable.
- More top-management time for long-range planning and less need to become involved in day-to-day operations.

Obviously, the matrix structure is the most complex of all organizational forms. Grinnell and Apple define four situations where it is most practical to consider a matrix[16]:

- When complex, short-run products are the organization's primary output.
- When a complicated design calls for both innovation and timely completion.
- When several kinds of sophisticated skills are needed in designing, building, and testing the products—skills then need constant updating and development.
- When a rapidly changing marketplace calls for significant changes in products, perhaps between the time they are conceived and delivered.

Matrix implementation requires:

- Training in matrix operations
- Training in how to maintain open communications
- Training in problem solving
- Compatible reward systems
- Role definitions

3.7 MODIFICATION OF MATRIX STRUCTURES

The matrix can take many forms, but there are basically three common varieties. Each type represents a different degree of authority attributed to the program manager and indirectly identifies the relative size of the company. As an example, in the matrix of Figure 3–6, all program managers report directly to the general manager. This type of arrangement works best for small companies that have few projects and assumes that the general manager has sufficient time to coordinate activities between his project managers. In this type of arrangement, all conflicts between projects are referred to the general manager for resolution.

As companies grow in size and the number of projects, the general manager will find it increasingly difficult to act as the focal point for all projects. A new position must be created, that of director of programs, or manager of programs or projects, who is responsible for all program management. See Figure 3–7.

Executives contend that an effective span of control is five to seven people. Does this apply to the director of project management as well? Consider a company that has fifteen

16. S. K. Grinnell and H. P. Apple, "When Two Bosses Are Better Than One," *Machine Design,* January 1975, pp. 84–87.

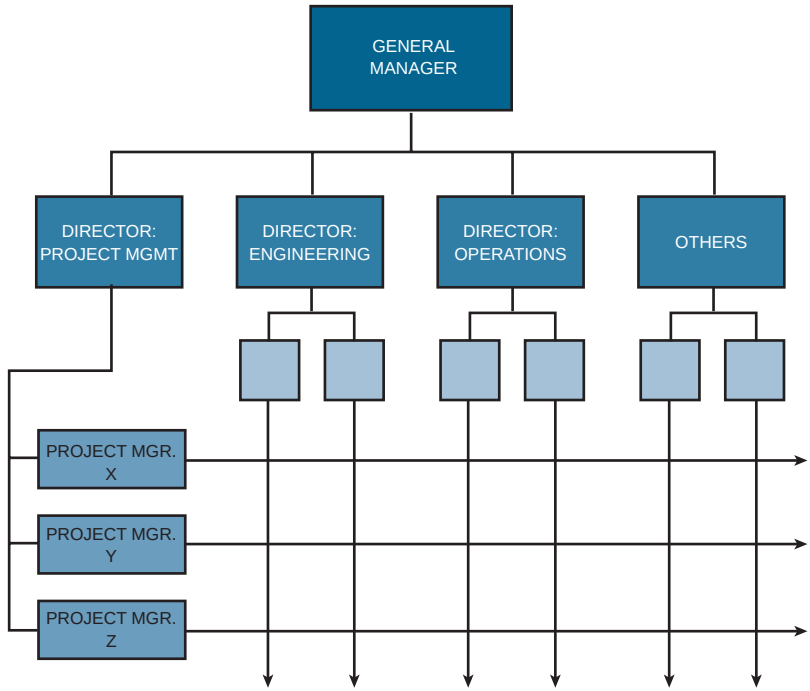

FIGURE 3–7. Development of a director of project management.

projects going on at once. There are three projects over $5 million, seven are between $1 and $3 million, and five projects are under $700,000. Each project has a full-time project manager. Can all fifteen project managers report to the same person? The company solved this problem by creating a deputy director of project management. All projects over $1 million reported to the director, and all projects under $1 million went to the deputy director. The director's rationale soon fell by the wayside when he found that the more severe problems that were occupying his time were occurring on projects with a smaller dollar volume, where flexibility in time, cost, and performance was nonexistent and trade-offs were almost impossible. If the project manager is actually a general manager, then the director of project management should be able to supervise effectively more than seven project managers. The desired span of control, of course, will vary from company to company and must take into account:

- The demands imposed on the organization by task complexity
- Available technology
- The external environment
- The needs of the organizational membership
- The types of customers and/or products

As companies expand, it is inevitable that new and more complex conflicts arise. The control of the engineering functions poses such a problem:

> Should the project manager have ultimate responsibility for the engineering functions of a project, or should there be a deputy project manager who reports to the director of engineering and controls all technical activity?

Although there are pros and cons for both arrangements, the problem resolved itself in the company mentioned above when projects grew so large that the project manager became unable to handle both the project management and project engineering functions. Then, as shown in Figure 3–8, a chief project engineer was assigned to each project as deputy project manager, but remained functionally assigned to the director of engineering. The project manager was now responsible for time and cost considerations, whereas the project engineer was concerned with technical performance. The project engineer can be either "solid" vertically and "dotted" horizontally, or vice versa. There are also situations where the project engineer may be "solid" in both directions. The decision usually rests with the director of engineering. Of course, in a project where the project engineer would be needed on a part-time basis only, he would be solid vertically and dotted horizontally.

Engineering directors usually demand that the project engineer be solid vertically in order to give technical direction. As one director of engineering stated, "Only engineers that report to me will have the authority to give technical direction to other engineers. After all, how else can I be responsible for the technical integrity of the product when direction comes from outside my organization?"

This subdivision of functions is necessary in order to control large projects adequately. However, for small projects, say $100,000 or less, it is quite common on R&D projects for

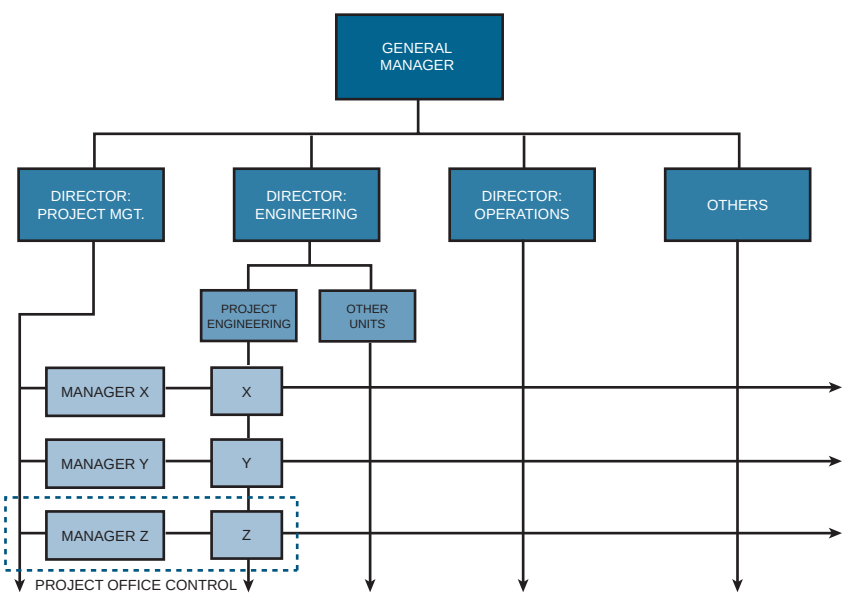

FIGURE 3–8. Placing project engineering in the project office.

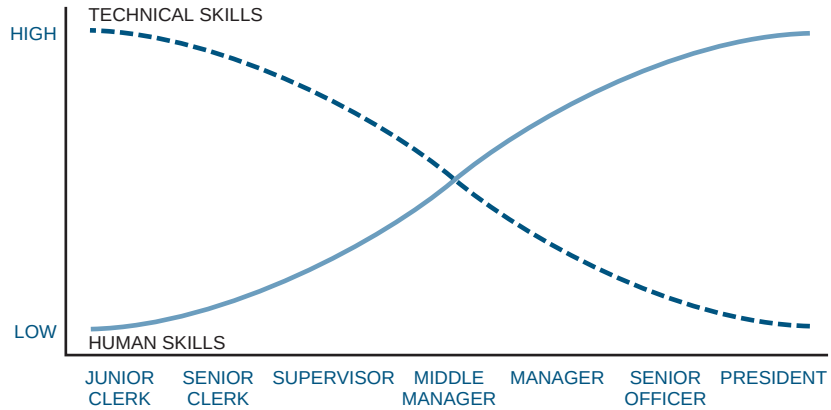

FIGURE 3–9. Philosophy of management.

an engineer to serve as the project manager as well as the project engineer. Here, the project manager must have technical expertise, not merely understanding. Furthermore, this individual can still be attached to a functional engineering support unit other than project engineering. As an example, a mechanical engineering department receives a government contract for $75,000 to perform tests on a new material. The proposal is written by an engineer attached to the department. When the contract is awarded, this individual, although not in the project engineering department, can fulfill the role of project manager and project engineer while still reporting to the manager of the mechanical engineering department. This arrangement works best (and is cost-effective) for short-duration projects that cross a minimum number of functional units.

Finally, we must discuss the characteristics of a project engineer. In Figure 3–9, most people would place the project manager to the right of center with stronger human skills than technical skills, and the project engineer to the left of center with stronger technical skills than human skills. How far from the center point will the project manager and project engineer be? Today, many companies are merging project management and project engineering into one position. This can be seen in Table 3–7. The project manager and project

TABLE 3–7. PROJECT MANAGEMENT COMPARED TO PROJECT ENGINEERING

Project Management	*Project Engineering*
• Total project planning • Cost control • Schedule control • System specifications • Logistics support	• Total project planning • Cost control • Schedule control • System specifications • Logistics support
• Contract control • Report preparation and distribution • Procurement • Identification of reliability and maintainability requirements • Staffing • Priority scheduling • Management information systems	• Configuration control • Fabrication, testing, and production technical leadership support

engineer have similar functions above the line but different ones below the line.[17] The main reason for separating project management from project engineering is so that the project engineer will remain "solid" to the director of engineering in order to have the full authority to give technical direction to engineering.

3.8 THE STRONG, WEAK, OR BALANCED MATRIX

PMBOK® Guide, 4th Edition
Matrix Organizational Structures
Figures 2–8, 2–9, 2–10

Matrix structures can be strong, weak, or balanced. The strength of the matrix is based upon who has more influence over the daily performance of the workers: project manager or line managers. If the project manager has more influence over the worker, then the matrix structure functions as a strong matrix as seen through the eyes of the project manager. If the line manager has more influence than does the project manager, then the organization functions as a weak matrix as seen by the project manager.

The most common differentiator between a strong and weak matrix is where the command of technology resides: project manager or line managers. If the project manager has a command of technology and is recognized by the line managers and the workers as being a technical expert, then the line managers will allow the workers to take technical direction from the project manager. This will result in a strong matrix structure. Workers will seek solutions to their problems from the project manager first and the line managers second. The reverse is true for a weak matrix. Project managers in a strong matrix generally possess more authority than in a weak matrix.

When a company desires a strong matrix, the project manager is generally promoted from within the organization and may have had assignments in several line functions throughout the organization. In a weak matrix, the company may hire from outside the organization but should at least require that the person selected understand the technology and the industry.

3.9 CENTER FOR PROJECT MANAGEMENT EXPERTISE

PMBOK® Guide, 4th Edition
1.4.4 Project Management Office

In project-driven companies, the creation of a project management division is readily accepted as a necessity to conduct business. Organizational restructuring can quite often occur based on environmental changes and customer needs. In non–project-driven organizations, employees are less tolerant of organizational change. Power, authority, and turf become important. The implementation of a separate division for project management is extremely difficult. Resistance can become so strong that the entire project management process can suffer.

Recently, non–project-driven companies have created centers for project management expertise. These centers are not necessarily formal line organizations, but more informal committees whose membership may come from each functional unit of the company. The assignment to the center for expertise can be part-time or full-time; it may be only for six

17. Procurement, reliability, and maintainability may fall under the responsibility of the project engineer in some companies.

months to a year; and it may or may not require the individual to manage projects. Usually, the center for expertise has as its charter:

- To develop and update a methodology for project management. The methodology usually advocates informal project management.
- To act as a facilitator or trainer in conducting project management training programs.
- To provide project management assistance to any employee who is currently managing projects and requires support in planning, scheduling, and controlling projects.
- To develop or maintain files on "lessons learned" and to see that this information is made available to all project managers.

Since these centers pose no threat to the power and authority of line managers, support is usually easy to obtain.

3.10 MATRIX LAYERING

Matrix layering can be defined as the creation of one matrix within a second matrix. For example, a company can have a total company matrix, and each division or department (i.e., project engineering) can have its own internalized matrix. In the situation of a matrix within a matrix, all matrices are formal operations.

Matrix layering can also be a mix of formal and informal organizations. The formal matrix exists for work flow, but there can also exist an informal matrix for information flow. There are also authority matrices, leadership matrices, reporting matrices, and informal technical direction matrices.

An example of layering would be the multidimensional matrix, shown in Figure 3–10, where each slice represents either time, distance, or geographic area. For example, a New York

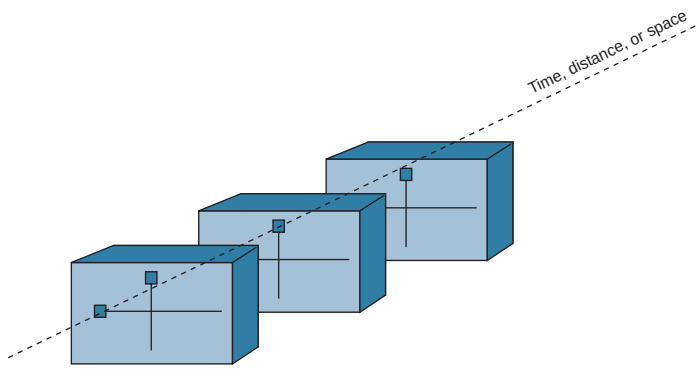

FIGURE 3–10. The multidimensional matrix.

bank utilizes a multinational matrix to control operations in foreign countries. In this case, each foreign country would represent a different slice of the total matrix.

3.11 SELECTING THE ORGANIZATIONAL FORM

PMBOK® Guide, 4th Edition
2.4 Organizational Influences

Project management has matured as an outgrowth of the need to develop and produce complex and/or large projects in the shortest possible time, within anticipated cost, with required reliability and performance, and (when applicable) to realize a profit. Granted that organizations have become so complex that traditional organizational structures and relationships no longer allow for effective management, how can executives determine which organizational form is best, especially since some projects last for only a few weeks or months while others may take years?

To answer this question, we must first determine whether the necessary characteristics exist to warrant a project management organizational form. Generally speaking, the project management approach can be effectively applied to a onetime undertaking that is[18]:

- Definable in terms of a specific goal
- Infrequent, unique, or unfamiliar to the present organization
- Complex with respect to interdependence of detailed tasks
- Critical to the company

Once a group of tasks is selected and considered to be a project, the next step is to define the kinds of projects, described in Section 2.5. These include individual, staff, special, and matrix or aggregate projects.

Unfortunately, many companies do not have a clear definition of what a project is. As a result, large project teams are often constructed for small projects when they could be handled more quickly and effectively by some other structural form. All structural forms have their advantages and disadvantages, but the project management approach appears to be the best possible alternative.

The basic factors that influence the selection of a project organizational form are:

- Project size
- Project length
- Experience with project management organization
- Philosophy and visibility of upper-level management
- Project location
- Available resources
- Unique aspects of the project

18. John M. Stewart, "Making Project Management Work." Reprinted with permission from *Business Horizons*, Fall 1965 (p. 54). Copyright © 1964 by the Board of Trustees at Indiana University.

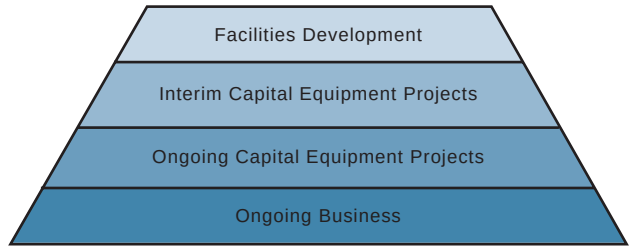

FIGURE 3–11. Matrix development in manufacturing.

This last item requires further comment. Project management (especially with a matrix) usually works best for the control of human resources and thus may be more applicable to labor-intensive projects rather than capital-intensive projects. Labor-intensive organizations have formal project management, whereas capital-intensive organizations may use informal project management. Figure 3–11 shows how matrix management was implemented by an electric equipment manufacturer. The company decided to use fragmented matrix management for facility development projects. After observing the success of the fragmented matrix, the executives expanded matrix operations to include interim and ongoing capital equipment projects. The first three levels were easy to implement. The fourth level, ongoing business, was more difficult to convert to matrix because of functional management resistance and the fear of losing authority.

Four fundamental parameters must be analyzed when considering implementation of a project organizational form:

- Integrating devices
- Authority structure
- Influence distribution
- Information system

Project management is a means of integrating all company efforts, especially research and development, by selecting an appropriate organizational form. Two questions arise when we think of designing the organization to facilitate the work of the integrators[19]:

- Is it better to establish a formal integration department, or simply to set up integrating positions independent of one another?
- If individual integrating positions are set up, how should they be related to the larger structure?

19. William P. Killian, "Project Management—Future Organizational Concepts," *Marquette Business Review,* Vol. 2, 1971, pp. 90–107.

Informal integration works best if, and only if, effective collaboration can be achieved between conflicting units. Without any clearly defined authority, the role of the integrator is simply to act as an exchange medium across the interface of two functional units. As the size of the organization increases, formal integration positions must exist, especially in situations where intense conflict can occur (e.g., research and development).

Not all organizations need a pure matrix structure to achieve this integration. Many problems can be solved simply through the chain of command, depending on the size of the organization and the nature of the project. The organization needed to achieve project control can vary in size from one person to several thousand people. The organizational structure needed for effective project control is governed by the desires of top management and project circumstances.

Top management must decide on the authority structure that will control the integration mechanism. The authority structure can range from pure functional authority (traditional management), to product authority (product management), and finally to dual authority (matrix management). This range is shown in Figure 3–12. From a management point of view, organizational forms are often selected based on how much authority top management wishes to delegate or surrender.

Integration of activities across functional boundaries can also be accomplished by influence. Influence includes such factors as participation in budget planning and approval, design changes, location and size of offices, salaries, and so on. Influence can also cut administrative red tape and develop a much more unified informal organization.

Matrix structures are characterized as strong or weak based on the relative influence that the project manager possesses over the assigned functional resources. When the

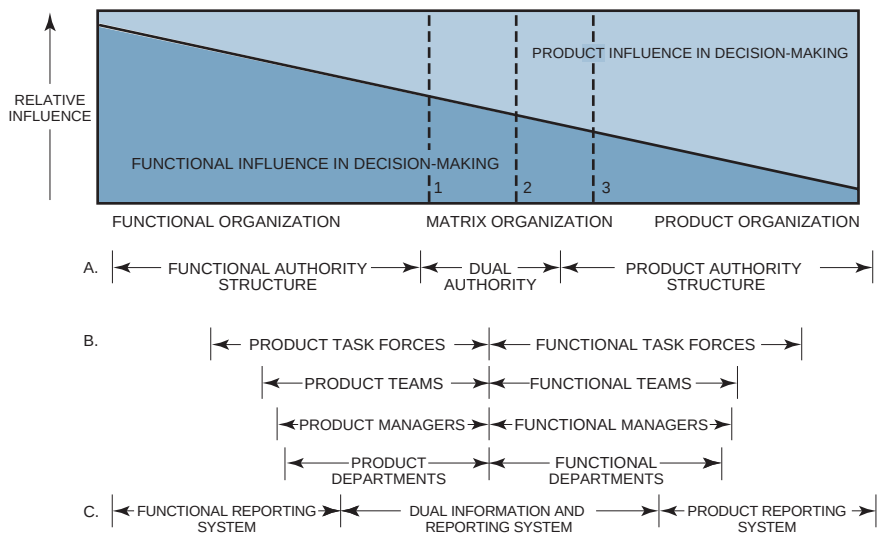

FIGURE 3–12. The range of alternatives. *Source:* Jay R. Galbraith, "Matrix Organization Designs." Reprinted with permission from *Business Horizons*, February 1971 (p. 37). Copyright © 1971 by the Board of Trustees at Indiana University.

project manager has more "relative influence" over the performance of the assigned resources than does the line manager, the matrix structure is a strong matrix. In this case, the project manager usually has the knowledge to provide technical direction, assign responsibilities, and may even have a strong input into the performance evaluation of the assigned personnel. If the balance of influence tilts in favor of the line manager, then the matrix is referred to as a weak matrix.

Information systems also play an important role. Previously we stated that one of the advantages of several project management structures is the ability to make both rapid and timely decisions with almost immediate response to environmental changes. Information systems are designed to get the right information to the right person at the right time in a cost-effective manner. Organizational functions must facilitate the flow of information through the management network.

Galbraith has described additional factors that can influence organizational selection. These factors are[20]:

- Diversity of product lines
- Rate of change of the product lines
- Interdependencies among subunits
- Level of technology
- Presence of economies of scale
- Organizational size

A diversity of project lines requires both top-level and functional managers to maintain knowledge in all areas. Diversity makes it more difficult for managers to make realistic estimates concerning resource allocations and the control of time, cost, schedules, and technology. The systems approach to management requires sufficient information and alternatives to be available so that effective trade-offs can be established. For diversity in a high-technology environment, the organizational choice might, in fact, be a trade-off between the flow of work and the flow of information. Diversity tends toward strong product authority and control.

Many functional organizations consider themselves companies within a company and pride themselves on their independence. This attitude poses a severe problem in trying to develop a synergistic atmosphere. Successful project management requires that functional units recognize the interdependence that must exist in order for technology to be shared and schedule dates to be met. Interdependency is also required in order to develop strong communication channels and coordination.

The use of new technologies poses a serious problem in that technical expertise must be established in all specialties, including engineering, production, material control, and safety. Maintaining technical expertise works best in strong functional disciplines, provided the information is not purchased outside the organization. The main problem, however, is how to communicate this expertise across functional lines. Independent R&D units can be established, as opposed to integrating R&D into each functional department's routine efforts. Organizational control requirements are much more difficult in high-technology industries with ongoing research and development than with pure production groups.

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20. Jay R. Galbraith, "Matrix Organization Designs." Reprinted with permission from *Business Horizons*, February 1971, pp. 29–40. Copyright © 1971 by the Board of Trustees at Indiana University.

Economies of scale and size can also affect organizational selection. The economies of scale are most often controlled by the amount of physical resources that a company has available. For example, a company with limited facilities and resources might find it impossible to compete with other companies on production or competitive bidding for larger dollar-volume products. Such a company must rely heavily on maintaining multiple projects (or products), each of low cost or volume, whereas a larger organization may need only three or four projects large enough to sustain the organization. The larger the economies of scale, the more the organization tends to favor pure functional management.

The size of the organization is important in that it can limit the amount of technical expertise in the economies of scale. While size may have little effect on the organizational structure, it does have a severe impact on the economies of scale. Small companies, for example, cannot maintain large specialist staffs and, therefore, incur a larger cost for lost specialization and lost economies of scale.

The four factors described above for organizational form selections together with the six alternatives of Galbraith can be regarded as universal. Beyond these universal factors, we must look at the company in terms of its product, business base, and personnel. Goodman has defined a set of subfactors related to R&D groups[21]:

- Clear location of responsibility
- Ease and accuracy of communication
- Effective cost control
- Ability to provide good technical supervision
- Flexibility of staffing
- Importance to the company
- Quick reaction capability to sudden changes in the project
- Complexity of the project
- Size of the project with relation to other work in-house
- Form desired by customer
- Ability to provide a clear path for individual promotion

Goodman asked general managers and project managers to select from the above list and rank the factors from most important to least important in designing an organization. With one exception—flexibility of staffing—the response from both groups correlated to a coefficient of 0.811. Clear location of responsibility was seen as the most important factor, and a path for promotion the least important.

Middleton conducted a mail survey of aerospace firms in an attempt to determine how well the companies using project management met their objectives. Forty-seven responses were received. Tables 3–8 and 3–9 identify the results. Middleton stated, "In evaluating the results of the survey, it appears that a company taking the project organization approach can be reasonably certain that it will improve controls and customer (out-of-company) relations, but internal operations will be more complex."[22]

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21. Richard A. Goodman, "Organizational Preference in Research and Development," *Human Relations*, Vol. 3, No. 4, 1970, pp. 279–298.

22. Reprinted with permission of *Harvard Business Review.* From C. J. Middleton, "How to Set Up a Project Organization," *Harvard Business Review*, March–April 1967, pp. 73–82. Copyright © 1967 by the Harvard Business School Publishing Corporation; all rights reserved.

TABLE 3–8. MAJOR COMPANY ADVANTAGES OF PROJECT MANAGEMENT

Advantages	Percent of Respondents
• Better control of projects	92%
• Better customer relations	80%
• Shorter product development time	40%
• Lower program costs	30%
• Improved quality and reliability	26%
• Higher profit margins	24%
• Better control over program security	13%
Other Benefits	
• Better project visibility and focus on results	
• Improved coordination among company divisions doing work on the project	
• Higher morale and better mission orientation for employees working on the project	
• Accelerated development of managers due to breadth of project responsibilities	

Source: Reprinted by permission of *Harvard Business Review.* An exhibit from "How to Set Up a Project Organization," by C. J. Middleton, March–April, 1967 (pp. 73–82). Copyright © 1967 by the Harvard Business School Publishing Corporation; all rights reserved.

The way in which companies operate their project organization is bound to affect the organization, both during the operation of the project and after the project has been completed and personnel have been disbanded. The overall effects on the company must be looked at from a personnel and cost control standpoint. This will be accomplished, in depth, in later chapters. Although project management is growing, the creation of a project organization does not necessarily ensure that an assigned objective will be accomplished successfully. Furthermore, weaknesses can develop in the areas of maintaining capability and structural changes.

TABLE 3–9. MAJOR COMPANY DISADVANTAGES OF PROJECT MANAGEMENT

Disadvantages	Percent of Respondents
• More complex internal operations	51%
• Inconsistency in application of company policy	32%
• Lower utilization of personnel	13%
• Higher program costs	13%
• More difficult to manage	13%
• Lower profit margins	2%
Other Disadvantages	
• Tendency for functional groups to neglect their job and let the project organization do everything	
• Too much shifting of personnel from project to project	
• Duplication of functional skills in project organization	

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An almost predictable result of using the project management approach is the increase in management positions. Killian describes the results of two surveys[23]:

> One company compared its organization and management structure as it existed before it began forming project units with the structure that existed afterward. The number of departments had increased from 65 to 106, while total employment remained practically the same. The number of employees for every supervisor had dropped from 13.4 to 12.8. The company concluded that a major cause of this change was the project groups [see footnote 26 for reference article].
>
> Another company uncovered proof of its conclusion when it counted the number of second-level and higher management positions. It found that it had 11 more vice presidents and directors, 35 more managers, and 56 more second-level supervisors. Although the company attributed part of this growth to an upgrading of titles, the effect of the project organization was the creation of 60 more management positions.

Although the project organization is a specialized, task-oriented entity, it seldom, if ever, exists apart from the traditional structure of the organization.[24] All project management structures overlap the traditional structure. Furthermore, companies can have more than one project organizational form in existence at one time. A major steel product, for example, has a matrix structure for R&D and a product structure elsewhere.

Accepting a project management structure is a giant step from which there may be no return. The company may have to create more management positions without changing the total employment levels. In addition, incorporation of a project organization is almost always accompanied by the upgrading of jobs. In any event, management must realize that whichever project management structure is selected, a dynamic state of equilibrium will be necessary.

3.12 STRUCTURING THE SMALL COMPANY

Small and medium companies generally prefer to have the project manager report fairly high up in the chain of command, even though the project manager may be working on a relatively low-priority project. Project managers are usually viewed as less of a threat in small organizations than in the larger ones, thus creating less of a problem if they report high up.

Organizing the small company for projects involves two major questions:

- Where should the project manager be placed within the organization?
- Are the majority of the projects internal or external to the organization?

---

23. William P. Killian, "Project Management—Future Organizational Concepts," *Marquette Business Review,* Vol. 2, 1971, pp. 90–107.

24. Allen R. Janger, "Anatomy of the Project Organization," *Business Management Record,* November 1963, pp. 12–18.

These two questions are implicitly related. For either large, complex projects or those involving outside customers, project managers generally report to a high level in the organization. For small or internal projects, the project manager reports to a middle- or lower-level manager.

Small and medium companies have been very successful in managing internal projects using departmental project management (see Figure 3–2), especially when only a few functional groups must interface with one another. Quite often, line managers are permitted to wear multiple hats and also act as project managers, thereby reducing the need for hiring additional project managers.

Customers external to the organization are usually favorably impressed if a small company identifies a project manager who is dedicated and committed to their project, even if only on a part-time basis. Thus outside customers, particularly through a competitive bidding environment, respond favorably to a matrix structure, even if the matrix structure is simply eyewash for the customer. For example, consider the matrix structure shown in Figure 3–13. Both large and small companies that operate on a matrix usually develop a separate organizational chart for each customer. Figure 3–13 represents the organizational chart that would be presented to Alpha Company. The Alpha Company project would be identified with bold lines and would be placed immediately below the vice president, regardless of the priority of the project. After all, if you were the Alpha Company customer, would you want your project to appear at the bottom of the list?

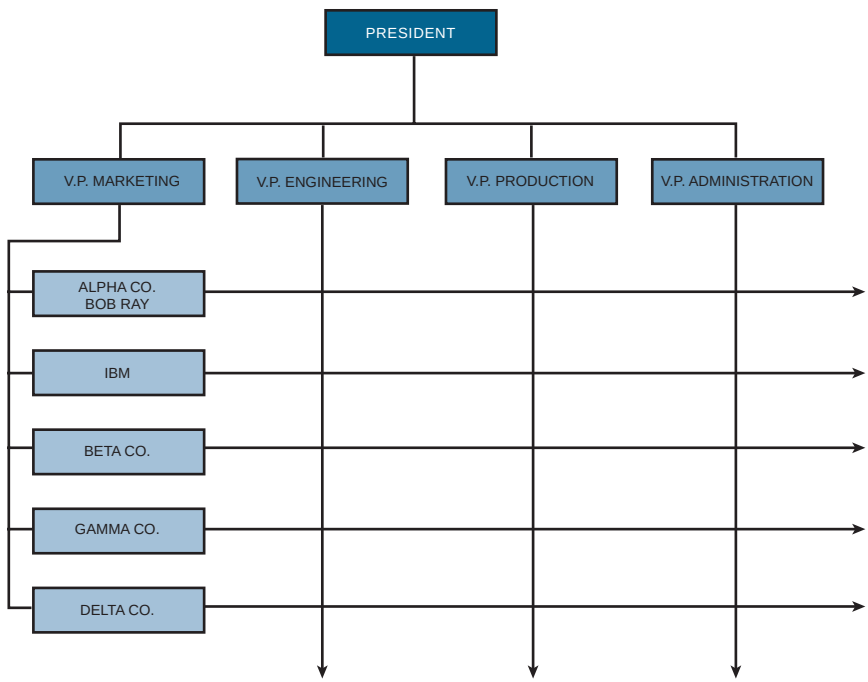


FIGURE 3–13. Matrix for a small company.

Figure 3–13 also identifies two other key points that are important to small companies. First, only the name of the Alpha Company project manager, Bob Ray, need be identified. The reason for this is that Bob Ray may also be the project manager for one or more of the other projects, and it is usually not a good practice to let the customer know that Bob Ray will have loyalties split among several projects. Actually, the organization chart shown in Figure 3–13 is for a machine tool company employing 280 people, with five major and thirty minor projects. The company has only two full-time project managers. Bob Ray manages the projects for Alpha, Gamma, and Delta Companies; the Beta Company project has the second full-time project manager; and the IBM project is being managed personally by the vice president of engineering, who happens to be wearing two hats.

The second key point is that small companies generally should not identify the names of functional employees because:

- The functional employees are probably part-time.
- It is usually best in small companies for all communications to be transmitted through the project manager.

Another example of how a simple matrix structure can be used to impress customers is shown in Figure 3–14. The company identified here actually employs only thirty-eight people. Very small companies normally assign the estimating department to report directly to the president, as shown in Figure 3–14. In addition, the senior engineers, who appear to

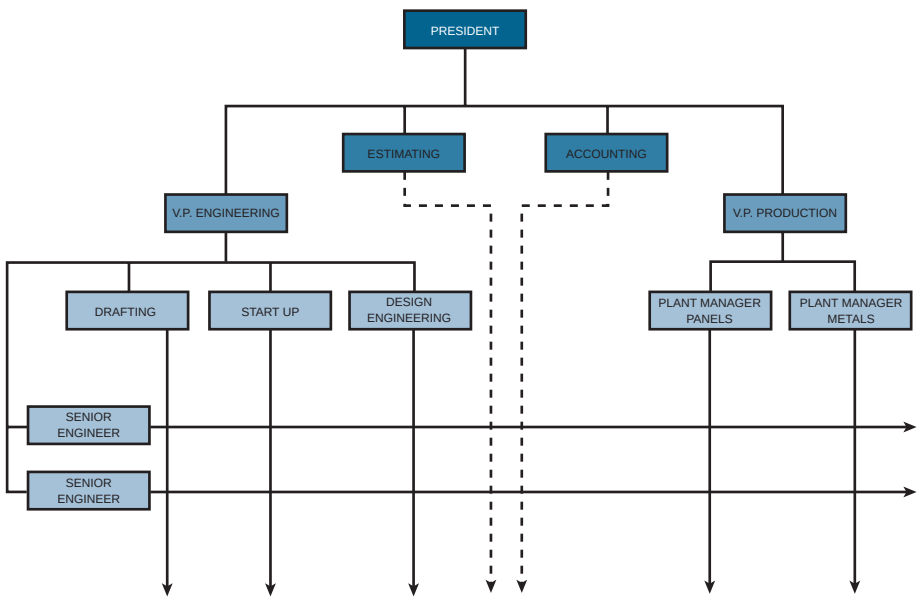


FIGURE 3–14. Matrix for a small company.

be acting in the role of project managers, may simply be the department managers for drafting, startup, and/or design engineering. Yet, from an outside customer's perspective, the company has a dedicated and committed project manager for the project.

3.13 STRATEGIC BUSINESS UNIT (SBU) PROJECT MANAGEMENT

During the past ten years, large companies have restructured into strategic business units (SBUs). An SBU is a grouping of functional units that have the responsibility for profit (or loss) of part of the organization's core businesses. Figure 3–15 shows how one of the automotive suppliers restructured into three SBUs; one each for Ford, Chrysler, and General Motors. Each strategic business unit is large enough to maintain its own project and program managers. The executive in charge of the strategic business unit may act as the sponsor for all of the program and project managers within the SBU. The major benefit of these types of project management SBUs is that it allows the SBU to work more closely with the customer. It is a customer-focused organizational structure.

It is possible for some resources to be shared across several SBUs. Manufacturing plants can end up supporting more than one SBU. Also, corporate may provide the resources for cost accounting, human resource management, and training.

A more recent organizational structure, and a more complex one, is shown in Figure 3–16. In this structure, each SBU may end up using the same platform (i.e., powertrain, chassis, and other underneath components). The platform managers are responsible for the design and enhancements of each platform, whereas the SBU program managers must adapt this platform to a new model car. This type of matrix is multidimensional inasmuch as each SBU could already have an internal matrix. Also, each manufacturing plant could

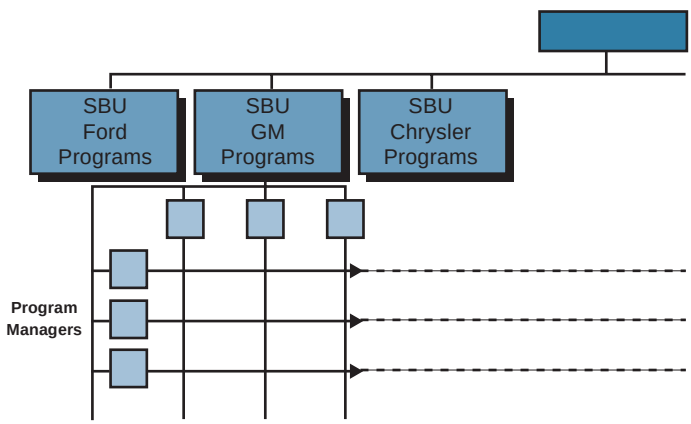


FIGURE 3–15. Strategic business unit project management.

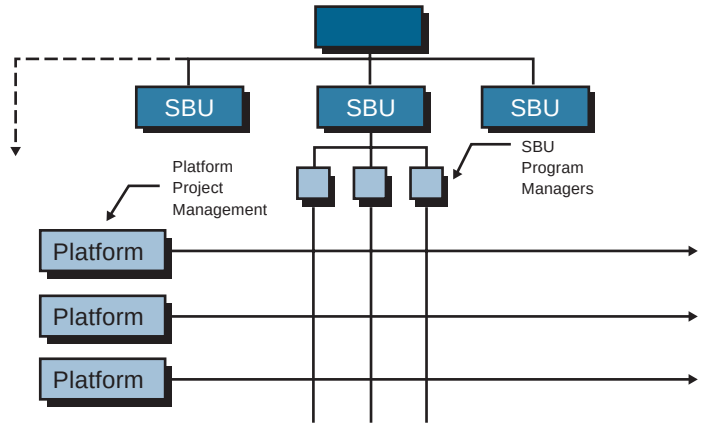


FIGURE 3–16. SBU project management using platform management.

be located outside of the continental United States, making this structure a multinational, multidimensional matrix.

3.14 TRANSITIONAL MANAGEMENT

Organizational redesign is occurring at a rapid rate because of shorter product life cycles, rapidly changing environments, accelerated development of sophisticated information systems, and increased marketplace competitiveness. Because of these factors, more companies are considering project management organizations as a solution.

Why have some companies been able to implement this change in a short period of time while other companies require years? The answer is that successful implementation requires good transitional management.

Transitional management is the art and science of managing the conversion period from one organizational design to another. Transitional management necessitates an understanding of the new goals, objectives, roles, expectations, and employees' fears.

A survey was conducted of executives, managers, and employees in thirty-eight companies that had implemented matrix management. Almost all executives felt that the greatest success could be achieved through proper training and education, both during and after transition. In addition to training, executives stated that the following fifteen challenges must be accounted for during transition:

- *Transfer of power.* Some line managers will find it extremely difficult to accept someone else managing their projects, whereas some project managers will find it difficult to give orders to workers who belong to someone else.

- *Trust.* The secret to a successful transition without formal executive authority will be trust between line managers, between project managers, and between project and line managers. It takes time for trust to develop. Senior management should encourage it throughout the transition life cycle.
- *Policies and procedures.* The establishment of well-accepted policies and procedures is a slow and tedious process. Trying to establish rigid policies and procedures at project initiation will lead to difficulties.
- *Hierarchical consideration.* During transition, every attempt should be made to minimize hierarchical considerations that could affect successful organizational maturity.
- *Priority scheduling.* Priorities should be established only when needed, not on a continual basis. If priority shifting is continual, confusion and disenchantment will occur.
- *Personnel problems.* During transition there will be personnel problems brought on by moving to new locations, status changes, and new informal organizations. These problems should be addressed on a continual basis.
- *Communications.* During transition, new channels of communications should be built but not at the expense of old ones. Transition phases should show employees that communication can be multidirectional, for example, a project manager talking directly to functional employees.
- *Project manager acceptance.* Resistance to the project manager position can be controlled through proper training. People tend to resist what they do not understand.
- *Competition.* Although some competition is healthy within an organization, it can be detrimental during transition. Competition should not be encouraged at the expense of the total organization.
- *Tools.* It is common practice for each line organization to establish its own tools and techniques. During transition, no attempt should be made to force the line organizations to depart from their current practices. Rather, it is better for the project managers to develop tools and techniques that can be integrated with those in the functional groups.
- *Contradicting demands.* During transition and after maturity, contradicting demands will be a way of life. When they first occur during transition, they should be handled in a "working atmosphere" rather than a crisis mode.
- *Reporting.* If any type of standardization is to be developed, it should be for project status reporting, regardless of the size of the project.
- *Teamwork.* Systematic planning with strong functional input will produce teamwork. Using planning groups during transition will not obtain the necessary functional and project commitments.
- *Theory X–Theory Y.* During transition, functional employees may soon find themselves managed under either Theory X or Theory Y approaches. People must realize (through training) that this is a way of life in project management, especially during crises.
- *Overmanagement costs.* A mistake often made by executives is thinking that projects can be managed with fewer resources. This usually leads to disaster because undermanagement costs may be an order of magnitude greater than overmanagement costs.

Transition to a project-driven matrix organization is not easy. Managers and professionals contemplating such a move should know:

- Proper planning and organization of the transition on a life-cycle basis will facilitate a successful change.
- Training of the executives, line managers, and employees in project management knowledge, skills, and attitudes is critical to a successful transition and probably will shorten the transition time.
- Employee involvement and acceptance may be the single most important function during transition.
- The strongest driving force of success during transition is a demonstration of commitment to and involvement in project management by senior executives.
- Organizational behavior becomes important during transition.
- Commitments made by senior executives prior to transition must be preserved during and following transition.
- Major concessions by senior management will come slowly.
- Schedule or performance compromises are not acceptable during transition; cost overruns may be acceptable.
- Conflict among participants increases during transition.
- If project managers are willing to manage with only implied authority during transition, then the total transition time may be drastically reduced.
- It is not clear how long transition will take.

Transition from a classical or product organization to a project-driven organization is not easy. With proper understanding, training, demonstrated commitment, and patience, transition will have a good chance for success.

3.15 STUDYING TIPS FOR THE PMI® PROJECT MANAGEMENT CERTIFICATION EXAM

This section is applicable as a review of the principles to support the knowledge areas and domain groups in the PMBOK® Guide. This chapter addresses:

- Human Resources Management
- Planning

Understanding the following principles is beneficial if the reader is using this text to study for the PMP® Certification Exam:

- Different types of organizational structures
- Advantages and disadvantages of each structure

- In which structure the project manager possesses the greatest amount of authority
- In which structure the project manager possesses the least amount of authority
- Three types of matrix structures

In Appendix C, the following Dorale Products mini–case studies are applicable:

- Dorale Products (G) [Human Resources Management]
- Dorale Products (H) [Human Resources Management]
- Dorale Products (J) [Human Resources Management]
- Dorale Products (K) [Human Resources Management]

The following multiple-choice questions will be helpful in reviewing the principles of this chapter:

1. In which organizational form is it most difficult to integrate project activities?
A. Classical/traditional
B. Projectized
C. Strong matrix
D. Weak matrix

2. In which organization form would the project manager possess the greatest amount of authority?
A. Classical/traditional
B. Projectized
C. Strong matrix
D. Weak matrix

3. In which organizational form does the project manager often have the least amount of authority?
A. Classical/traditional
B. Projectized
C. Strong matrix
D. Weak matrix

4. In which organizational form is the project manager least likely to share resources with other projects?
A. Classical/traditional
B. Projectized
C. Strong matrix
D. Weak matrix

5. In which organizational form do project managers have the greatest likelihood of possessing reward power and have a wage-and-salary administration function? (The project and line manager are the same person.)
A. Classical/traditional
B. Projectized
C. Strong matrix
D. Weak matrix

6. In which organizational form is the worker in the greatest jeopardy of losing his or her job if the project gets canceled?
A. Classical/traditional
B. Projectized
C. Strong matrix
D. Weak matrix

7. In which type of matrix structure would a project manager most likely have a command of technology?
A. Strong matrix
B. Balanced matrix
C. Weak matrix
D. Cross-cultural matrix

ANSWERS

1. A
2. B
3. D
4. B
5. A
6. B
7. A

PROBLEMS

3–1 Much has been written about how to identify and interpret signs that indicate that a new organizational form is needed. Grinnell and Apple have identified five signs in addition to those previously described in Section 3.6[25]:

- Management is satisfied with its technical skills, but projects are not meeting time, cost, and other project requirements.
- There is a high commitment to getting project work done, but great fluctuation in how well performance specifications are met.
- Highly talented specialists involved in the project feel exploited and misused.
- Particular technical groups or individuals constantly blame each other for failure to meet specifications or delivery dates.
- Projects are on time and to specification, but groups and individuals aren't satisfied with the achievement.

Grinnell and Apple state that there is a good chance that a matrix structure will eliminate or alleviate these problems. Do you agree or disagree? Does your answer depend on the type of project? Give examples or counterexamples to defend your answers.

25. See note 16.

3–2 One of the most difficult problems facing management is that of how to minimize the transition time between changeover from a purely traditional organizational form to a project organizational form. Managing the changeover is difficult in that management must consistently "provide individual training on teamwork and group problem solving; also, provide the project and functional groups with assignments to help build teamwork."

3–3 Do you think that personnel working in a project organizational structure should undergo "therapy" sessions or seminars on a regular basis so as to better understand their working environment? If yes, how frequently? Does the frequency depend upon the project organizational form selected, or should they all be treated equally?

3–4 Which organizational form would be best for the following corporate strategies?

a. Developing, manufacturing, and marketing many diverse but interrelated technological products and materials
b. Having market interests that span virtually every major industry
c. Becoming multinational with a rapidly expanding global business
d. Working in a business environment of rapid and drastic change, together with strong competition

3–5 Do you think that documenting relationships is necessary in order to operate effectively in any project organizational structure? How would you relate your answer to a statement made in the previous chapter that each project can set up its own policies, procedures, rules, and directives as long as they conform to company guidelines?

3–6 In general, how could each of the following parameters influence your choice for an organizational structure? Explain your answers in as much depth as possible.

a. The project cost
b. The project schedule
c. The project duration
d. The technology requirements
e. The geographical locations
f. The required working relationships with the customer

3–7 In general, what are the overall advantages and disadvantages of superimposing one organizational form over another?

3–8 In deciding to go to a new organizational form, what impact should the capabilities of the following groups have on your decision?

a. Top management
b. Middle management
c. Lower-level management

3–9 Should a company be willing to accept a project that requires immediate organizational restructuring? If so, what factors should it consider?

3–10 Table 2–6 identifies the different life cycles of programs, projects, systems, and products. For each of the life cycles' phases, select a project organizational form that you feel would work best. Defend your answer with examples, advantages, and disadvantages.

3–11 A major steel producer in the United States uses a matrix structure for R&D. Once the product is developed, the product organizational structure is used. Are there any advantages to this setup?

3–12 A major American manufacturer of automobile parts has a division that has successfully existed for the past ten years with multiple products, a highly sophisticated R&D section, and a pure traditional structure. The growth rate for the past five years has been 12 percent. Almost all middle and upper-level managers who have worked in this division have received promotions and transfers to either another division or corporate headquarters. According to "the book," this division has all the prerequisites signifying that they should have a project organizational form of some sort, and yet they are extremely successful without it. Just from the amount of information presented, how can you account for their continued success? What do you think would be the major obstacles in convincing the personnel that a new organizational form would be better? Do you think that continued success can be achieved under the present structure?

3–13 Several authors contend that technology suffers in a pure product organizational form because there is no one group responsible for long-range planning, whereas the pure functional organization tends to sacrifice time and schedule. Do you agree or disagree with this statement? Defend your choice with examples.

3–14 Below are three statements that are often used to describe the environment of a matrix. Do you agree or disagree? Defend your answer.

a. Project management in a matrix allows for fuller utilization of personnel.
b. The project manager and functional manager must agree on priorities.
c. Decision-making in a matrix requires continual trade-offs on time, cost, technical risk, and uncertainty.

3–15 Assume that you have to select a project organizational form for a small company. For each form described in this chapter, discuss the applicability and state the advantages and disadvantages as they apply to this small company. (You may find it necessary to first determine the business base of the small company.)

3–16 How would each person identified below respond to the question, "How many bosses do you have?"

a. Project manager
b. Functional team member
c. Functional manager

(Repeat for each organizational form discussed in this chapter.)

3–17 If a project were large enough to contain its own resources, would a matrix organizational form be acceptable?

3–18 One of the most common reasons for not wanting to adopt a matrix is the excessive administrative costs and accompanying overhead rates. Would you expect the overhead rates to decrease as the matrix matures? (Disregard other factors that can influence the overhead rates, such as business base, growth rate, etc.)

3–19 Which type of organizational structure is best for R&D personnel to keep in touch with other researchers?

3–20 Which type of organizational form fosters teamwork in the best manner?

3–21 Canadian bankers have been using the matrix organizational structure to create "banking general managers" for all levels of a bank. Does the matrix structure readily admit itself to a banking environment in order to create future managers? Can we consider a branch manager as a matrix project manager?

3–22 A major utility company in Cleveland has what is commonly called "fragmented" project management, where each department maintains project managers through staff positions. The project managers occasionally have to integrate activities that involve departments other than their own. Each project normally requires involvement of several people. The company also has product managers operating out of a rather crude project (product) organizational structure. Recently, the product managers and project managers were competing for resources within the same departments.

To complicate matters further, management has put a freeze on hiring. Last week top management identified 120 different projects that could be undertaken. Unfortunately, under the current structure there are not enough staff project managers available to handle these projects. Also, management would like to make better use of the scarce functional resources.

Staff personnel contend that the solution to the above problems is the establishment of a project management division under which there will be a project management department and a product management department. The staff people feel that under this arrangement better utilization of line personnel will be made, and that each project can be run with fewer staff people, thus providing the opportunity for more projects. Do you agree or disagree, and what problems do you foresee?

3–23 Some organizational structures are considered to be "project-driven." Define what is meant by "project-driven." Which organizational forms described in this chapter would fall under your definition?

3–24 Are there any advantages to having a single project engineer as opposed to having a committee of key functional employees who report to the director of engineering?

3–25 The major difficulty in the selection of a project organizational form involves placement of the project manager. In the evolutionary process, the project manager started out reporting to a department head and ultimately ended up reporting to a senior executive. In general, what were the major reasons for having the project manager report higher and higher in the organizational structure?

3–26 Ralph is a department manager who is quite concerned about the performance of the people beneath him. After several months of analysis, Ralph has won the acceptance of his superiors for setting up a project management structure in his department. Out of the twenty-three departments in the company, his will be the only one with formalized project management. Can this situation be successful even though several projects require interfacing with other departments?

3–27 A large electronics corporation has a multimillion dollar project in which 90 percent of the work stays within one division. The division manager wants to be the project manager. Should this be allowed even though there exists a project management division?

3–28 The internal functioning of an organization must consider:

- The demands imposed on the organization by task complexity
- Available technology
- The external environment
- The needs of the organizational membership

Considering these facts, should an organization search for the one best way to organize under all conditions? Should managers examine the functioning of an organization relative to its needs, or vice versa?

3–29 Project managers, in order to get the job accomplished, need adequate organizational status and authority. One corporate executive contends that an organizational chart such as that in Figure 3–6 can be modified to show that the project managers have adequate authority by placing the department managers in boxes at the top of the functional responsibility arrowheads. The executive further contends that, with this approach, the project managers appear to be higher in the organization than their departmental counterparts but are actually equal in status. Do you agree or disagree with the executive's idea? Will there be a proper balance of power between project and department managers with this organizational structure?

3–30 Defend or attack the following two statements concerning the operation of a matrix:

- There should be no disruption due to dual accountability.
- A difference in judgment should not delay work in progress.

3–31 A company has fifteen projects going on at once. Three projects are over $5 million, seven projects are between $1 million and $3 million, and five projects are between $500,000 and $700,000. Each project has a full-time project manager. Just based upon this information, which organizational form would be best? Can all the project managers report to the same person?

3–32 A major insurance company is considering the implementation of project management. The majority of the projects in the company are two weeks in duration, with very few existing beyond one month. Can project management work here?

3–33 The definition of project management in Section 1.9 identifies project teams and task forces. How would you distinguish between a project team and a task force, and what industries and/or projects would be applicable to each?

3–34 Can informal project management work in a structured environment at the same time as formal project management and share the same resources?

3–35 Several people believe that the matrix structure can be multidimensional (as shown in Figure 3–12). Explain the usefulness of such a structure.

3–36 Many companies have informal project management where work flows horizontally, but in an informal manner. What are the characteristics of informal project management? Which types of companies can operate effectively with informal project management?

3–37 Some companies have tried to develop a matrix within a matrix. Is it possible to have a matrix for formal project control and an internal authority matrix, communication matrix, responsibility matrix, or a combination of several of these?

3–38 Is it possible for a matrix to get out of control because of too many small projects, each competing for the same shared resources? If so, how many projects are too many? How can management control the number of projects? Does your answer depend on whether the organization is project-driven or non–project-driven?

3–39 A government subcontractor operates with a pure specialized product management organizational structure and has four product lines. All employees are required to have a top secret security clearance. The subcontractor's plant is structured such that each of the four product lines occupies a secured area in the building. Employees wear security badges that give them access to the different areas. Most of the employees are authorized to have access only to their area. Only the executives have access to all four areas. For security reasons, functional employees are not permitted to discuss the product lines with each other.

Many of the projects performed in each of the product lines are identical, and severe duplication of efforts exist. Management is interested in converting over to a matrix structure to minimize the duplication of effort. What problems must be overcome before and during matrix implementation?

3–40 A company has decided to go to full project management utilizing a matrix structure. Can the implementation be done in stages? Can the matrix be partially implemented, say, in one portion of the organization, and then gradually expanded across the rest of the company?

3–41 A company has two major divisions, both housed under the same roof. One division is the aerospace group, where all activities are performed within a formal matrix. The second division is the industrial group, which operates with pure product management, except for the MIS department, which has an informal matrix. If both divisions have to share common corporate resources, what problems can occur?

3–42 Several Fortune 100 corporations have a corporate engineering group that assumes the responsibility of the project management–project engineering function for all major capital projects in all divisions worldwide. Explain how the corporate engineering function should work, as well as its advantages and disadvantages.

CASE STUDY

*JONES AND SHEPHARD ACCOUNTANTS, INC.**

By 1990, Jones and Shephard Accountants, Inc. (J&S) was a midsized company and ranked 38th in size by the American Association of Accountants. In order to compete with the larger firms, J&S formed an Information Services Division designed primarily for studies and analyses. By 1995, the Information Services Division (ISD) had fifteen employees.

In 1997, the ISD purchased three largecomputers. With this increased capacity, J&S expanded its services to help satisfy the needs of outside customers. By September 1998, the internal and external workloads had increased to a point where the ISD now employed over fifty people.

The director of the division was very disappointed in the way that activities were being handled. There was no single person assigned to push through a project, and outside customers did not know whom to call to get answers regarding project status. The director found that most of his time was being spent on day-to-day activities such as conflict resolution instead of strategic planning and policy formulation.

The biggest problems facing the director were the two continuous internal projects (called Project X and Project Y, for simplicity) that required month-end data collation and reporting. The director felt that these two projects were important enough to require a full-time project manager on each effort.

* Revised 2007.

In October 1998, corporate management announced that the ISD director would be reassigned on February 1, 1999, and that the announcement of his replacement would not be made until the middle of January. The same week that the announcement was made, two individuals were hired from outside the company to take charge of Project X and Project Y. Exhibit 3–1 shows the organizational structure of the ISD.

Within the next thirty days, rumors spread throughout the organization about who would become the new director. Most people felt that the position would be filled from within the division and that the most likely candidates would be the two new project managers. In addition, the associate director was due to retire in December, thus creating two openings.

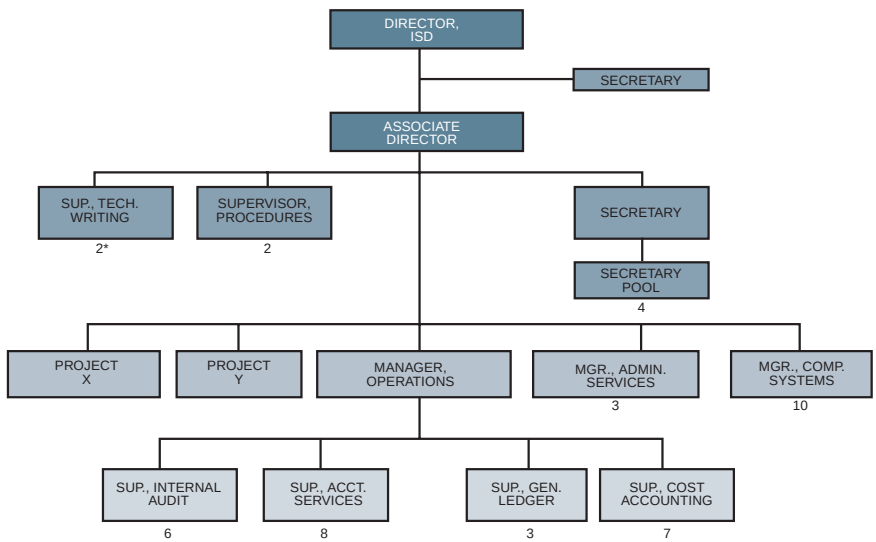
On January 3, 1999, a confidential meeting was held between the ISD director and the systems manager.

ISD Director: "Corporate has approved my request to promote you to division director. Unfortunately, your job will not be an easy one. You're going to have to restructure the organization somehow so that our employees will not have as many conflicts as they are now faced with. My secretary is typing up a confidential memo for you explaining my observations on the problems within our division.

"Remember, your promotion should be held in the strictest confidence until the final announcement later this month. I'm telling you this now so that you can begin planning the restructuring. My memo should help you." (See Exhibit 3–2 for the memo.)

The systems manager read the memo and, after due consideration, decided that some form of matrix would be best. To help him structure the organization properly, an outside consultant

Exhibit 3–1. ISD organizational chart



was hired to help identify the potential problems with changing over to a matrix. The following problem areas were identified by the consultant:

1. The operations manager controls more than 50 percent of the people resources. You might want to break up his empire. This will have to be done very carefully.
2. The secretary pool is placed too high in the organization.
3. The supervisors who now report to the associate director will have to be reassigned lower in the organization if the associate director's position is abolished.
4. One of the major problem areas will be trying to convince corporate management that their change will be beneficial. You'll have to convince them that this change can be accomplished without having to increase division manpower.
5. You might wish to set up a separate department or a separate project for customer relations.
6. Introducing your employees to the matrix will be a problem. Each employee will look at the change differently. Most people have the tendency of looking first at the shift in the balance of power—have I gained or have I lost power and status?

Exhibit 3–2. Confidential memo

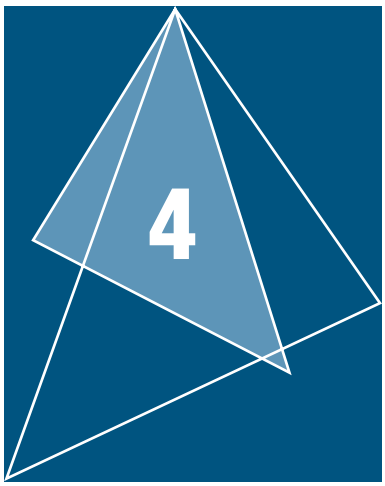
From: **ISD Director**
To: **Systems Manager**
Date: **January 3, 1999**

Congratulations on your promotion to division director. I sincerely hope that your tenure will be productive both personally and for corporate. I have prepared a short list of the major obstacles that you will have to consider when you take over the controls.

1. Both Project X and Project Y managers are highly competent individuals. In the last four or five days, however, they have appeared to create more conflicts for us than we had previously. This could be my fault for not delegating them sufficient authority, or could be a result of the fact that several of our people consider these two individuals as prime candidates for my position. In addition, the operations manager does not like other managers coming into his "empire" and giving direction.
2. I'm not sure that we even need an associate director. That decision will be up to you.
3. Corporate has been very displeased with our inability to work with outside customers. You must consider this problem with any organizational structure you choose.
4. The corporate strategic plan for our division contains an increased emphasis on special, internal MIS projects. Corporate wants to limit our external activities for a while until we get our internal affairs in order.
5. I made the mistake of changing our organizational structure on a day-to-day basis. Perhaps it would have been better to design a structure that could satisfy advanced needs, especially one that we can grow into.

The systems manager evaluated the consultant's comments and then prepared a list of questions to ask the consultant at their next meeting:

1. What should the new organizational structure look like? Where should I put each person, specifically the managers?
2. When should I announce the new organizational change? Should it be at the same time as my appointment or at a later date?
3. Should I invite any of my people to provide input to the organizational restructuring? Can this be used as a technique to ease power plays?
4. Should I provide inside or outside seminars to train my people for the new organizational structure? How soon should they be held?



Organizing and Staffing the Project Office and Team

Related Case Studies (from Kerzner/*Project Management Case Studies*, 3rd Edition)	Related Workbook Exercises (from Kerzner/*Project Management Workbook and PMP®/CAPM® Exam Study Guide*, 10th Edition)	PMBOK® Guide, 4th Edition, Reference Section for the PMP® Certification Exam
• Government Project Management • Falls Engineering • White Manufacturing • Martig Construction Company • Ducor Chemical • The Carlson Project	• The Bad Apple • Multiple Choice Exam	• Human Resource Management

4.0 INTRODUCTION

PMBOK® Guide, 4th Edition
Chapter 9 Human Resource Management

Successful project management, regardless of the organizational structure, is only as good as the individuals and leaders who are managing the key functions. Project management is not a one-person operation; it requires a group of individuals dedicated to the achievement of a specific goal. Project management includes:

- A project manager
- An assistant project manager

- A project (home) office
- A project team

Generally, project office personnel are assigned full-time to the project and work out of the project office, whereas the project team members work out of the functional units and may spend only a small percentage of their time on the project. Normally, project office personnel report directly to the project manager, but they may still be solid to their line function just for administrative control. A project office usually is not required on small projects, and sometimes the project can be accomplished by just one person who may fill all of the project office positions.

Before the staffing function begins, five basic questions are usually considered:

- What are the requirements for an individual to become a successful project manager?
- Who should be a member of the project team?
- Who should be a member of the project office?
- What problems can occur during recruiting activities?
- What can happen downstream to cause the loss of key team members?

On the surface, these questions may not seem especially complex. But when we apply them to a project environment (which is by definition a "temporary" situation) where a constant stream of projects is necessary for corporate growth, the staffing problems become complex, especially if the organization is understaffed.

4.1 THE STAFFING ENVIRONMENT

PMBOK® Guide, 4th Edition
9.1 Human Resource Planning

To understand the problems that occur during staffing, we must first investigate the characteristics of project management, including the project environment, the project management process, and the project manager.

Two major kinds of problems are related to the project environment: personnel performance problems and personnel policy problems. Performance is difficult for many individuals in the project environment because it represents a change in the way of doing business. Individuals, regardless of how competent they are, find it difficult to adapt continually to a changing situation in which they report to multiple managers.

On the other hand, many individuals thrive on temporary assignments because it gives them a "chance for glory." Unfortunately, some employees might consider the chance for glory more important than the project. For example, an employee may pay no attention to the instructions of the project manager and instead perform the task his own way. In this situation, the employee wants only to be recognized as an achiever and really does not care if the project is a success or failure, as long as he still has a functional home to return to where he will be identified as an achiever with good ideas.

The second major performance problem lies in the project–functional interface, where an individual suddenly finds himself reporting to two bosses, the functional manager and the project manager. If the functional manager and the project manager are in agreement about the work to be accomplished, then performance may not be hampered. But if conflicting

directions are received, then the individual may let his performance suffer because of his compromising position. In this case, the employee will "bend" in the direction of the manager who controls his purse strings.

Personnel policy problems can create havoc in an organization, especially if the "grass is greener" in a project environment than in the functional environment. Functional organizations normally specify grades and salaries for employees. Project offices, on the other hand, have no such requirements and can promote and pay according to achievement. The difficulty here is that one can distinguish between employees in grades 7, 8, 9, 10, and 11 in a line organization, whereas for a project manager the distinction might appear only in the size of the project or the amount of responsibility. Bonuses are also easier to obtain in the project office but may create conflict and jealousy between the horizontal and vertical elements.

Because each project is different, the project management process allows each project to have its own policies, procedures, rules, and standards, provided they fall within broad company guidelines. Each project must be recognized as a project by top management so that the project manager has the delegated authority necessary to enforce the policies, procedures, rules, and standards.

Project management is successful only if the project manager and his team are totally dedicated to the successful completion of the project. This requires each team member of the project team and office to have a good understanding of the fundamental project requirements, which include:

- Customer liaison
- Project direction
- Project planning
- Project control
- Project evaluation
- Project reporting

Ultimately, the person with the greatest influence during the staffing phase is the project manager. The personal attributes and abilities of project managers will either attract or deter highly desirable individuals. Basic characteristics include:

- Honesty and integrity
- Understanding of personnel problems
- Understanding of project technology
- Business management competence
  - Management principles
  - Communications
- Alertness and quickness
- Versatility
- Energy and toughness
- Decision-making ability
- Ability to evaluate risk and uncertainty

Project managers must exhibit honesty and integrity to foster an atmosphere of trust. They should not make impossible promises, such as immediate promotions for everyone if a follow-on contract is received. Also, on temporarily assigned activities, such as a

project, managers cannot wait for personnel to iron out their own problems because time, cost, and performance requirements will not be satisfied.

Project managers should have both business management and technical expertise. They must understand the fundamental principles of management, especially those involving the rapid development of temporary communication channels. Project managers must understand the technical implications of a problem, since they are ultimately responsible for all decision-making. However, many good technically oriented managers have failed because they have become too involved with the technical side of the project rather than the management side. There are strong arguments for having a project manager who has more than just an understanding of the necessary technology.

Because a project has a relatively short time duration, decision-making must be rapid and effective. Managers must be alert and quick in their ability to perceive "red flags" that can eventually lead to serious problems. They must demonstrate their versatility and toughness in order to keep subordinates dedicated to goal accomplishment. Executives must realize that the project manager's objectives during staffing are to:

- Acquire the best available assets and try to improve them
- Provide a good working environment for all personnel
- Make sure that all resources are applied effectively and efficiently so that all constraints are met, if possible

4.2 SELECTING THE PROJECT MANAGER: AN EXECUTIVE DECISION

PMBOK® Guide, 4th Edition
9.2.1 Acquire Project Team
9.3.1 General Management Skills

Probably the most difficult decision facing upper-level management is the selection of project managers. Some managers work best on long-duration projects where decision-making can be slow; others may thrive on short-duration projects that can result in a constant-pressure environment. A director was asked whom he would choose for a key project manager position—an individual who had been a project manager on previous programs in which there were severe problems and cost overruns, or a new aggressive individual who might have the capability to be a good project manager but had never had the opportunity. The director responded that he would go with the seasoned veteran assuming that the previous mistakes would not be made again. The argument here is that the project manager must learn from his own mistakes so they will not be made again. The new individual is apt to make the same mistakes the veteran made. However, this may limit career path opportunities for younger personnel. Stewart has commented on the importance of experience[1]:

> Though the project manager's previous experience is apt to have been confined to a single functional area of business, he must be able to function on the project as a kind of general

1. John M. Stewart, "Making Project Management Work." Reprinted with permission from *Business Horizons*, Fall 1965, p. 63. Copyright © 1965 by the Board of Trustees at Indiana University.

manager in miniature. He must not only keep track of what is happening but also play the crucial role of advocate for the project. Even for a seasoned manager, this task is not likely to be easy. Hence, it is important to assign an individual whose administrative abilities and skills in personal relations have been convincingly demonstrated under fire.

The selection process for project managers is not easy. Five basic questions must be considered:

- What are the internal and external sources?
- How do we select?
- How do we provide career development in project management?
- How can we develop project management skills?
- How do we evaluate project management performance?

Project management cannot succeed unless a good project manager is at the controls. It is far more likely that project managers will succeed if it is obvious to the subordinates that the general manager has appointed them. Usually, a brief memo to the line managers will suffice. The major responsibilities of the project manager include:

- To produce the end-item with the available resources and within the constraints of time, cost, and performance/technology
- To meet contractual profit objectives
- To make all required decisions whether they be for alternatives or termination
- To act as the customer (external) and upper-level and functional management (internal) communications focal point
- To "negotiate" with all functional disciplines for accomplishment of the necessary work packages within the constraints of time, cost, and performance/technology
- To resolve all conflicts

If these responsibilities were applied to the total organization, they might reflect the job description of the general manager. This analogy between project and general managers is one of the reasons why future general managers are asked to perform functions that are implied, rather than spelled out, in the job description. As an example, you are the project manager on a high-technology project. As the project winds down, an executive asks you to write a paper so that he can present it at a technical meeting in Tokyo. His name will appear first on the paper. Should this be a part of your job? As this author sees it, you really don't have much of a choice.

In order for project managers to fulfill their responsibilities successfully, they are constantly required to demonstrate their skills in interface, resource, and planning and control management. These implicit responsibilities are shown below:

- Interface Management
  - Product interfaces
    - Performance of parts or subsections
    - Physical connection of parts or subsections
  - Project interfaces
  - Customer
  - Management (functional and upper-level)

  - Change of responsibilities
  - Information flow
  - Material interfaces (inventory control)
- Resource Management
  - Time (schedule)
  - Manpower
  - Money
  - Facilities
  - Equipment
  - Material
  - Information/technology
- Planning and Control Management
  - Increased equipment utilization
  - Increased performance efficiency
  - Reduced risks
  - Identification of alternatives to problems
  - Identification of alternative resolutions to conflicts

Consider the following advertisement for a facilities planning and development project manager (adapted from *The New York Times*, January 2, 1972):

> Personable, well-educated, literate individual with college degree in Engineering to work for a small firm. Long hours, no fringe benefits, no security, little chance for advancement are among the inducements offered. Job requires wide knowledge and experience in manufacturing, materials, construction techniques, economics, management and mathematics. Competence in the use of the spoken and written English is required. Must be willing to suffer personal indignities from clients, professional derision from peers in the more conventional jobs, and slanderous insults from colleagues.
>
> Job involves frequent extended trips to inaccessible locations throughout the world, manual labor and extreme frustration from the lack of data on which to base decisions.
>
> Applicant must be willing to risk personal and professional future on decisions based upon inadequate information and complete lack of control over acceptance of recommendations by clients. Responsibilities for the work are unclear and little or no guidance is offered. Authority commensurate with responsibility is not provided either by the firm or its clients.
>
> Applicant should send resume, list of publications, references and other supporting documentation to. . . .

Fortunately, these types of job descriptions are very rare today.

Finding the person with the right qualifications is not an easy task because the selection of project managers is based more on personal characteristics than on the job description. In Section 4.1 a brief outline of desired characteristics was presented. Russell Archibald defines a broader range of desired personal characteristics[2]:

- Flexibility and adaptability
- Preference for significant initiative and leadership

2. Russell D. Archibald, *Managing High-Technology Programs and Projects* (New York: Wiley, 1976), p. 55.

PMBOK® Guide, 4th Edition
9.3 Develop Project Team

- Aggressiveness, confidence, persuasiveness, verbal fluency
- Ambition, activity, forcefulness
- Effectiveness as a communicator and integrator
- Broad scope of personal interests
- Poise, enthusiasm, imagination, spontaneity
- Able to balance technical solutions with time, cost, and human factors
- Well organized and disciplined
- A generalist rather than a specialist
- Able and willing to devote most of his time to planning and controlling
- Able to identify problems
- Willing to make decisions
- Able to maintain proper balance in the use of time

This ideal project manager would probably have doctorates in engineering, business, and psychology, and experience with ten different companies in a variety of project office positions, and would be about twenty-five years old. Good project managers in industry today would probably be lucky to have 70 to 80 percent of these characteristics. The best project managers are willing and able to identify their own shortcomings and know when to ask for help.

The difficulty in staffing, especially for project managers or assistant project managers, is in determining what questions to ask during an interview to see if an individual has the necessary or desired characteristics. Individuals may be qualified to be promoted vertically but not horizontally. An individual with poor communication skills and interpersonal skills can be promoted to a line management slot because of his technical expertise, but this same individual is not qualified for project management promotion.

One of the best ways to interview is to read each element of the job description to the potential candidate. Many individuals want a career path in project management but are totally unaware of what the project manager's duties are.

So far we have discussed the personal characteristics of the project manager. There are also job-related questions to consider, such as:

- Are feasibility and economic analyses necessary?
- Is complex technical expertise required? If so, is it within the individual's capabilities?
- If the individual is lacking expertise, will there be sufficient backup strength in the line organizations?
- Is this the company's or the individual's first exposure to this type of project and/or client? If so, what are the risks to be considered?
- What is the priority for this project, and what are the risks?
- With whom must the project manager interface, both inside and outside the organization?

Most good project managers know how to perform feasibility studies and cost-benefit analyses. Sometimes these studies create organizational conflict. A major utility

company begins each computer project with a feasibility study in which a cost-benefit analysis is performed. The project managers, all of whom report to a project management division, perform the study themselves without any direct functional support. The functional managers argue that the results are grossly inaccurate because the functional experts are not involved. The project managers, on the other hand, argue that they never have sufficient time or money to perform a complete analysis. Some companies resolve this by having a special group perform these studies.

Most companies would prefer to find project managers from within. Unfortunately, this is easier said than done.

There are also good reasons for recruiting from outside the company. A new project manager hired from the outside would be less likely to have strong informal ties to any one line organization and thus could be impartial. Some companies further require that the individual spend an apprenticeship period of twelve to eighteen months in a line organization to find out how the company functions, to become acquainted with the people, and to understand the company's policies and procedures.

One of the most important but often least understood characteristics of good project managers is the ability to know their own strengths and weaknesses and those of their employees. Managers must understand that in order for employees to perform efficiently:

- They must know what they are supposed to do.
- They must have a clear understanding of authority and its limits.
- They must know what their relationship with other people is.
- They should know what constitutes a job well done in terms of specific results.
- They should know where and when they are falling short.
- They must be made aware of what can and should be done to correct unsatisfactory results.
- They must feel that their superior has an interest in them as individuals.
- They must feel that their superior believes in them and wants them to succeed.

4.3 SKILL REQUIREMENTS FOR PROJECT AND PROGRAM MANAGERS

PMBOK® Guide, 4th Edition
Chapter 9 Human Resources Management
9.3.2.1 Interpersonal Skills
1.4.2 Program Management

Managing complex programs represents a challenge requiring skills in team building, leadership, conflict resolution, technical expertise, planning, organization, entrepreneurship, administration, management support, and the allocation of resources. This section examines these skills relative to program management effectiveness. A key factor to good program performance is the program manager's ability to integrate personnel from many disciplines into an effective work team.

To get results, the program manager must relate to (1) the people to be managed, (2) the task to be done, (3) the tools available, (4) the organizational structure, and (5) the organizational environment, including the customer community.

With an understanding of the interaction of corporate organization and behavior elements, the manager can build an environment conducive to the working team's needs. The

internal and external forces that impinge on the organization of the project must be reconciled to mutual goals. Thus the program manager must be both socially and technically aware to understand how the organization functions and how these functions will affect the program organization of the particular job to be done. In addition, the program manager must understand the culture and value system of the organization he is working with. Effective program management is directly related to proficiency in these ten skills:

- Team building
- Leadership
- Conflict resolution
- Technical expertise
- Planning
- Organization
- Entrepreneurship
- Administration
- Management support
- Resource allocation

It is important that the personal management style underlying these skills facilitate the integration of multidisciplinary program resources for synergistic operation. The days of the manager who gets by with technical expertise alone or pure administrative skills are gone.

Team-Building Skills

Building the program team is one of the prime responsibilities of the program manager. Team building involves a whole spectrum of management skills required to identify, commit, and integrate the various task groups from the traditional functional organization into a single program management system.

To be effective, the program manager must provide an atmosphere conducive to teamwork. He must nurture a climate with the following characteristics:

- Team members committed to the program
- Good interpersonal relations and team spirit
- The necessary expertise and resources
- Clearly defined goals and program objectives
- Involved and supportive top management
- Good program leadership
- Open communication among team members and support organizations
- A low degree of detrimental interpersonal and intergroup conflict

Three major considerations are involved in all of the above factors: (1) effective communications, (2) sincere interest in the professional growth of team members, and (3) commitment to the project.

Leadership Skills

A prerequisite for program success is the program manager's ability to lead the team within a relatively unstructured environment. It involves

dealing effectively with managers and supporting personnel across functional lines and the ability to collect and filter relevant data for decision-making in a dynamic environment. It involves the ability to integrate individual demands, requirements, and limitations into decisions and to resolve intergroup conflicts.

As with a general manager, quality leadership depends heavily on the program manager's personal experience and credibility within the organization. An effective management style might be characterized this way:

- Clear project leadership and direction
- Assistance in problem-solving
- Facilitating the integration of new members into the team
- Ability to handle interpersonal conflict
- Facilitating group decisions
- Capability to plan and elicit commitments
- Ability to communicate clearly
- Presentation of the team to higher management
- Ability to balance technical solutions against economic and human factors

The personal traits desirable and supportive of the above skills are:

- Project management experience
- Flexibility and change orientation
- Innovative thinking
- Initiative and enthusiasm
- Charisma and persuasiveness
- Organization and discipline

Conflict Resolution Skills

Conflict is fundamental to complex task management. Understanding the determinants of conflicts is important to the program manager's ability to deal with conflicts effectively. When conflict becomes dysfunctional, it often results in poor program decision-making, lengthy delays over issues, and a disruption of the team's efforts, all negative influences to program performance. However, conflict can be beneficial when it produces involvement and new information and enhances the competitive spirit.

To successfully resolve conflict and improve overall program performance, program managers must:

- Understand interaction of the organizational and behavioral elements in order to build an environment conducive to their team's motivational needs. This will enhance active participation and minimize unproductive conflict.
- Communicate effectively with all organizational levels regarding both project objectives and decisions. Regularly scheduled status review meetings can be an important communication vehicle.
- Recognize the determinants of conflict and their timing in the project life cycle. Effective project planning, contingency planning, securing of commitments, and

involving top management can help to avoid or minimize many conflicts before they impede project performance.

The accomplished manager needs a "sixth sense" to indicate when conflict is desirable, what kind of conflict will be useful, and how much conflict is optimal for a given situation. In the final analysis, he has the sole responsibility for his program and how conflict will contribute to its success or failure.

Technical Skills

The program manager rarely has all the technical, administrative, and marketing expertise needed to direct the program single-handedly. It is essential, however, for the program manager to understand the technology, the markets, and the environment of the business. Without this understanding, the consequences of local decisions on the total program, the potential growth ramifications, and relationships to other business opportunities cannot be foreseen by the manager. Further technical expertise is necessary to evaluate technical concepts and solutions, to communicate effectively in technical terms with the project team, and to assess risks and make trade-offs between cost, schedule, and technical issues. This is why in complex problem-solving situations so many project managers must have an engineering background.

Technical expertise is composed of an understanding of the:

- Technology involved
- Engineering tools and techniques employed
- Specific markets, their customers, and requirements
- Product applications
- Technological trends and evolutions
- Relationship among supporting technologies
- People who are part of the technical community

The technical expertise required for effective management of engineering programs is normally developed through progressive growth in engineering or supportive project assignments in a specific technology area. Frequently, the project begins with an exploratory phase leading into a proposal. This is normally an excellent testing ground for the future program manager. It also allows top management to judge the new candidate's capacity for managing the technological innovations and integration of solutions.

Planning Skills

Planning skills are helpful for any undertaking; they are absolutely essential for the successful management of large complex programs. The project plan is the road map that defines how to get from the start to the final results.

Program planning is an ongoing activity at all organizational levels. However, the preparation of a project summary plan, prior to project start, is the responsibility of the program manager. Effective project planning requires particular skills far beyond writing a document with schedules and budgets. It requires communication and information processing skills to define the actual resource requirements and administrative support

necessary. It requires the ability to negotiate the necessary resources and commitments from key personnel in various support organizations with little or no formal authority.

Effective planning requires skills in the areas of:

- Information processing
- Communication
- Resource negotiations
- Securing commitments
- Incremental and modular planning
- Assuring measurable milestones
- Facilitating top management involvement

In addition, the program manager must assure that the plan remains a viable document. Changes in project scope and depth are inevitable. The plan should reflect necessary changes through formal revisions and should be the guiding document throughout the life cycle of the program. An obsolete or irrelevant plan is useless.

Finally, program managers need to be aware that planning can be overdone. If not controlled, planning can become an end in itself and a poor substitute for innovative work. It is the responsibility of the program manager to build flexibility into the plan and police it against misuse.

Organizational Skills

The program manager must be a social architect; that is, he must understand how the organization works and how to work with the organization. Organizational skills are particularly important during project formation and startup when the program manager is integrating people from many different disciplines into an effective work team. It requires defining the reporting relationships, responsibilities, lines of control, and information needs. A good program plan and a task matrix are useful organizational tools. In addition, the organizational effort is facilitated by clearly defined program objectives, open communication channels, good program leadership, and senior management support.

Entrepreneurial Skills

The program manager also needs a general management perspective. For example, economic considerations affect the organization's financial performance, but objectives often are much broader than profits. Customer satisfaction, future growth, cultivation of related market activities, and minimum organizational disruptions of other programs might be equally important goals. The effective program manager is concerned with all these issues.

Entrepreneurial skills are developed through actual experience. However, formal MBA-type training, special seminars, and cross-functional training programs can help to develop the entrepreneurial skills needed by program managers.

Administrative Skills

Administrative skills are essential. The program manager must be experienced in planning, staffing, budgeting, scheduling, and other

control techniques. In dealing with technical personnel, the problem is seldom to make people understand administrative techniques such as budgeting and scheduling, but to impress on them that costs and schedules are just as important as elegant technical solutions.

Particularly on larger programs, managers rarely have all the administrative skills required. While it is important that program managers understand the company's operating procedures and available tools, it is often necessary for the program manager to free himself from administrative details regardless of his ability to handle them. He has to delegate considerable administrative tasks to support groups or hire a project administrator.

Some helpful tools for the manager in the administration of his program include: (1) the meeting, (2) the report, (3) the review, and (4) budget and schedule controls. Program managers must be thoroughly familiar with these available tools and know how to use them effectively.

Management Support Building Skills

The program manager is surrounded by a myriad of organizations that either support him or control his activities. An understanding of these interfaces is important to program managers as it enhances their ability to build favorable relationships with senior management. Project organizations are shared-power systems with personnel of many diverse interests and "ways of doing things." Only a strong leader backed by senior management can prevent the development of unfavorable biases.

Four key variables influence the project manager's ability to create favorable relationships with senior management: (1) his ongoing credibility, (2) the visibility of his program, (3) the priority of his program relative to other organizational undertakings, and (4) his own accessibility.

Resource Allocation Skills

A program organization has many bosses. Functional lines often shield support organizations from direct financial control by the project office. Once a task has been authorized, it is often impossible to control the personnel assignments, priorities, and indirect manpower costs. In addition, profit accountability is difficult owing to the interdependencies of various support departments and the often changing work scope and contents.

Effective and detailed program planning may facilitate commitment and reinforce control. Part of the plan is the "Statement of Work," which establishes a basis for resource allocation. It is also important to work out specific agreements with all key contributors and their superiors on the tasks to be performed and the associated budgets and schedules. Measurable milestones are not only important for hardware components, but also for the "invisible" program components such as systems and software tasks. Ideally, these commitments on specs, schedules, and budgets should be established through involvement by key personnel in the early phases of project formation, such as the proposal phase. This is the time when requirements are still flexible, and trade-offs among performance, schedule, and budget parameters are possible. Further, this is normally the time when the competitive spirit among potential contributors is highest, often leading to a more cohesive and challenging work plan.

4.4 SPECIAL CASES IN PROJECT MANAGER SELECTION

Thus far we have assumed that the project is large enough for a full-time project manager to be appointed. This is not always the case. There are four major problem areas in staffing projects:

- Part-time versus full-time assignments
- Several projects assigned to one project manager
- Projects assigned to functional managers
- The project manager role retained by the general manager

The first problem is generally related to the size of the project. If the project is small (in time duration or cost), a part-time project manager may be selected. Many executives have fallen into the trap of letting line personnel act as part-time project managers while still performing line functions. If the employee has a conflict between what is best for the project and what is best for his line organization, the project will suffer. It is only natural that the employee will favor the place the salary increases come from.

It is a common practice for one project manager to control several projects, especially if they are either related or similar. Problems come about when the projects have drastically different priorities. The low-priority efforts will be neglected.

If the project is a high-technology effort that requires specialization and can be performed by one department, then it is not unusual for the line manager to take on a dual role and act as project manager as well. This can be difficult to do, especially if the project manager is required to establish the priorities for the work under his supervision. The line manager may keep the best resources for the project, regardless of the priority. Then that project will be a success at the expense of every other project he must supply resources to.

Probably the worst situation is that in which an executive fills the role of project manager for a particular effort. The executive may not have the time necessary for total dedication to the achievement of the project. He cannot make effective decisions as a project manager while still discharging normal duties. Additionally, the executive may hoard the best resources for his project.

4.5 SELECTING THE WRONG PROJECT MANAGER

Even though executives know the personal characteristics and traits that project managers should possess, and even though job descriptions are often clearly defined, management may still select the wrong person because they base their decision on the following criteria.

Maturity

Some executives consider gray hair to be a sure indication of maturity, but this is not the type of maturity needed for project management. Maturity in project management generally comes from exposure to several types of projects

in a variety of project office positions. In aerospace and defense, it is possible for a project manager to manage the same type of project for ten years or more. When placed on a new project, the individual may try to force personnel and project requirements to adhere to the same policies and procedures that existed on the ten-year project. The project manager may know only one way of managing projects.

Hard-Nosed Tactics

Applying hard-nosed tactics to subordinates can be very demoralizing. Project managers must give people sufficient freedom to get the job done, without providing continuous supervision and direction. A line employee who is given "freedom" by his line manager but suddenly finds himself closely supervised by the project manager will be very unhappy.

Line managers, because of their ability to control an employee's salary, need only one leadership style and can force the employees to adapt. The project manager, on the other hand, cannot control salaries and must have a wide variety of leadership styles. The project manager must adapt a leadership style to the project employees, whereas the reverse is true in the line organization.

Availability

Executives should not assign individuals as project managers simply because of availability. People have a tendency to cringe when you suggest that project managers be switched halfway through a project. For example, manager X is halfway through his project. Manager Y is waiting for an assignment. A new project comes up, and the executive switches managers X and Y. There are several reasons for this. The most important phase of a project is planning, and, if it is accomplished correctly, the project could conceivably run itself. Therefore, manager Y should be able to handle manager X's project.

There are several other reasons why this switch may be necessary. The new project may have a higher priority and require a more experienced manager. Second, not all project managers are equal, especially when it comes to planning. When an executive finds a project manager who demonstrates extraordinary talents at planning, there is a natural tendency for the executive to want this project manager to plan all projects.

Technical Expertise

Executives quite often promote technical line managers without realizing the consequences. Technical specialists may not be able to divorce themselves from the technical side of the house and become project managers rather than project doers. There are also strong reasons to promote technical specialists to project managers. These people often:

- Have better relationships with fellow researchers
- Can prevent duplication of effort
- Can foster teamwork
- Have progressed up through the technical ranks
- Are knowledgeable in many technical fields
- Understand the meaning of profitability and general management philosophy

- Are interested in training and teaching
- Understand how to work with perfectionists

Promoting an employee to project management because of his technical expertise may be acceptable if, and only if, the project requires this expertise and technical direction, as in R&D efforts. For projects in which a "generalist" is acceptable as a project manager, there may be a great danger in assigning highly technical personnel. According to Wilemon and Cicero[3]:

- The greater the project manager's technical expertise, the higher the propensity that he will overly involve himself in the technical details of the project.
- The greater the project manager's difficulty in delegating technical task responsibilities, the more likely it is that he will overinvolve himself in the technical details of the project. (Depending upon his expertise to do so.)
- The greater the project manager's interest in the technical details of the project, the more likely it is that he will defend the project manager's role as one of a technical specialist.
- The lower the project manager's technical expertise, the more likely it is that he will overstress the nontechnical project functions (administrative functions).

Customer Orientation

Executives quite often place individuals as project managers simply to satisfy a customer request. Being able to communicate with the customer does not guarantee project success, however. If the choice of project manager is simply a concession to the customer, then the executive must insist on providing a strong supporting team.

New Exposure

Executives run the risk of project failure if an individual is appointed project manager simply to gain exposure to project management. An executive of a utility company wanted to rotate his line personnel into project management for twelve to eighteen months and then return them to the line organization where they would be more well-rounded individuals and better understand the working relationship between project management and line management. There are two major problems with this. First, the individual may become technically obsolete after eighteen months in project management. Second, and more important, individuals who get a taste of project management will generally not want to return to the line organization.

Company Exposure

The mere fact that individuals have worked in a variety of divisions does not guarantee that they will make good project managers. Their working in a variety of divisions may indicate that they couldn't hold any one job. In that case, they have reached their true level of incompetency, and putting them into project

3. D. L. Wilemon and J. P. Cicero, "The Project Manager—Anomalies and Ambiguities," *Academy of Management Journal*, Vol. 13, 1970, pp. 269–282.

TABLE 4–1. METHODS AND TECHNIQUES FOR DEVELOPING PROJECT MANAGERS

I.	Experiential training/on-the-job
	Working with experienced professional leader
	Working with project team member
	Assigning a variety of project management responsibilities, consecutively
	Job rotation
	Formal on-the-job training
	Supporting multifunctional activities
	Customer liaison activities
II.	Conceptual training/schooling
	Courses, seminars, workshops
	Simulations, games, cases
	Group exercises
	Hands-on exercises in using project management techniques
	Professional meetings
	Conventions, symposia
	Readings, books, trade journals, professional magazines
III.	Organizational development
	Formally established and recognized project management function
	Proper project organization
	Project support systems
	Project charter
	Project management directives, policies, and procedures

management will only maximize the damage they can do to the company. Some executives contend that the best way to train a project manager is by rotation through the various functional disciplines for two weeks to a month in each organization. Other executives maintain that this is useless because the individual cannot learn anything in so short a period of time.

Tables 4–1 and 4–2 identify current thinking on methods for training project managers.

Finally, there are three special points to consider:

- Individuals should not be promoted to project management simply because they are at the top of their pay grade.
- Project managers should be promoted and paid based on performance, not on the number of people supervised.
- It is not necessary for the project manager to be the highest ranking or salaried individual on the project team with the rationale that sufficient "clout" is needed.

TABLE 4–2. HOW TO TRAIN PROJECT MANAGERS

Company Management Say Project Managers Can Be Trained in a Combination of Ways:	
Experiential learning, on-the-job	60%
Formal education and special courses	20%
Professional activities, seminars	10%
Readings	10%

4.6 NEXT GENERATION PROJECT MANAGERS

The skills needed to be an effective, twenty-first century project manager have changed from those needed during the 1980s. Historically, only engineers were given the opportunity to become project managers. The belief was that the project manager had to have a command of technology in order to make all of the technical decisions. As projects became larger and more complex, it became obvious that project managers might need simply an understanding rather than a command of technology. The true technical expertise would reside with the line managers, except for special situations such as R&D project management.

As project management began to grow and mature, the project manager was converted from a technical manager to a business manager. The primary skills needed to be an effective project manager in the twenty-first century are:

- Knowledge of the business
- Risk management
- Integration skills

The critical skill is risk management. However, to perform risk management effectively, a sound knowledge of the business is required. Figure 4–1 shows the changes in project management skills needed between 1985 and 2008.

As projects become larger, the complexities of integration management become more pronounced. Figure 4–2 illustrates the importance of integration management. In 1985, project managers spent most of their time planning and replanning with their team. This was necessary because the project manager was the technical expert. Today, line managers are the technical experts and perform the majority of the planning and replanning within their line. The project manager's efforts are now heavily oriented toward integration of the

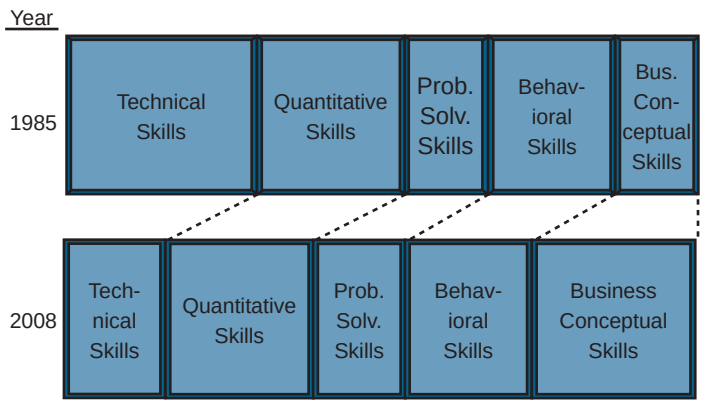


FIGURE 4–1. Project management skills.

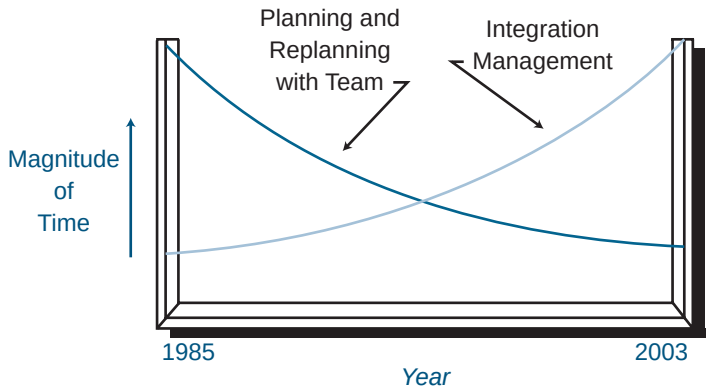


FIGURE 4–2. How do project managers spend their time?

function plans into a total project plan. Some people contend that, with the increased risks and complexities of integration management, the project manager of the future will become an expert in damage control.

4.7 DUTIES AND JOB DESCRIPTIONS

Since projects, environments, and organizations differ from company to company as well as project to project, it is not unusual for companies to struggle to provide reasonable job descriptions of the project manager and associated personnel. Below is a simple list identifying the duties of a project manager in the construction industry[4]:

- Planning
  - Become completely familiar with all contract documents
  - Develop the basic plan for executing and controlling the project
  - Direct the preparation of project procedures
  - Direct the preparation of the project budget
  - Direct the preparation of the project schedule
  - Direct the preparation of basic project design criteria and general specifications
  - Direct the preparation of the plan for organizing, executing, and controlling field construction activities
  - Review plans and procedures periodically and institute changes if necessary

4. Source unknown.

- Organizing
  - Develop organization chart for project
  - Review project position descriptions, outlining duties, responsibilities, and restrictions for key project supervisors
  - Participate in the selection of key project supervisors
  - Develop project manpower requirements
  - Continually review project organization and recommend changes in organizational structure and personnel, if necessary
- Directing
  - Direct all work on the project that is required to meet contract obligations
  - Develop and maintain a system for decision-making within the project team whereby decisions are made at the proper level
  - Promote the growth of key project supervisors
  - Establish objectives for project manager and performance goals for key project supervisors
  - Foster and develop a spirit of project team effort
  - Assist in resolution of differences or problems between departments or groups on assigned projects
  - Anticipate and avoid or minimize potential problems by maintaining current knowledge of overall project status
  - Develop clear written strategy guidelines for all major problems with clear definitions of responsibilities and restraints
- Controlling
  - Monitor project activities for compliance with company purpose and philosophy and general corporate policies
  - Interpret, communicate, and require compliance with the contract, the approved plan, project procedures, and directives of the client
  - Maintain personal control of adherence to contract warranty and guarantee provisions
  - Closely monitor project activities for conformity to contract scope provisions. Establish change notice procedure to evaluate and communicate scope changes
  - See that the plans for controlling and reporting on costs, schedule, and quality are effectively utilized
  - Maintain effective communications with the client and all groups performing project work

A more detailed job description of a construction project manager (for a utility company) appears below:

Duties

Under minimum supervision establishes the priorities for and directs the efforts of personnel (including their consultants or contractors) involved or to be involved on

project controlled tasks to provide required achievement of an integrated approved set of technical, manpower, cost, and schedule requirements.

1. Directs the development of initial and revised detailed task descriptions and forecasts of their associated technical, manpower, cost, and schedule requirements for tasks assigned to the Division.
2. Directs the regular integration of initial and revised task forecasts into Divisional technical, manpower, cost, and schedule reports and initiates the approval cycle for the reports.
3. Reviews conflicting inter- and extra-divisional task recommendations or actions that may occur from initial task description and forecast development until final task completion and directs uniform methods for their resolution.
4. Evaluates available and planned additions to Division manpower resources, including their tasks applications, against integrated technical and manpower reports and initiates actions to assure that Division manpower resources needs are met by the most economical mix of available qualified consultant and contractor personnel.
5. Evaluates Divisional cost and schedule reports in light of new tasks and changes in existing tasks and initiates actions to assure that increases or decreases in task cost and schedule are acceptable and are appropriately approved.
6. Prioritizes, adjusts, and directs the efforts of Division personnel (including their consultants and contractors) resource allocations as necessary to both assure the scheduled achievement of state and federal regulatory commitments and maintain Divisional adherence to integrated manpower, cost, and schedule reports.
7. Regularly reports the results of Divisional manpower, cost, and schedule evaluations to higher management.
8. Regularly directs the development and issue of individual task and integrated Project programs reports.
9. Recommends new or revised Division strategies, goals, and objectives in light of anticipated long-term manpower and budget needs.
10. Directly supervises project personnel in the regular preparation and issue of individual task descriptions and their associated forecasts, integrated Division manpower, cost, and schedule reports, and both task and Project progress reports.
11. Establishes basic organizational and personnel qualification requirements for Division (including their consultants or contractors) performance on tasks.
12. Establishes the requirements for, directs the development of, and approves control programs to standardize methods used for controlling similar types of activities in the Project and in other Division Departments.
13. Establishes the requirements for, directs the development of, and approves administrative and technical training programs for Divisional personnel.
14. Approves recommendations for the placement of services or material purchase orders by Division personnel and assures that the cost and schedule data associated with such orders is consistent with approved integrated cost and schedule reports.
15. Promotes harmonious relations among Division organizations involved with Project tasks.
16. Exercises other duties related to Divisional project controls as assigned by the project manager.

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TABLE 4–3. PROJECT MANAGEMENT POSITIONS AND RESPONSIBILITIES

Project Management Position	Typical Responsibility	Skill Requirements
• Project Administrator • Project Coordinator • Technical Assistant	Coordinating and integrating of subsystem tasks. Assisting in determining technical and manpower requirements, schedules, and budgets. Measuring and analyzing project performance regarding technical progress, schedules, and budgets.	• Planning • Coordinating • Analyzing • Understanding the organization
• Task Manager • Project Engineer • Assistant Project Manager	Same as above, but stronger role in establishing and maintaining project requirements. Conducting trade-offs. Directing the technical implementation according to established schedules and budgets.	• Technical expertise • Assessing trade-offs • Managing task implementation • Leading task specialists
• Project Manager • Program Manager	Same as above, but stronger role in project planning and controlling. Coordinating and negotiating requirements between sponsor and performing organizations. Bid proposal development and pricing. Establishing project organization and staffing. Overall leadership toward implementing project plan. Project profit. New business development.	• Overall program leadership • Team building • Resolving conflict • Managing multidisciplinary tasks • Planning and allocating resources • Interfacing with customers/ sponsors
• Executive Program Manager	Title reserved for very large programs relative to host organization. Responsibilities same as above. Focus is on directing overall program toward desired business results. Customer liaison. Profit performance. New business development. Organizational development.	• Business leadership • Managing overall program businesses • Building program organizations • Developing personnel • Developing new business
• Director of Programs • V.P. Program Development	Responsible for managing multiprogram businesses via various project organizations, each led by a project manager. Focus is on business planning and development, profit performance, technology development, establishing policies and procedures, program management guidelines, personnel development, organizational development.	• Leadership • Strategic planning • Directing and managing program businesses • Building organizations • Selecting and developing key personnel • Identifying and developing new business

Qualifications

1. A Bachelor of Science Degree in Engineering or a Business Degree with a minor in Engineering or Science from an accredited four (4) year college or university.
2. a) (For Engineering Graduate) Ten (10) or more years of Engineering and Construction experience including a minimum of five (5) years of supervisory experience and two (2) years of management and electric utility experience.
   b) (For Business Graduate) Ten (10) or more years of management experience including a minimum of five (5) years of supervisory experience in an engineering and construction related management area and two (2) years of experience as the manager or assistant manager of major engineering and construction related projects and two (2) recent years of electric utility experience.
3. Working knowledge of state and federal regulations and requirements that apply to major design and construction projects such as fossil and nuclear power stations.
4. Demonstrated ability to develop high level management control programs.
5. Experience related to computer processing of cost and schedule information.
6. Registered Professional Engineer and membership in appropriate management and technical societies is desirable (but not necessary).
7.[5] At least four (4) years of experience as a staff management member in an operating nuclear power station or in an engineering support on- or off-site capacity.
8.[5] Detailed knowledge of federal licensing requirement for nuclear power stations.
9.[5] Reasonably effective public speaker.

Because of the potential overlapping nature of job descriptions in a project management environment, some companies try to define responsibilities for each project management position, as shown in Table 4–3.

4.8 THE ORGANIZATIONAL STAFFING PROCESS

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Chapter 9 Human Resources Management
9.2 Acquire Project Team

Staffing the project organization can become a long and tedious effort, especially on large and complex engineering projects. Three major questions must be answered:

- What people resources are required?
- Where will the people come from?
- What type of project organizational structure will be best?

To determine the people resources required, the types of individuals (possibly job descriptions) must be decided on, as well as how many individuals from each job category are necessary and when these individuals will be needed.

5. Qualifications 7 through 9 apply only for Nuclear Project Directors.

Consider the following situation: As a project manager, you have an activity that requires three separate tasks, all performed within the same line organization. The line manager promises you the best available resources right now for the first task but cannot make any commitments beyond that. The line manager may have only below-average workers available for the second and third tasks. However, the line manager is willing to make a deal with you. He can give you an employee who can do the work but will only give an average performance. If you accept the average employee, the line manager will guarantee that the employee will be available to you for all three tasks. How important is continuity to you? There is no clearly definable answer to this question. Some people will always want the best resources and are willing to fight for them, whereas others prefer continuity and dislike seeing new people coming and going. The author prefers continuity, provided that the assigned employee has the ability to do the up-front planning needed during the first task. The danger in selecting the best employee is that a higher-priority project may come along, and you will lose the employee; or if the employee is an exceptional worker, he may simply be promoted off your project.

Sometimes, a project manager may have to make concessions to get the right people. For example, during the seventh, eighth, and ninth months of your project you need two individuals with special qualifications. The functional manager says that they will be available two months earlier, and that if you don't pick them up then, there will be no guarantee of their availability during the seventh month. Obviously, the line manager is pressuring you, and you may have to give in. There is also the situation in which the line manager says that he'll have to borrow people from another department in order to fulfill his commitments for your project. You may have to live with this situation, but be very careful—these employees will be working at a low level on the learning curve, and overtime will not necessarily resolve the problem. You must expect mistakes here.

Line managers often place new employees on projects so they can be upgraded. Project managers often resent this and immediately go to top management for help. If a line manager says that he can do the work with lower-level people, then the project manager must believe the line manager. After all, the line manager, not the assigned employees, makes the commitment to do the work, and it is the line manager's neck that is stuck out.

Mutual trust between project and line managers is crucial, especially during staffing sessions. Once a project manager has developed a good working relationship with employees, the project manager would like to keep those individuals assigned to his activities. There is nothing wrong with a project manager requesting the same administrative and/or technical staff as before. Line managers realize this and usually agree to it.

There must also be mutual trust between the project managers themselves. Project managers must work as a team, recognize each other's needs, and be willing to make decisions that are in the best interest of the company.

Once the resources are defined, the next question must be whether staffing will be from within the existing organization or from outside sources, such as new hires or consultants. Outside consultants are advisable if, and only if, internal manpower resources are being fully utilized on other programs, or if the company does not possess the required project skills. The answer to this question will indicate which organizational form is best for achievement of the objectives. The form might be a matrix, product, or staff project management structure.

Not all companies permit a variety of project organizational forms to exist within the main company structure. Those that do, however, consider the basic questions of classical management before making a decision. These include:

- How is labor specialized?
- What should the span of management be?
  - How much planning is required?
  - Are authority relationships delegated and understood?
  - Are there established performance standards?
  - What is the rate of change of the job requirements?
- Should we have a horizontal or vertical organization?
  - What are the economics?
  - What are the morale implications?
- Do we need a unity-of-command position?

As in any organization, the subordinates can make the superior look good in the performance of his duties. Unfortunately, the project environment is symbolized by temporary assignments in which the main effort put forth by the project manager is to motivate his (temporary) subordinates toward project dedication and to make them fully understand that:

- Teamwork is vital for success.
- Esprit de corps contributes to success.
- Conflicts can occur between project and functional tiers.
- Communication is essential for success.
- Conflicting orders may be given by the:
  - Project manager
  - Functional manager
  - Upper-level manager
- Unsuccessful performance may result in transfer or dismissal from the project as well as disciplinary action.

Earlier we stated that a project operates as a separate entity but remains attached to the company through company administration policies and procedures. Although project managers can establish their own policies, procedures, and rules, the criteria for promotion must be based on company standards. Project managers should be careful about making commitments they can't keep. After unkept promises on previous projects, a project manager will find it very difficult to get top-quality personnel to volunteer for another project. Even if top management orders key individuals to be assigned to his project, they will always be skeptical about any promises that he may make.

Selecting the project manager is only one-third of the staffing problem. The next step, selecting the project office personnel and team members, can be a time-consuming chore. The project office consists of personnel who are usually assigned as full-time members of the project. The evaluation process should include active project team members, functional team members available for promotion or transfer, and outside applicants.

Upon completion of the evaluation process, the project manager meets with upper-level management. This coordination is required to assure that:

- All assignments fall within current policies on rank, salary, and promotion.
- The individuals selected can work well with both the project manager (formal reporting) and upper-level management (informal reporting).
- The individuals selected have good working relationships with the functional personnel.

Good project office personnel usually have experience with several types of projects and are self-disciplined.

The third and final step in the staffing of the project office is a meeting between the project manager, upper-level management, and the project manager on whose project the requested individuals are currently assigned. Project managers are very reluctant to give up qualified personnel to other projects, but unfortunately, this procedure is a way of life in a project environment. Upper-level management attends these meetings to show all negotiating parties that top management is concerned with maintaining the best possible mix of individuals from available resources and to help resolve staffing conflicts. Staffing from within is a negotiation process in which upper-level management establishes the ground rules and priorities.

The selected individuals are then notified of the anticipated change and asked their opinions. If individuals have strong resentment to being transferred or reassigned, alternate personnel may be selected to avoid potential problems.

Figure 4–3 shows the typical staffing pattern as a function of time. There is a manpower buildup in the early phases and a manpower decline in the later stages. This means

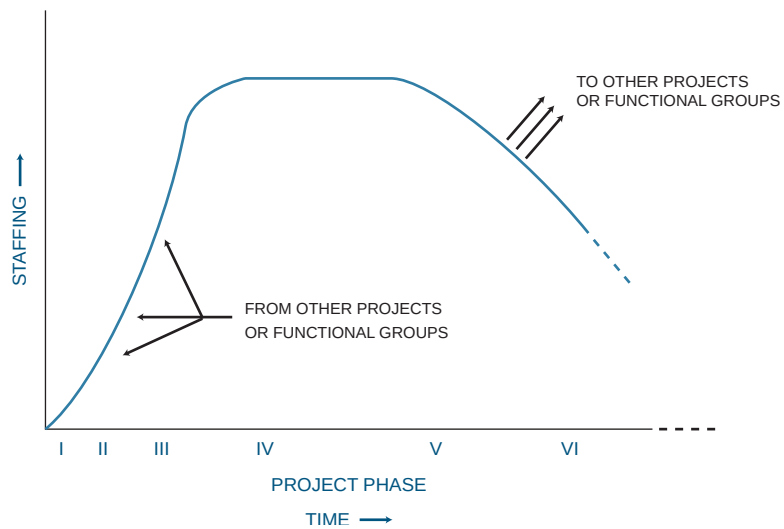

FIGURE 4–3. Staffing pattern versus time.

that the project manager should bring people on board as *needed* and release them as *early* as possible.

There are several psychological approaches that the project manager can use during the recruitment and staffing process. Consider the following:

- Line managers often receive no visibility or credit for a job well done. Be willing to introduce line managers to the customer.
- Be sure to show people how they can benefit by working for you or on your project.
- Any promises made during recruitment should be documented. The functional organization will remember them long after your project terminates.
- As strange as it may seem, the project manager should encourage conflicts to take place during recruiting and staffing. These conflicts should be brought to the surface and resolved. It is better for conflicts to be resolved during the initial planning stages than to have major confrontations later.

It is unfortunate that recruiting and retaining good personnel are more difficult in a project organizational structure than in a purely traditional one. Clayton Reeser identifies nine potential problems that can exist in project organizations[6]:

- Personnel connected with project forms of organization suffer more anxieties about possible loss of employment than members of functional organizations.
- Individuals temporarily assigned to matrix organizations are more frustrated by authority ambiguity than permanent members of functional organizations.
- Personnel connected with project forms of organization that are nearing their phase-out are more frustrated by what they perceive to be "make work" assignments than members of functional organizations.
- Personnel connected with project forms of organization feel more frustrated because of lack of formal procedures and role definitions than members of functional organizations.
- Personnel connected with project forms of organization worry more about being set back in their careers than members of functional organizations.
- Personnel connected with project forms of organization feel less loyal to their organization than members of functional organizations.
- Personnel connected with project forms of organization have more anxieties in feeling that there is no one concerned about their personal development than members of functional organizations.
- Permanent members of project forms of organization are more frustrated by multiple levels of management than members of functional organizations.
- Frustrations caused by conflict are perceived more seriously by personnel connected with project forms of organization than members of functional organizations.

6. Clayton Reeser, "Some Potential Human Problems of the Project Form of Organization," *Academy of Management Journal*, Vol. XII, 1969, pp. 462–466.

Employees are more likely to be motivated to working on a project if the employee had been given the right to accept or refuse the assignment. Although employees usually do not refuse assignments, there is still the question of how much permissiveness should be given to the worker. The following would be a listing or possible degrees of permissiveness:

- The line manager (or project manager) explains the project to the worker and the worker has the right to refuse the assignment. The worker does not need to explain the reason for refusing the assignment and the refusal does not limit the worker's opportunity for advancement or assignment to other project teams.
- With this degree of permissiveness, the worker has the right to refuse the assignment but must provide a reason for the refusal. The reason could be due to personal or career preference considerations such as having to travel, relocation, health reasons, possibly too much overtime involved, simply not an assignment that is viewed as enhancing the individual's career, or the employee wants an assignment on some other project.
- With this degree of permissiveness, the worker has no choice but to accept the assignment. Only an emergency would be considered as a valid reason for refusing the assignment. In this case, refusing the assignment might be damaging to the employee's career.

Grinnell and Apple have identified four additional major problems associated with staffing[7]:

- People trained in single line-of-command organizations find it hard to serve more than one boss.
- People may give lip service to teamwork, but not really know how to develop and maintain a good working team.
- Project and functional managers sometimes tend to compete rather than cooperate with each other.
- Individuals must learn to do more "managing" of themselves.

Thus far we have discussed staffing the project. Unfortunately, there are also situations in which employees must be terminated from the project because of:

- Nonacceptance of rules, policies, and procedures
- Nonacceptance of established formal authority
- Professionalism being more important to them than company loyalty
- Focusing on technical aspects at the expense of the budget and schedule
- Incompetence

There are three possible solutions for working with incompetent personnel. First, the project manager can provide an on-the-spot appraisal of the employee. This includes identification of weaknesses, corrective action to be taken, and threat of punishment if the situation continues. A second solution is reassignment of the employee to less critical activities. This solution is usually not preferred by project managers. The third and most frequent solution is the removal of the employee.

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7. S. K. Grinnell and H. P. Apple, "When Two Bosses Are Better Than One," *Machine Design*, January 1975, pp. 84–87.

Although project managers can get project office people (who report to the project manager) removed directly, the removal of a line employee is an indirect process and must be accomplished through the line manager. The removal of the line employee should be made to look like a transfer; otherwise the project manager will be branded as an individual who fires people.

Executives must be ready to cope with the staffing problems that can occur in a project environment. C. Ray Gullett has summarized these major problems[8]:

- Staffing levels are more variable in a project environment.
- Performance evaluation is more complex and more subject to error in a matrix form of organization.
- Wage and salary grades are more difficult to maintain under a matrix form of organization. Job descriptions are often of less value.
- Training and development are more complex and at the same time more necessary under a project form of organization.
- Morale problems are potentially greater in a matrix organization.

4.9 THE PROJECT OFFICE

PMBOK® Guide, 4th Edition
1.4.4 Project Management Office

The project team is a combination of the project office and functional employees as shown in Figure 4–4. Although the figure identifies the project office personnel as assistant project managers, some employees may not have any such title. The advantage of such a title is that it entitles the employee to speak directly to the customer. For example, the project engineer might also be called the assistant project manager for engineering. The title is important because when the assistant project manager speaks to the customer, he represents the company, whereas the functional employee represents himself.

The project office is an organization developed to support the project manager in carrying out his duties. Project office personnel must have the same dedication toward the project as the project manager and must have good working relationships with both the project and functional managers. The responsibilities of the project office include:

- Acting as the focal point of information for both in-house control and customer reporting
- Controlling time, cost, and performance to adhere to contractual requirements
- Ensuring that all work required is documented and distributed to all key personnel
- Ensuring that all work performed is both authorized and funded by contractual documentation

The major responsibility of the project manager and the project office personnel is the integration of work across the functional lines of the organization. Functional units, such as engineering, R&D, and manufacturing, together with extra-company subcontractors, must work toward the same specifications, designs, and even objectives. The lack of proper

8. C. Ray Gullett, "Personnel Management in the Project Environment," *Personnel Administration/Public Personnel Review,* November–December 1972, pp. 17–22.

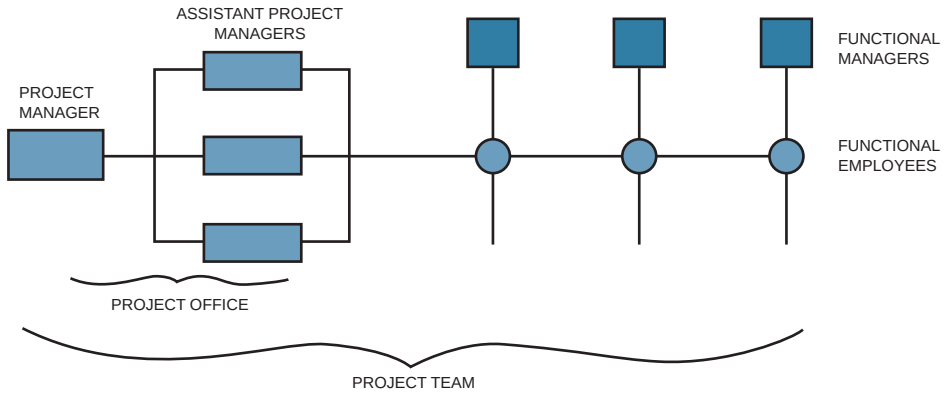

FIGURE 4–4. Project organization.

integration of these functional units is the most common cause of project failure. The team members must be dedicated to all activities required for project success, not just their own functional responsibilities. The problems resulting from lack of integration can best be solved by full-time membership and participation of project office personnel. Not all team members are part of the project office. Functional representatives, performing at the interface position, also act as integrators but at a closer position to where the work is finally accomplished (i.e., the line organization).

One of the biggest challenges facing project managers is determining the size of the project office. The optimal size is determined by a trade-off between the maximum number of members necessary to assure compliance with requirements and the maximum number for keeping the total administrative costs under control. Membership is determined by factors such as project size, internal support requirements, type of project (i.e., R&D, qualification, production), level of technical competency required, and customer support requirements. Membership size is also influenced by how strategic management views the project to be. There is a tendency to enlarge project offices if the project is considered strategic, especially if follow-on work is possible.

On large projects, and even on some smaller efforts, it is often impossible to achieve project success without permanently assigned personnel. The four major activities of the project office, shown below, indicate the need for using full-time people:

- Integration of activities
- In-house and out-of-house communication
- Scheduling with risk and uncertainty
- Effective control

These four activities require continuous monitoring by trained project personnel. The training of good project office members may take weeks or even months, and can extend beyond the time allocated for a project. Because key personnel are always in demand, project managers should ask themselves and upper-level management one pivotal question when attempting to staff the project office:

Are there any projects downstream that could cause me to lose key members of my team?

If the answer to this question is yes, then it might benefit the project to have the second- or third-choice person selected for the position or even to staff the position on a part-time basis. Another alternative, of course, would be to assign the key members to activities that are not so important and that can be readily performed by replacement personnel. This, however, is impractical because such personnel will not be employed efficiently.

Program managers would like nothing better than to have all of their key personnel assigned full-time for the duration of the program. Unfortunately, this is undesirable, if not impossible, for many projects because[9]:

- Skills required by the project vary considerably as the project matures through each of its life-cycle phases.
- Building up large permanently assigned project offices for each project inevitably causes duplication of certain skills (often those in short supply), carrying of people who are not needed on a full-time basis or for a long period, and personnel difficulties in reassignment.
- The project manager may be diverted from his primary task and become the project engineer, for example, in addition to his duties of supervision, administration, and dealing with the personnel problems of a large office rather than concentrating on managing all aspects of the project itself.
- Professionally trained people often prefer to work within a group devoted to their professional area, with permanent management having qualifications in the same field, rather than becoming isolated from their specialty peers by being assigned to a project staff.
- Projects are subject to sudden shifts in priority or even to cancellation, and full-time members of a project office are thus exposed to potentially serious threats to their job security; this often causes a reluctance on the part of some people to accept a project assignment.

All of these factors favor keeping the full-time project office as small as possible and dependent on established functional departments and specialized staffs. The approach places great emphasis on the planning and control procedures used on the project. On the other hand, there are valid reasons for assigning particular people of various specialties to the project office. These specialties usually include:

- Systems analysis and engineering (or equivalent technical discipline) and product quality and configuration control, if the product requires such an effort
- Project planning, scheduling, control, and administrative support

Many times a project office is staffed by promotion of functional specialists. This situation is quite common to engineering firms with a high percentage of technical employees, but is not without problems.

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9. Russell D. Archibald, *Managing High-Technology Programs and Projects* (New York: Wiley, 1976), p. 82.

> In professional firms, personnel are generally promoted to management on the basis of their professional or technical competence rather than their managerial ability. While this practice may be unavoidable, it does tend to promote men with insufficient knowledge of management techniques and creates a frustrating environment for the professional down the line.[10]

There is an unfortunate tendency for executives to create an environment where line employees feel that the "grass is greener" in project management and project engineering than in the line organization. How should an executive handle a situation where line specialists continually apply for transfer to project management? One solution is the development of a dual ladder system, with a pay scale called "consultant." This particular company created the consultant position because:

- There were several technical specialists who were worth more money to the company but who refused to accept a management position to get it.
- Technical specialists could not be paid more money than line managers.

Promoting technical specialists to a management slot simply to give them more money can:

- Create a poor line manager
- Turn a specialist into a generalist
- Leave a large technical gap in the line organization

Line managers often argue that they cannot perform their managerial duties and control these "prima donnas" who earn more money and have a higher pay grade than the line managers. That is faulty reasoning. Every time the consultants do something well, it reflects on the entire line organization, not merely on themselves.

The concept of having functional employees with a higher pay grade than the line manager can also be applied to the horizontal project. It is possible for a junior project manager suddenly to find that the line managers have a higher pay grade than the project manager. It is also possible for assistant project managers (as project engineers) to have a higher pay grade than the project manager. Project management is designed to put together the best mix of people to achieve the objective. If this best mix requires that a grade 7 report to a grade 9 (on a "temporary" project), then so be it. Executives should not let salaries, and pay grades, stand in the way of constructing a good project organization.

Another major concern is the relationship that exists between project office personnel and functional managers. In many organizations, membership in the project office is considered to be more important than in the functional department. Functional members have a tendency to resent an individual who has just been promoted out of a functional department and into project management. Killian has described ways of resolving potential conflicts[11]:

> It must be kept in mind that veteran functional managers cannot be expected to accept direction readily from some lesser executive who is suddenly labelled a Project Manager. Management can avoid this problem by:
>
> - Selecting a man who already has a high position of responsibility or placing him high enough in the organization.

10. William P. Killian, "Project Management—Future Organizational Concept," *Marquette Business Review,* 1971, pp. 90–107.
11. William P. Killian, "Project Management—Future Organizational Concept," *Marquette Business Review,* 1971, pp. 90–107.

- Assigning him a title as important-sounding as those of functional managers.
- Supporting him in his dealings with functional managers.

> If the Project Manager is expected to exercise project control over the functional departments, then he must report to the same level as the departments, or higher.

Executives can severely hinder project managers by limiting their authority to select and organize (when necessary) a project office and team. According to Cleland[12]:

> His [project manager's] staff should be qualified to provide personal administrative and technical support. He should have sufficient authority to increase or decrease his staff as necessary throughout the life of the project. The authorization should include selective augmentation for varying periods of time from the supporting functional areas.

Many executives have a misconception concerning the makeup and usefulness of the project office. People who work in the project office should be individuals whose first concern is project management, not the enhancement of their technical expertise. It is almost impossible for individuals to perform for any extended period of time in the project office without becoming cross-trained in a second or third project office function. For example, the project manager for cost could acquire enough expertise eventually to act as the assistant to the assistant project manager for procurement. This technique of project office cross-training is an excellent mechanism for creating good project managers.

We have mentioned two important facts concerning the project management staffing process:

- The individual who aspires to become a project manager must be willing to give up technical expertise and become a generalist.
- Individuals can be qualified to be promoted vertically but not horizontally.

Once an employee has demonstrated the necessary attributes to be a good project manager, there are three ways the individual can become a project manager or part of the project office. The executive can:

- Promote the individual in salary and grade and transfer him into project management.
- Laterally transfer the individual into project management without any salary or grade increase. If, after three to six months, the employee demonstrates that he can perform, he will receive an appropriate salary and grade increase.
- Give the employee a small salary increase without any grade increase or a grade increase without any salary increase, with the stipulation that additional awards will be forthcoming after the observation period, assuming that the employee can handle the position.

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12. David I. Cleland, "Why Project Management?" Reprinted with permission from *Business Horizons*, Winter 1964, p. 85. Copyright © 1964 by the Board of Trustees at Indiana University.

Many executives believe in the philosophy that once an individual enters the world of project management, there are only two places to go: up in the organization or out the door. If an individual is given a promotion and pay increase and is placed in project management and fails, his salary may not be compatible with that of his previous line organization, and now there is no place for him to go. Most executives, and employees, prefer the second method because it actually provides some protection for the employee.

Many companies don't realize until it is too late that promotions to project management may be based on a different set of criteria from promotions to line management. Promotions on the horizontal line are strongly based on communicative skills, whereas line management promotions are based on technical skills.

4.10 THE FUNCTIONAL TEAM

PMBOK® Guide, 4th Edition
Chapter 9 Human Resources Management
2.3 Project Team Definition

The project team consists of the project manager, the project office (whose members may or may not report directly to the project manager), and the functional or interface members (who must report horizontally as well as vertically for information flow). Functional team members are often shown on organizational charts as project office team members. This is normally done to satisfy customer requirements.

Upper-level management can have an input into the selection process for functional team members but should not take an active role unless the project and functional managers cannot agree. Functional management must be represented at all staffing meetings because functional staffing is directly dependent on project requirements and because:

- Functional managers generally have more expertise and can identify high-risk areas.
- Functional managers must develop a positive attitude toward project success. This is best achieved by inviting their participation in the early activities of the planning phase.

Functional team members are not always full-time. They can be full-time or part-time for either the duration of the project or only specific phases.

The selection process for both the functional team member and the project office must include evaluation of any special requirements. The most common special requirements develop from:

- Changes in technical specifications
- Special customer requests
- Organizational restructuring because of deviations from existing policies
- Compatibility with the customer's project office

A typical project office may include between ten and thirty members, whereas the total project team may be in excess of a hundred people, causing information to be shared slowly. For large projects, it is desirable to have a full-time functional representative from

each major division or department assigned permanently to the project, and perhaps even to the project office. Such representation might include:

- Program management
- Project engineering
- Engineering operations
- Manufacturing operations
- Procurement
- Quality control
- Cost accounting
- Publications
- Marketing
- Sales

Both the project manager and team members must understand fully the responsibilities and functions of each other team member so that total integration can be achieved rapidly and effectively. On high-technology programs the chief project engineer assumes the role of deputy project manager. Project managers must understand the problems that the line managers have when selecting and assigning the project staff. Line managers try to staff with people who understand the need for teamwork.

When employees are attached to a project, the project manager must identify the "star" employees. These are the employees who are vital for the success of the project and who can either make or break the project manager. Most of the time, star employees are found in the line organization, not the project office.

As a final point, project managers can assign line employees added responsibilities within the scope of the project. If the added responsibilities can result in upgrading, then the project manager should consult with the line manager before such situations are initiated. Quite often, line managers (or even personnel representatives) send "check" people into the projects to verify that employees are performing at their proper pay grade. This is very important when working with blue-collar workers who, by union contractual agreements, must be paid at the grade level at which they are performing.

Also, project managers must be willing to surrender resources when they are no longer required. If the project manager constantly cries wolf in a situation where a problem really does not exist, the line manager will simply pull away the resources (this is the line manager's right), and a deteriorating working relationship will result.

4.11 THE PROJECT ORGANIZATIONAL CHART

One of the first requirements of the project startup phase is to develop the organizational chart for the project and determine its relationship to the parent organizational structure. Figure 4–5 shows, in abbreviated form, the six major programs at Dalton Corporation. Our concern is with the Midas Program. Although the Midas Program may have the lowest priority of the six programs, it is placed at the top, and in boldface, to give the impression

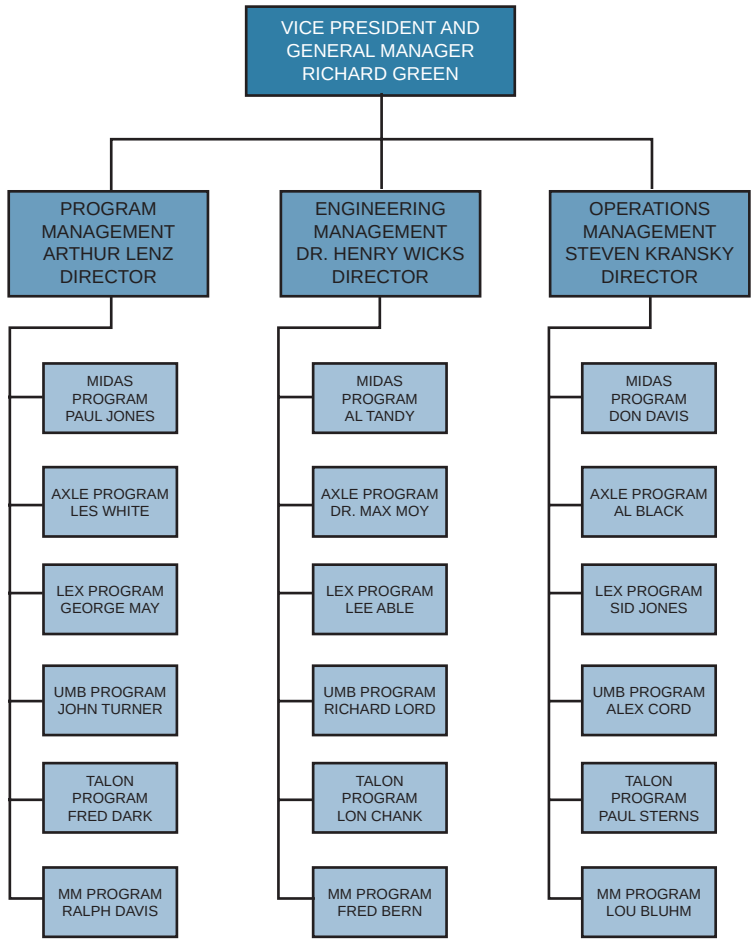


FIGURE 4–5. Dalton Corporation.

that it is the top priority. This type of representation usually makes the client or customer feel that his program is important to the contractor.

The employees shown in Figure 4–5 may be part-time or full-time, depending upon the project's requirements. Perturbations on Figure 4–5 might include one employee's name identified on two or more vertical positions (i.e., the project engineer on two projects) or the same name in two horizontal boxes (i.e., for a small project, the same person could be the project manager and project engineer). Remember, this type of chart is for the customer's benefit and may not show the true "dotted/solid" reporting relationships in the company.

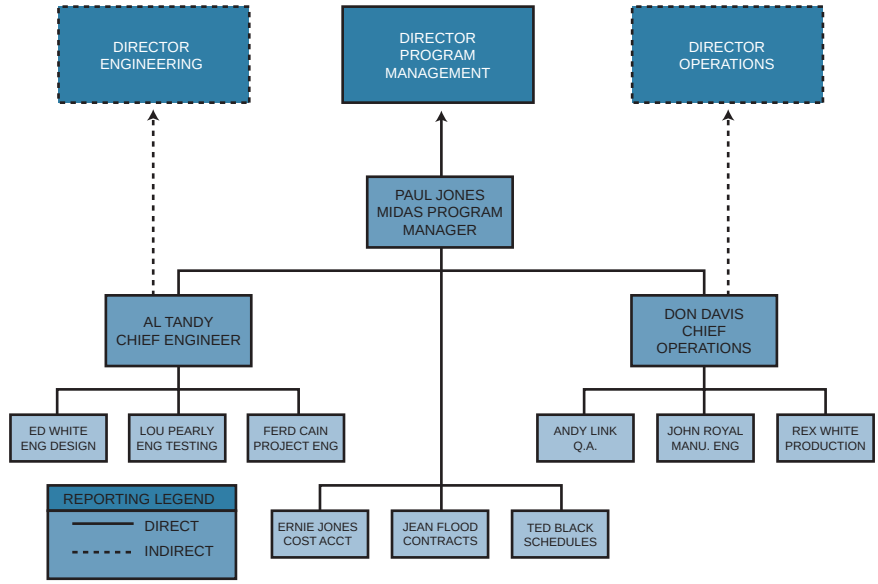


FIGURE 4–6. Midas Program office.

The next step is to show the program office structure, as illustrated in Figure 4–6. Note that the chief of operations and the chief engineer have dual reporting responsibility; they report directly to the program manager and indirectly to the directors. Again, this may be just for the customer's benefit with the real reporting structure being reversed. Beneath the chief engineer, there are three positions. Although these positions appear as solid lines, they might actually be dotted lines. For example, Ed White might be working only part-time on the Midas Program but is still shown on the chart as a permanent program office member. Jean Flood, under contracts, might be spending only ten hours per week on the Midas Program.

If the function of two positions on the organizational chart takes place at different times, then both positions may be shown as manned by the same person. For example, Ed White may have his name under both engineering design and engineering testing if the two activities are far enough apart that he can perform them independently.

The people shown in the project office organizational chart, whether full-time or part-time, may not be physically sitting in the project office. For full-time, long-term assignments, as in construction projects, the employees may be physically sitting side by side, whereas for part-time assignments, it may be imperative for them to sit in their functional group. Remember, these types of charts may simply be eyewash for the customer.

Most customers realize that the top-quality personnel may be shared with other programs and projects. Project manning charts, such as the one shown in Figure 4–7, can be used for this purpose. These manning charts are also helpful in preparing the management volume of proposals to show the customer that key personnel will be readily available on his project.

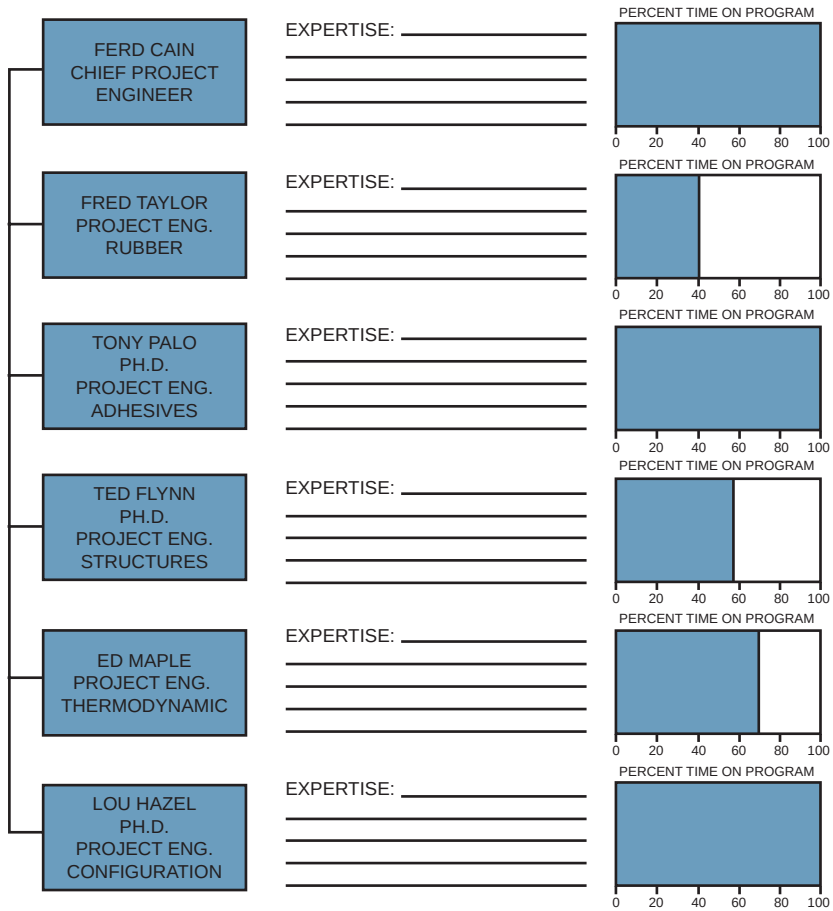


FIGURE 4–7. Project engineering department manning for the Midas Program.

4.12 SPECIAL PROBLEMS

There are always special problems that influence the organizational staffing process. For example, the department shown in Figure 4–8 has a departmental matrix. All activities stay within the department. Project X and project Y are managed by line employees who have been temporarily assigned to the projects, whereas project Z is headed by supervisor B. The department's activities involve high-technology engineering as well as R&D.

The biggest problem facing the department managers is that of training their new employees. The training process requires nine to twelve months. The employees become familiar with the functioning of all three sections, and only after training is an employee assigned to one of the sections. Line managers claim that they do not have sufficient time to supervise training. As a result, the department manager in the example found staff person C to be the most competent person to supervise training. A special department training project was set up, as shown in Figure 4–8.

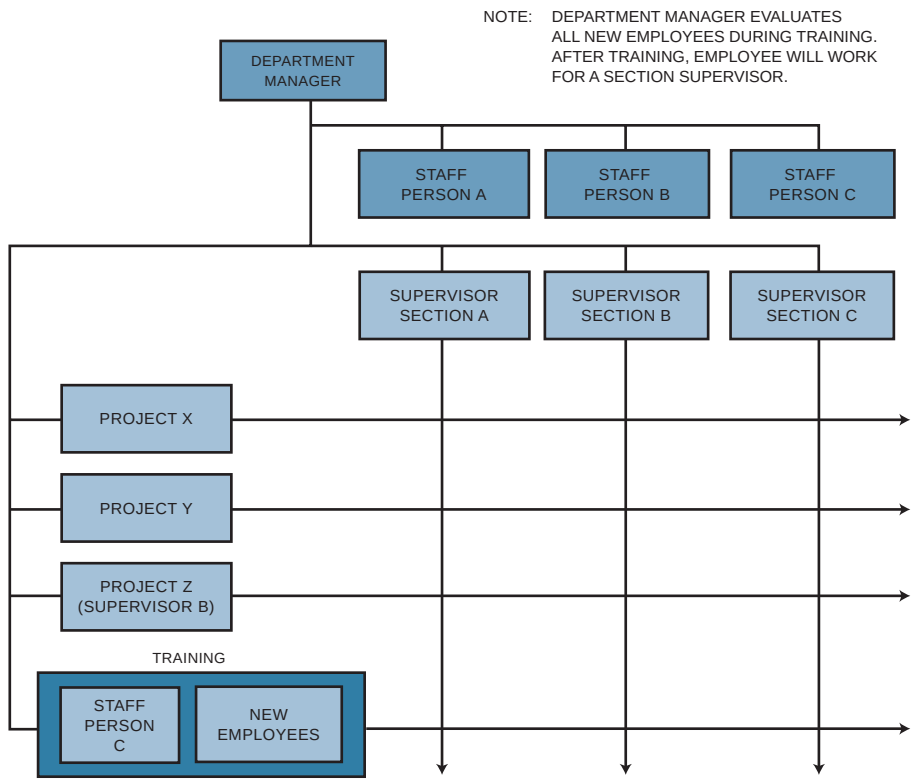


FIGURE 4–8. The training problem.

Figure 4–9 shows a utility company that has three full-time project managers controlling three projects, all of which cut across the central division. Unfortunately, the three full-time project managers cannot get sufficient resources from the central division because the line managers are also acting as divisional project managers and saving the best resources for their own projects.

The obvious solution to the problem is that the central division line managers not be permitted to wear two hats. Instead, one full-time project manager can be added to the left division to manage all three central division projects. It is usually best for all project managers to report to the same division for priority setting and conflict resolution.

Line managers have a tendency to feel demoted when they are suddenly told that they can no longer wear two hats. For example, Mr. Adams was a department manager with thirty years of experience in a company. For the last several years, he had worn two hats and acted as both project manager and functional manager on a variety of projects. He was regarded as an expert in his field. The company decided to incorporate formal project management and established a project management department. Mr. Bell, a thirty-year-old employee with three years of experience with the company, was assigned as the project manager. In order to staff his project, Bell asked Adams for Mr. Cane (Bell's friend) to be assigned to the project as the functional representative. Cane had been with the company for two years. Adams agreed to the request and informed Cane of his new assignment,

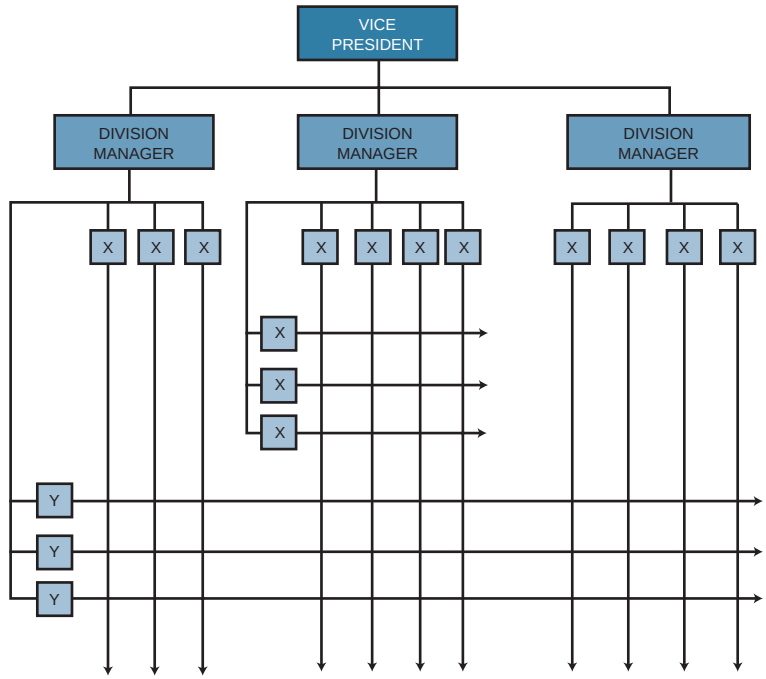


FIGURE 4–9. Utility service organization.

closing with the remarks, "This project is yours all the way. I don't want to have anything to do with it. I'll be busy with paperwork as a result of the new organizational structure. Just send me a memo once in a while telling me what's happening."

During the project kickoff meeting, it became obvious to everyone that the only person with the necessary expertise was Adams. Without his support, the duration of the project could be expected to double.

The real problem here was that Adams wanted to feel important and needed, and was hoping that the project manager would come to him asking for his assistance. The project manager correctly analyzed the situation but refused to ask for the line manager's help. Instead, the project manager asked an executive to step in and force the line manager to help. The line manager gave his help, but with great reluctance. Today, the line manager provides poor support to the projects that come across his line organization.

4.13 SELECTING THE PROJECT MANAGEMENT IMPLEMENTATION TEAM

PMBOK® Guide, 4th Edition
Chapter 9 Human Resources Management
9.2 Acquire Project Team

The implementation of project management within an organization requires strong executive support and an implementation team that is dedicated to making project management work. Selecting the wrong team players can either lengthen the implementation process or reduce

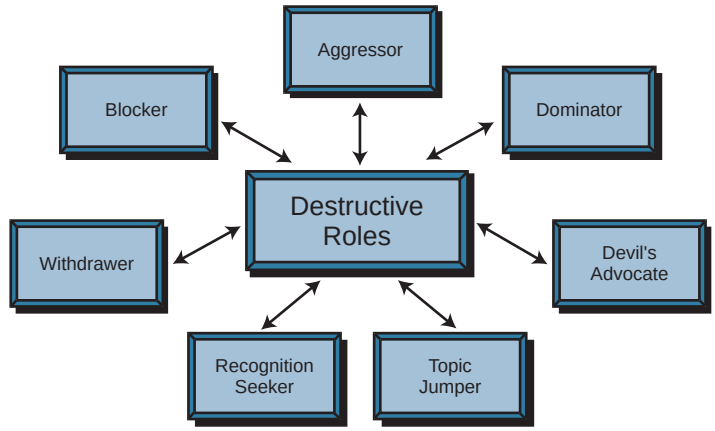


FIGURE 4–10. Roles people play that undermine project management implementation.

employee morale. Some employees may play destructive roles on a project team. These roles, which undermine project management implementation, are shown in Figure 4–10 and described below:

- The aggressor
  - Criticizes everybody and everything on project management
  - Deflates the status and ego of other team members
  - Always acts aggressively
- The dominator
  - Always tries to take over
  - Professes to know everything about project management
  - Tries to manipulate people
  - Will challenge those in charge for leadership role
- The devil's advocate
  - Finds fault in all areas of project management
  - Refuses to support project management unless threatened
  - Acts more of a devil than an advocate
- The topic jumper
  - Must be the first one with a new idea/approach to project management
  - Constantly changes topics
  - Cannot focus on ideas for a long time unless it is his/her idea
  - Tries to keep project management implementation as an action item forever
- The recognition seeker
  - Always argues in favor of his/her own ideas
  - Always demonstrates status consciousness
  - Volunteers to become the project manager if status is recognized
  - Likes to hear himself/herself talk
  - Likes to boast rather than provide meaningful information

- The withdrawer
  - Is afraid to be criticized
  - Will not participate openly unless threatened
  - May withhold information
  - May be shy
- The blocker
  - Likes to criticize
  - Rejects the views of others
  - Cites unrelated examples and personal experiences
  - Has multiple reasons why project management will not work

These types of people should not be assigned to project management implementation teams. The types of people who should be assigned to implementation teams are shown in Figure 4–11 and described below. Their roles are indicated by their words:

- The initiators
  - "Is there a chance that this might work?"
  - "Let's try this."
- The information seekers
  - "Have we tried anything like this before?"
  - "Do we know other companies where this has worked?"
  - "Can we get this information?"
- The information givers
  - "Other companies found that . . ."
  - "The literature says that . . ."
  - "Benchmarking studies indicate that . . ."
- The encouragers
  - "Your idea has a lot of merit."
  - "The idea is workable, but we may have to make small changes."
  - "What you said will really help us."

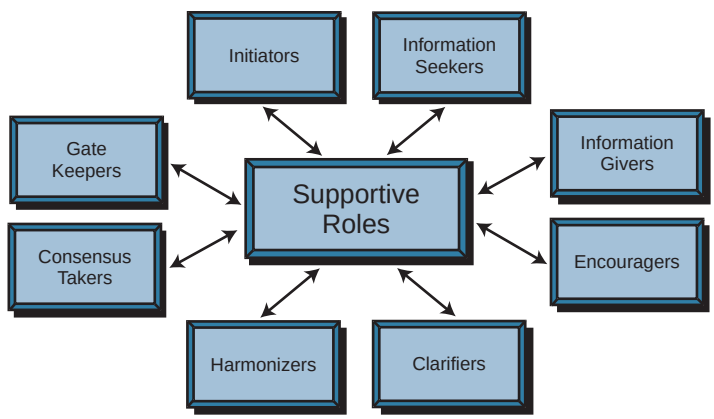


FIGURE 4–11. Roles people play that support project management implementation.

- The clarifiers
  - "Are we saying that . . . ?"
  - "Let me state in my own words what I'm hearing from the team."
  - "Let's see if we can put this into perspective."
- The harmonizers
  - "We sort of agree, don't we?"
  - "Your ideas and mine are close together."
  - "Aren't we saying the same thing?"
- The consensus takers
  - "Let's see if the team is in agreement."
  - "Let's take a vote on this."
  - "Let's see how the rest of the group feels about this."
- The gate keepers
  - "Who has not given us their opinions on this yet?"
  - "Should we keep our options open?"
  - "Are we prepared to make a decision or recommendation, or is there additional information to be reviewed?"

4.14 STUDYING TIPS FOR THE PMI® PROJECT MANAGEMENT CERTIFICATION EXAM

This section is applicable as a review of the principles to support the knowledge areas and domain groups in the PMBOK® Guide. This chapter addresses:

- Human Resources Management
- Planning
- Project Staffing

Understanding the following principles is beneficial if the reader is using this text to study for the PMP® Certification Exam:

- What is meant by a project team
- Staffing process and environment
- Role of the line manager in staffing
- Role of the executive in staffing
- Skills needed to be a project manager
- That the project manager is responsible for helping the team members grow and learn while working on the project

In Appendix C, the following Dorale Products mini–case studies are applicable:

- Dorale Products (G) [Human Resources Management]
- Dorale Products (H) [Human Resources Management]

- Dorale Products (I) [Human Resources Management]
- Dorale Products (J) [Human Resources Management]
- Dorale Products (K) [Human Resources Management]

The following multiple-choice questions will be helpful in reviewing the principles of this chapter:

1. During project staffing, the *primary* role of senior management is in the selection of the:
A. Project manager
B. Assistant project managers
C. Functional team
D. Executives do not get involved in staffing.

2. During project staffing, the *primary* role of line management is:
A. Approving the selection of the project manager
B. Approving the selection of assistant project managers
C. Assigning functional resources based upon who is available
D. Assigning functional resources based upon availability and the skill set needed

3. A project manager is far more likely to succeed if it is obvious to everyone that:
A. The project manager has a command of technology.
B. The project manager is a higher pay grade than everyone else on the team.
C. The project manager is over 45 years of age.
D. Executive management has officially appointed the project manager.

4. Most people believe that the best way to train someone in project management is through:
A. On-the-job training
B. University seminars
C. Graduate degrees in project management
D. Professional seminars and meeting

5. In staffing negotiations with the line manager, you identify a work package that requires a skill set of a grade 7 worker. The line manager informs you that he will assign a grade 6 and a grade 8 worker. You should:
A. Refuse to accept the grade 6 because you are not responsible for training
B. Ask for two different people
C. Ask the sponsor to interfere
D. Be happy! You have two workers.

6. You priced out a project at 1000 hours assuming a grade 7 employee would be assigned. The line manager assigns a grade 9 employee. This will result in a significant cost overrun. The project manager should:
A. Reschedule the start date of the project based upon the availability of a grade 7
B. Ask the sponsor for a higher priority for your project
C. Reduce the scope of the project
D. See if the grade 9 can do the job in less time

7. As a project begins to wind down, the project manager should:
A. Release all nonessential personnel so that they can be assigned to other projects
B. Wait until the project is officially completed before releasing anyone
C. Wait until the line manager officially requests that the people be released
D. Talk to other project managers to see who wants your people

ANSWERS

1. A
2. D
3. D
4. A
5. D
6. D
7. A

PROBLEMS

4–1 From S. K. Grinnell and H. P. Apple ("When Two Bosses Are Better Than One," *Machine Design*, January 1975, pp. 84–87):

- People trained in single-line-of-command organizations find it hard to serve more than one boss.
- People may give lip service to teamwork, but not really know how to develop and maintain a good working team.
- Project and functional managers sometimes tend to compete rather than cooperate with each other.
- Individuals must learn to do more "managing" of themselves.

The authors identify the above four major problems associated with staffing. Discuss each problem and identify the type of individual most likely to be involved (i.e., engineer, contract administrator, cost accountant, etc.) and in which organizational form this problem would be most apt to occur.

4–2 David Cleland ("Why Project Management?" Reprinted from *Business Horizons*, Winter 1964, p. 85. Copyright © 1964 by the Foundation for the School of Business at Indiana University. Used with permission) made the following remarks:

> His [project manager's] staff should be qualified to provide personal administrative and technical support. He should have sufficient authority to increase or decrease his staff as necessary throughout the life of the project. This authorization should include selective augmentation for varying periods of time from the supporting functional areas.

Do you agree or disagree with these statements? Should the type of project or type of organization play a dominant role in your answer?

4–3 The contractor's project office is often structured to be compatible with the customer's project office, sometimes on a one-to-one basis. Some customers view the contractor's project organization merely as an extension of their own company. Below are three statements concerning this relationship. Are these statements true or false? Defend your answers.

- There must exist mutual trust between the customer and contractor together with a close day-to-day working relationship.

- The project manager and the customer must agree on the hierarchy of decision that each must make, either independently or jointly. (Which decisions can each make independently or jointly?)
- Both the customer and contractor's project personnel must be willing to make decisions as fast as possible.

4–4 C. Ray Gullet ("Personnel Management in the Project Organization," *Personnel Administration/Public Personnel Review,* November–December 1972, pp. 17–22) has identified five personnel problems. How would you, as a project manager, cope with each problem?

- Staffing levels are more variable in a project environment.
- Performance evaluation is more complex and more subject to error in a matrix form of organization.
- Wage and salary grades are more difficult to maintain under a matrix form of organization. Job descriptions are often of less value.
- Training and development are more complex and at the same time more necessary under a project form of organization.
- Morale problems are potentially greater in a matrix organization.

4–5 Some people believe that a project manager functions, in some respects, like a physician. Is there any validity in this?

4–6 Paul is a project manager for an effort that requires twelve months. During the seventh, eighth, and ninth months he needs two individuals with special qualifications. The functional manager has promised that these individuals will be available two months before they are needed. If Paul does not assign them to his project at that time, they will be assigned elsewhere and he will have to do with whomever will be available later. What should Paul do? Do you have to make any assumptions in order to defend your answer?

4–7 Some of the strongest reasons for promoting functional engineers to project engineers are:

- Better relationships with fellow researchers
- Better prevention of duplication of effort
- Better fostering of teamwork

These reasons are usually applied to R&D situations. Could they also be applied to product life-cycle phases other than R&D?

4–8 The following have been given as qualifications for a successful advanced-technology project manager:

- Career has progressed up through the technical ranks
- Knowledgeable in many engineering fields
- Understands general management philosophy and the meaning of profitability
- Interested in training and teaching his superiors
- Understands how to work with perfectionists

Can these same qualifications be modified for non-R&D project management? If so, how?

4–9 W. J. Taylor and T. F. Watling (*Successful Project Management,* London: Business Books, 1972, p. 32) state:

> It is often the case, therefore, that the Project Manager is more noted for his management technique expertise, his ability to "get things done" and his ability to "get on with people" than for his sheer technical prowess. However, it can be dangerous to minimize this latter talent when choosing Project Managers dependent upon project type and size. The

Project Manager should preferably be an expert either in the field of the project task or a subject allied to it.

How dangerous can it be if this latter talent is minimized? Will it be dangerous under all circumstances?

4–10 Frank Boone is the most knowledgeable piping engineer in the company. For five years, the company has turned down his application for transfer to project engineering and project management stating that he is too valuable to the company in his current position. If you were a project manager, would you want this individual as part of your functional team? How should an organization cope with this situation?

4–11 Tom Weeks is manager of the insulation group. During a recent group meeting, Tom commented, "The company is in trouble. As you know, we're bidding on three programs right now. If we win just one of them, we can probably maintain our current work level. If, by some slim chance, we were to win all three, you'll all be managers tomorrow." The company won all three programs, but the insulation group did not hire anyone, and there were no promotions. What would you, as a project manager on one of the new projects, expect your working relations to be with the insulation group?

4–12 You are a project engineer on a high-technology program. As the project begins to wind down, your boss asks you to write a paper so that he can present it at a technical meeting. His name goes first on the paper. Should this be part of your job? How do you feel about this situation?

4–13 Research has indicated that the matrix structure is often confusing because it requires multiple roles for people, with resulting confusion about these roles (Keith Davis, *Human Relations at Work*, New York: McGraw-Hill, 1967, pp. 296–297). Unfortunately, not all program managers, project managers, and project engineers possess the necessary skills to operate in this environment. Stuckenbruck has stated, "The path to success is strewn with the bodies of project managers who were originally functional line managers and then went into project management" (Linn Stuckenbruck, "The Effective Project Manager," *Project Management Quarterly*, Vol. VII, No. 1, March 1976, pp. 26–27). What do you feel is the major cause for this downfall of the functional manager?

4–14 For each of the organizational forms shown below, who determines what resources are needed, when they are needed, and how they will be employed? Who has the authority and responsibility to mobilize these resources?

a. Traditional organization
b. Matrix organization
c. Product line organization
d. Line/staff project organization

4–15 Do you agree or disagree that project organizational forms encourage peer-to-peer communications and dynamic problem-solving?

4–16 The XYZ Company operates on a traditional structure. The company has just received a contract to develop a new product line for a special group of customers. The company has decided to pull out selected personnel from the functional departments and set up a single product organizational structure to operate in parallel with the functional departments.

a. Set up the organizational chart.
b. Do you think this setup can work? Does your answer depend on how many years this situation must exist?

4–17 You are the project engineer on a program similar to one that you directed previously. Should you attempt to obtain the same administrative and/or technical staff that you had before?

4–18 A person assigned to your project is performing unsatisfactorily. What should you do? Will it make a difference if he is in the project office or a functional employee?

4–19 You have been assigned to the project office as an assistant project engineer. You are to report to the chief project engineer who reports formally to the project manager and informally to the vice president of engineering. You have never worked with this chief project engineer before. During the execution of the project, it becomes obvious to you that the chief project engineer is making decisions that do not appear to be in the best interest of the project. What should you do about this?

4–20 Should individuals be promoted to project management because they are at the top of their functional pay grade?

4–21 Should one functional department be permitted to "borrow" (on a temporary basis) people from another functional department in order to fulfill project manning requirements? Should this be permitted if overtime is involved?

4–22 Should a project manager be paid for performance or for the number of people he supervises?

4–23 Should a project manager try to upgrade his personnel?

4–24 Why should a functional manager assign his best people to you on a long-term project?

4–25 A coal company has adopted the philosophy that the project manager for new mine startup projects will be the individual who will eventually become the mine superintendent. The coal company believes that this type of "ownership" philosophy is good. Do you agree?

4–26 Can a project manager be considered as a "hired gun"?

4–27 Manufacturing organizations are using project management/project engineering strictly to give new employees exposure to total company operations. After working on one or two projects, each approximately one to two years in duration, the employee is transferred to line management for his career path and opportunities for advancement. Can a situation such as this, where there is no career path in either project management or project engineering, work successfully? Could there be any detrimental effects on the projects?

4–28 Can a project manager create dedication and a true winning spirit and still be hated by all?

4–29 Can anyone be trained to be a project manager?

4–30 A power and light company has part-time project management in which an individual acts as both a project manager and a functional employee at the same time. The utility company claims that this process prevents an employee from becoming "technically obsolete," and that when the employee returns to full-time functional duties, he is a more well-rounded individual. Do you agree or disagree? What are the arrangement's advantages and disadvantages?

4–31 Some industries consider the major criterion for promotion and advancement to be gray hair and/or baldness. Is this type of maturity advantageous?

4–32 In Figure 4–8 we showed that Al Tandy and Don Davis (as well as other project office personnel) reported directly to the project manager and indirectly to functional management. Could this situation be reversed, with the project office personnel reporting indirectly to the project manager and directly to functional management?

4–33 Most organizations have "star" people who are usually identified as those individuals who are the key to success. How does a project manager identify these people? Can they be in the project office, or must they be functional employees or managers?

4–34 Considering your own industry, what job-related or employee-related factors would you wish to know before selecting someone to be a project manager or a project engineer on an effort valued at:

a. $30,000?
b. $300,000?
c. $3,000,000?
d. $30,000,000?

4–35 One of the major controversies in project management occurs over whether the project manager needs a command of technology in order to be effective. Consider the following situation:

You are the project manager on a research and development project. Marketing informs you that they have found a customer for your product and that you must make major modifications to satisfy the customer's requirements. The engineering functional managers tell you that these modifications are impossible. Can a project manager without a command of technology make a viable decision as to whether to risk additional funds and support marketing, or should he believe the functional managers, and tell marketing that the modifications are impossible? How can a project manager, either with or without a command of technology, tell whether the functional managers are giving him an optimistic or a pessimistic opinion?

4–36 As a functional employee, you demonstrate that you have exceptionally good writing skills. You are then promoted to the position of special staff assistant to the division manager and told that you are to assume full responsibility for all proposal work that must flow through your division. How do you feel about this? Is it a promotion? Where can you go from here?

4–37 Government policymakers content that only high-ranking individuals (high GS grades) can be project managers because a good project manager needs sufficient "clout" to make the project go. In government, the project manager is generally the highest grade on the project team. How can problems of pay grade be overcome? Is the government's policy effective?

4–38 A major utility company is worried about the project manager's upgrading functional employees. On an eight-month project that employs four hundred full-time project employees, the department managers have set up "check" people whose responsibility is to see that functional employees do not have unauthorized (i.e., not approved by the functional manager) work assignments above their current grade level. Can this system work? What if the work is at a position below their grade level?

4–39 A major utility company begins each computer project with a feasibility study in which a cost-benefit analysis is performed. The project managers, all of whom report to a project management division, perform the feasibility study themselves without any functional support. The functional personnel argue that the feasibility study is inaccurate because the functional "experts" are not involved. The project managers, on the other hand, stipulate that they never have sufficient time or money to involve the functional personnel. Can this situation be resolved?

4–40 How would you go about training individuals within your company or industry to be good project managers? What assumptions are you making?

4–41 Should project teams be allowed to evolve by themselves?

4–42 At what point or phase in the life cycle of a project should a project manager be appointed?

4–43 Top management generally has two schools of thought concerning project management. One school states that the project manager should be used as a means for coordinating activities that cut across several functional departments. The second school states that the project management position should be used as a means of creating future general managers. Which school of thought is correct?

4–44 Some executives feel that personnel working in a project office should be cross-trained in several assistant project management functions. What do you think about this?

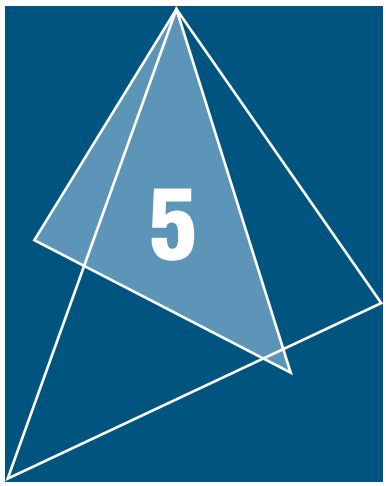
4–45 A company has a policy that employees wishing to be project managers must first spend one to one-and-a-half years in the functional employee side of the house so that they can get to know the employees and company policy. What do you think about this?

4–46 Your project has grown to a point where there now exist openings for three full-time assistant project managers. Unfortunately, there are no experienced assistant project managers available. You are told by upper-level management that you will fill these three positions by promotions from within. Where in the organization should you look? During an interview, what questions should you ask potential candidates? Is it possible that you could find candidates who are qualified to be promoted vertically but not horizontally?

4–47 A functional employee has demonstrated the necessary attributes of a potentially successful project manager. Top management can:

- Promote the individual in salary and grade and transfer him into project management.
- Laterally transfer the employee into project management without any salary or grade increase. If, after three to six months, the employee demonstrates that he can perform, he will receive an appropriate salary and grade increase.
- Give the employee either a grade increase without any salary increase, or a small salary increase without any grade increase, under the stipulation that additional awards will be given at the end of the observation period, assuming that the employee can handle the position.

If you were in top management, which method would you prefer? If you dislike the above three choices, develop your own alternative. What are the advantages and disadvantages of each choice? For each choice, discuss the ramifications if the employee cannot handle the project management position.



Management Functions

Related Case Studies (from Kerzner/*Project Management Case Studies*, 3rd Edition)	Related Workbook Exercises (from Kerzner/*Project Management Workbook and PMP®/CAPM® Exam Study Guide*, 10th Edition)	PMBOK® Guide, 4th Edition, Reference Section for the PMP® Certification Exam
• Wynn Computer Equipment (WCE) • The Trophy Project*	• The Communication Problem • Meetings, Meetings, and Meetings • The Empowerment Problem • Project Management Psychology • Multiple Choice Exam • Crossword Puzzle on Human Resource Management • Crossword Puzzle on Communications Management	• Human Resource Management • Communications Management

5.0 INTRODUCTION

PMBOK® Guide, 4th Edition
1.6 Project Management Skills
1.4.4 Role of the PMO

As we have stated, the project manager measures his success by how well he can negotiate with both upper-level and functional management for the resources necessary to achieve the project objective. Moreover, the project manager may have a great deal of delegated authority but very little

*Case Study also appears at end of chapter.

power. Hence, the managerial skills he requires for successful performance may be drastically different from those of his functional management counterparts.

The difficult aspect of the project management environment is that individuals at the project–functional interface must report to two bosses. Functional managers and project managers, by virtue of their different authority levels and responsibilities, treat their people in different fashions depending on their "management school" philosophies. There are generally five management schools, as described below:

- *The classical/traditional school:* Management is the process of getting things done (i.e., achieving objectives) by working both with and through people operating in organized groups. Emphasis is placed on the end-item or objective, with little regard for the people involved.
- *The empirical school:* Managerial capabilities can be developed by studying the experiences of other managers, whether or not the situations are similar.
- *The behavioral school:* Two classrooms are considered within this school. First, we have the human relations classroom in which we emphasize the interpersonal relationship between individuals and their work. The second classroom includes the social system of the individual. Management is considered to be a system of cultural relationships involving social change.
- *The decision theory school:* Management is a rational approach to decision making using a system of mathematical models and processes, such as operations research and management science.
- *The management systems school:* Management is the development of a systems model, characterized by input, processing, and output, and directly identifies the flow of resources (money, equipment, facilities, personnel, information, and material) necessary to obtain some objective by either maximizing or minimizing some objective function. The management systems school also includes contingency theory, which stresses that each situation is unique and must be optimized separately within the constraints of the system.

In a project environment, functional managers are generally practitioners of the first three schools of management, whereas project managers utilize the last two. This imposes hardships on both the project managers and functional representatives. The project manager must motivate functional representatives toward project dedication on the horizontal line using management systems theory and quantitative tools, often with little regard for the employee. After all, the employee might be assigned for a very short-term effort, whereas the end-item is the most important objective. The functional manager, however, expresses more concern for the individual needs of the employee using the traditional or behavioral schools of management.

Modern practitioners still tend to identify management responsibilities and skills in terms of the principles and functions developed in the early management schools, namely:

- Planning
- Organizing
- Staffing
- Controlling
- Directing

Although these management functions have generally been applied to traditional management structures, they have recently been redefined for temporary management positions. Their fundamental meanings remain the same, but the applications are different.

5.1 CONTROLLING

Controlling is a three-step process of measuring progress toward an objective, evaluating what remains to be done, and taking the necessary corrective action to achieve or exceed the objectives. These three steps—measuring, evaluating, and correcting—are defined as follows:

- *Measuring:* determining through formal and informal reports the degree to which progress toward objectives is being made.
- *Evaluating:* determining cause of and possible ways to act on significant deviations from planned performance.
- *Correcting:* taking control action to correct an unfavorable trend or to take advantage of an unusually favorable trend.

The project manager is responsible for ensuring the accomplishment of group and organizational goals and objectives. To effect this, he must have a thorough knowledge of standards and cost control policies and procedures so that a comparison is possible between operating results and preestablished standards. The project manager must then take the necessary corrective actions. Later chapters provide a more in-depth analysis of control, especially the cost control function.

In Chapter 1, we stated that project managers must understand organizational behavior in order to be effective and must have strong interpersonal skills. This is especially important during the controlling function. Line managers may have the luxury of time to build up relationships with each of their workers. But for a project manager time is a constraint, and it is not always easy to predict how well or how poorly an individual will interact with a group, especially if the project manager has never worked with this employee previously. Understanding the physiological and social behavior of how people perform in a group cannot happen overnight.

5.2 DIRECTING

Directing is the implementing and carrying out (through others) of those approved plans that are necessary to achieve or exceed objectives. Directing involves such steps as:

- *Staffing:* seeing that a qualified person is selected for each position.
- *Training:* teaching individuals and groups how to fulfill their duties and responsibilities.
- *Supervising:* giving others day-to-day instruction, guidance, and discipline as required so that they can fulfill their duties and responsibilities.
- *Delegating:* assigning work, responsibility, and authority so others can make maximum utilization of their abilities.
- *Motivating:* encouraging others to perform by fulfilling or appealing to their needs.

- *Counseling:* holding private discussions with another about how he might do better work, solve a personal problem, or realize his ambitions.
- *Coordinating:* seeing that activities are carried out in relation to their importance and with a minimum of conflict.

Directing subordinates is not an easy task because of both the short time duration of the project and the fact that employees might still be assigned to a functional manager while temporarily assigned to your effort. The luxury of getting to "know" one's subordinates may not be possible in a project environment.

Project managers must be decisive and move forward rapidly whenever directives are necessary. It is better to decide an issue and be 10 percent wrong than it is to wait for the last 10 percent of a problem's input and cause a schedule delay and improper use of resources. Directives are most effective when the KISS (keep it simple, stupid) rule is applied. Directives should be written with one simple and clear objective so that subordinates can work effectively and get things done right the first time. Orders must be issued in a manner that expects immediate compliance. Whether people will obey an order depends mainly on the amount of respect they have for you. Therefore, never issue an order that you cannot enforce. Oral orders and directives should be disguised as suggestions or requests. The requestor should ask the receiver to repeat the oral orders so that there is no misunderstanding.

PMBOK® Guide, 4th Edition
Chapter 9 Human Resources Management
9.4 Manage the Team

Project managers must understand human behavior in order to motivate people toward successful accomplishment of project objectives. Douglas McGregor advocated that most workers can be categorized according to two theories.[1] The first, often referred to as Theory X, assumes that the average worker is inherently lazy and requires supervision. Theory X further assumes that:

- The average worker dislikes work and avoids work whenever possible.
- To induce adequate effort, the supervisor must threaten punishment and exercise careful supervision.
- The average worker avoids increased responsibility and seeks to be directed.

The manager who accepts Theory X normally exercises authoritarian-type control over workers and allows little participation during decision-making. Theory X employees generally favor lack of responsibility, especially in decision-making.

According to Theory Y, employees are willing to get the job done without constant supervision. Theory Y further assumes that:

- The average worker wants to be active and finds the physical and mental effort on the job satisfying.
- Greatest results come from willing participation, which will tend to produce self-direction toward goals without coercion and control.
- The average worker seeks opportunity for personal improvement and self-respect.

1. Douglas McGregor, *The Human Side of Enterprise* (New York: McGraw-Hill, 1960), pp. 33–34.

The manager who accepts Theory Y normally advocates participation and a management–employee relationship. However, in working with professionals, especially engineers, special care must be exercised because these individuals often pride themselves on their ability to find a better way to achieve the end result regardless of cost. If this happens, project managers must become authoritarian leaders and treat Theory Y employees as though they are Theory X.

William Ouchi has identified a Theory Z that emphasizes the Japanese cultural values and the behavior of the Japanese workers.[2] According to Theory Z, there exist significant differences between the Japanese and American cultures and how the workers are treated. The Japanese focus on lifetime employment whereas the Americans look at short-term employment. The Japanese focus on collective decision-making such as in quality circles whereas Americans focus on individual decision-making. The Japanese emphasize informal administrative control whereas the Americans lean toward a more formal control. Japanese companies place workers on nonspecialized career paths with slow evaluation and promotion whereas Americans prefer specialized career path opportunities with rapid evaluation and promotion. Finally, Japanese managers have more of an interest in the personal life of their workers than do American managers.

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Chapter 9 Human Resources Management
9.3.2 Develop the Team

Many psychologists have established the existence of a prioritized hierarchy of needs that motivate individuals toward satisfactory performance. Maslow was the first to identify these needs.[3] Maslow's hierarchy of needs is shown in Figure 5–1. The first level is that of the basic or physiological needs, namely, food, water, clothing, shelter, sleep, and sexual satisfaction. Simply speaking, human primal desire to satisfy these basic needs motivates him to do a good job.

After an employee has fulfilled his physiological needs, he turns to the next lower need, safety. Safety needs include economic security and protection from harm, disease, and violence. Safety can also include security. It is important that project managers realize this because these managers may find that as a project nears termination, functional employees are more interested in finding a new role for themselves than in giving their best to the current situation.

The next level contains the social needs, including love, belonging, togetherness, approval, and group membership. At this level, the informal organization plays a dominant role. Many people refuse promotions to project management (as project managers, project office personnel, or functional representatives) because they fear that they will lose their "membership" in the informal organization. This problem can occur even on short-duration projects. In a project environment, project managers generally do not belong to any informal organization and, therefore, tend to look outside the organization to fulfill this need. Project managers consider authority and funding to be very important in gaining project support. Functional personnel, however, prefer friendship and work assignments. In other words, the project manager can use the project itself as a means of helping fulfill the third level for the line employees (i.e., team spirit).

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2. W. G. Ouchi and A. M. Jaeger, "Type Z Organization: Stability in the Midst of Mobility," *Academy of Management Review*, April 1978, pp. 305–314.

3. Abraham Maslow, *Motivation and Personality* (New York: Harper and Brothers, 1954).

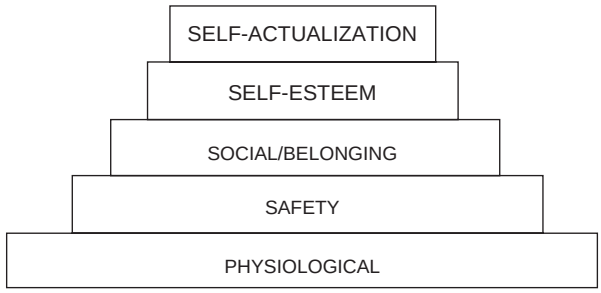


FIGURE 5–1. Maslow's hierarchy of needs.

The two lowest needs are esteem and self-actualization. The esteem need includes self-esteem (self-respect), reputation, the esteem of others, recognition, and self-confidence. Highly technical professionals are often not happy unless esteem needs are fulfilled. For example, many engineers strive to publish and invent as a means of satisfying these needs. These individuals often refuse promotions to project management because they believe that they cannot satisfy esteem needs in this position. Being called a project manager does not carry as much importance as being considered an expert in one's field by one's peers. The lowest need is self-actualization and includes doing what one can do best, desiring to utilize one's potential, full realization of one's potential, constant self-development, and a desire to be truly creative. Many good project managers find this level to be the most important and consider each new project as a challenge by which they can achieve self-actualization.

Frederick Herzberg and his associates conducted motivational research studies.[4] Herzberg concluded that Maslow's lower three levels (physiological, safety, and social needs) were hygiene factors that were either satisfied or dissatisfied. The only real motivational factors were the self-esteem and self-actualization needs. Herzberg believed that the physiological needs were hygiene factors and were extremely short-term needs. Self-esteem and self-actualization were more long-term needs and could be increased through job rotation, which includes job enrichment.

Another motivational technique can be related to the concept of expectancy theory (also referred to as the immature–mature organization), which was developed by the behaviorist Chris Argyris. Expectancy theory says that when the needs of the organization and the needs of the individual are congruent, both parties benefit and motivation increases. When there is incongruence between the needs of the individual and the needs of the organization, the individual will experience:

- Frustration
- Psychological failure
- Short-term perspectives
- Conflict

4. F. Herzberg, B. Mausner, and B. B. Snyderman, *The Motivation to Work* (New York: John Wiley & Sons, 1959).

Project managers must motivate temporarily assigned individuals by appealing to their desires to fulfill the lowest two levels, but not by making promises that cannot be met. Project managers must motivate by providing:

- A feeling of pride or satisfaction for one's ego
- Security of opportunity
- Security of approval
- Security of advancement, if possible
- Security of promotion, if possible
- Security of recognition
- A means for doing a better job, not a means to keep a job

Understanding professional needs is an important factor in helping people realize their true potential. Such needs include:

- Interesting and challenging work
- Professionally stimulating work environment
- Professional growth
- Overall leadership (ability to lead)
- Tangible rewards
- Technical expertise (within the team)
- Management assistance in problem-solving
- Clearly defined objectives
- Proper management control
- Job security
- Senior management support
- Good interpersonal relations
- Proper planning
- Clear role definition
- Open communications
- A minimum of changes

Motivating employees so that they feel secure on the job is not easy, especially since a project has a finite lifetime. Specific methods for producing security in a project environment include:

- Letting people know why they are where they are
- Making individuals feel that they belong where they are
- Placing individuals in positions for which they are properly trained
- Letting employees know how their efforts fit into the big picture

Since project managers cannot motivate by promising material gains, they must appeal to each person's pride. The guidelines for proper motivation are:

- Adopt a positive attitude
- Do not criticize management

- Do not make promises that cannot be kept
- Circulate customer reports
- Give each person the attention he requires

There are several ways of motivating project personnel. Some effective ways include:

- Giving assignments that provide challenges
- Clearly defining performance expectations
- Giving proper criticism as well as credit
- Giving honest appraisals
- Providing a good working atmosphere
- Developing a team attitude
- Providing a proper direction (even if Theory Y)

5.3 PROJECT AUTHORITY

PMBOK® Guide, 4th Edition
9.1.3 Human Resource Planning

Project management structures create a web of relationships that can cause chaos in the delegation of authority and the internal authority structure. Four questions must be considered in describing project authority:

- What is project authority?
- What is power, and how is it achieved?
- How much project authority should be granted to the project manager?
- Who settles project authority interface problems?

One form of the project manager's authority can be defined as the legal or rightful power to command, act, or direct the activities of others. Authority can be delegated from one's superiors. Power, on the other hand, is granted to an individual by his subordinates and is a measure of their respect for him. A manager's authority is a combination of his power and influence such that subordinates, peers, and associates willingly accept his judgment.

In the traditional structure, the power spectrum is realized through the hierarchy, whereas in the project structure, power comes from credibility, expertise, or being a sound decision-maker.

Authority is the key to the project management process. The project manager must manage across functional and organizational lines by bringing together activities required to accomplish the objectives of a specific project. Project authority provides the way of thinking required to unify all organizational activities toward accomplishment of the project regardless of where they are located. The project manager who fails to build and maintain his alliances will soon find opposition or indifference to his project requirements.

The amount of authority granted to the project manager varies according to project size, management philosophy, and management interpretation of potential conflicts with

functional managers. There do exist, however, certain fundamental elements over which the project manager must have authority in order to maintain effective control. According to Steiner and Ryan[5]:

> The project manager should have broad authority over all elements of the project. His authority should be sufficient to permit him to engage all necessary managerial and technical actions required to complete the project successfully. He should have appropriate authority in design and in making technical decisions in development. He should be able to control funds, schedule and quality of product. If subcontractors are used, he should have maximum authority in their selection.

Generally speaking, a project manager should have more authority than his responsibility calls for, the exact amount of authority usually depending on the amount of risk that the project manager must take. The greater the risk, the greater the amount of authority. A good project manager knows where his authority ends and does not hold an employee responsible for duties that he (the project manager) does not have the authority to enforce. Some projects are directed by project managers who have only monitoring authority. These project managers are referred to as influence project managers.

Failure to establish authority relationships can result in:

- Poor communication channels
- Misleading information
- Antagonism, especially from the informal organization
- Poor working relationships with superiors, subordinates, peers, and associates
- Surprises for the customer

The following are the most common sources of power and authority problems in a project environment:

- Poorly documented or no formal authority
- Power and authority perceived incorrectly
- Dual accountability of personnel
- Two bosses (who often disagree)
- The project organization encouraging individualism
- Subordinate relations stronger than peer or superior relationships
- Shifting of personnel loyalties from vertical to horizontal lines
- Group decision-making based on the strongest group
- Ability to influence or administer rewards and punishment
- Sharing resources among several projects

The project manager does not have unilateral authority in the project effort. He frequently negotiates with the functional manager. The project manager has the authority to

5. Reprinted from George A. Steiner and William G. Ryan, *Industrial Project Management* (1968), p. 24. Copyright © 1968 by the Trustees of Columbia University in the City of New York. Reprinted with permission of The Free Press, a division of Simon and Schuster.

determine the "when" and "what" of the project activities, whereas the functional manager has the authority to determine "how the support will be given." The project manager accomplishes his objectives by working with personnel who are largely professional. For professional personnel, project leadership must include explaining the rationale of the effort as well as the more obvious functions of planning, organizing, directing, and controlling.

Certain ground rules exist for authority control through negotiations:

- Negotiations should take place at the lowest level of interaction.
- Definition of the problem must be the first priority:
  - The issue
  - The impact
  - The alternative
  - The recommendations
- Higher-level authority should be used if, and only if, agreement cannot be reached.

The critical stage of any project is planning. This includes more than just planning the activities to be accomplished; it also includes the planning and establishment of the authority relationships that must exist for the duration of the project. Because the project management environment is an ever-changing one, each project establishes its own policies and procedures, a situation that can ultimately result in a variety of authority relationships. It is therefore possible for functional personnel to have different responsibilities on different projects, even if the tasks are the same.

During the planning phase the project team develops a responsibility assignment matrix (RAM) that contains such elements as:

- General management responsibility
- Operations management responsibility
- Specialized responsibility
- Who must be consulted
- Who may be consulted
- Who must be notified
- Who must approve

The responsibility matrix is often referred to as a linear responsibility chart (LRC) or responsibility assignment matrix (RAM). Linear responsibility charts identify the participants, and to what degree an activity will be performed or a decision will be made. The LRC attempts to clarify the authority relationships that can exist when functional units share common work. As described by Cleland and King[6]:

> The need for a device to clarify the authority relationships is evident from the relative unity of the traditional pyramidal chart, which (1) is merely a simple portrayal of the overall

6. From David I. Cleland and William Richard King, *Systems Analysis and Project Management* (New York: McGraw-Hill), p. 271.

functional and authority models and (2) must be combined with detailed position descriptions and organizational manuals to delineate authority relationships and work performance duties.

Figure 5–2 shows a typical linear responsibility chart. The rows, which indicate the activities, responsibilities, or functions required, can be all of the tasks in the work breakdown structure. The columns identify either positions, titles, or the people themselves. If the chart will be given to an outside customer, then only the titles should appear, or the customer will call the employees directly without going through the project manager. The symbols indicate the degrees of authority or responsibility existing between the rows and columns.

Another example of an LRC is shown in Figure 5–3. In this case, the LRC is used to describe how internal and external communications should take place. This type of chart can be used to eliminate communications conflicts. Consider a customer who is unhappy about having all of his information filtered through the project manager and requests that his line people be permitted to talk to your line people on a one-on-one basis.

PMBOK® Guide, 4th Edition
9.1.2 Human Resource Planning
Tools and Techniques

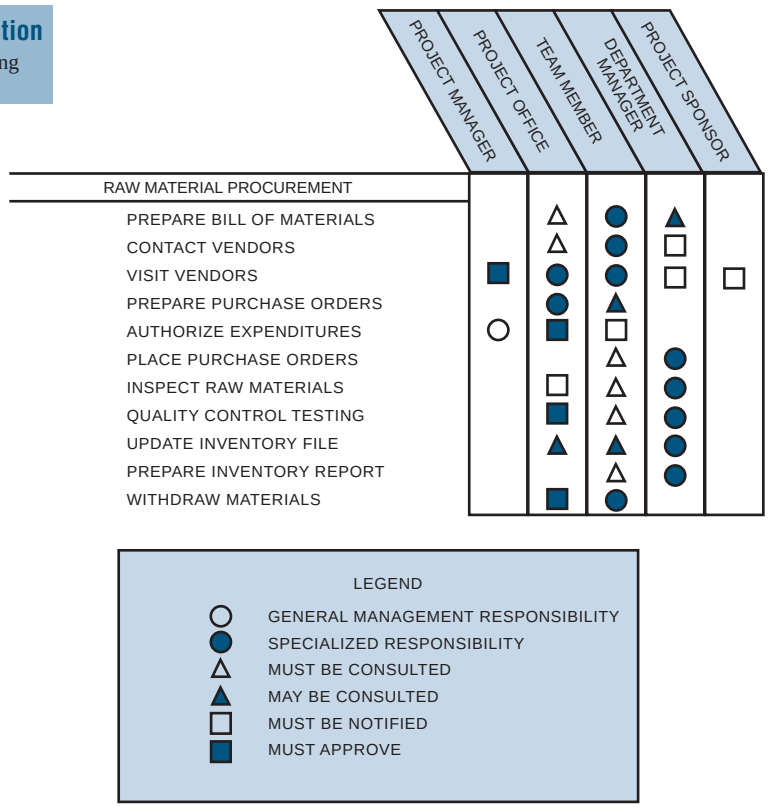


FIGURE 5–2. Linear responsibility chart (responsibility assignment matrix).

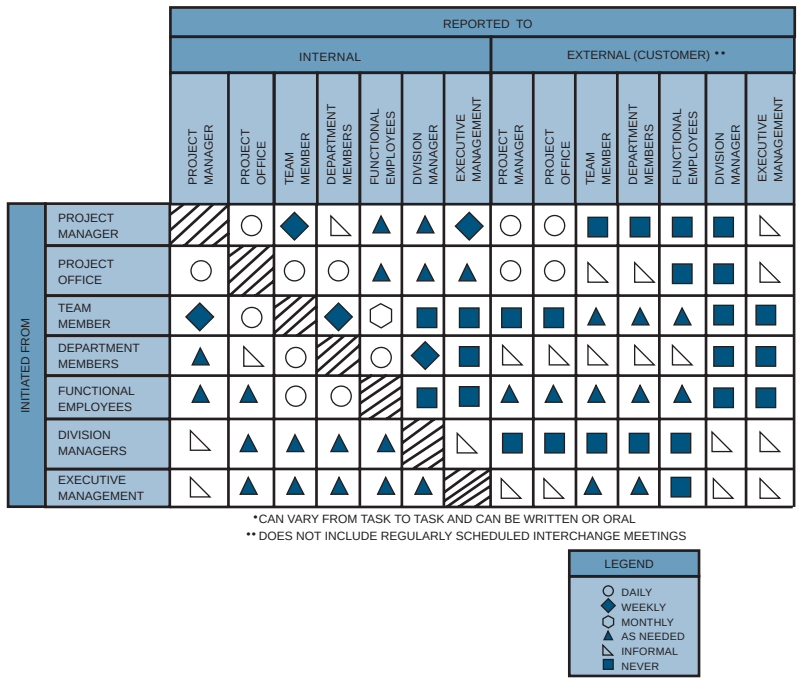


FIGURE 5–3. Communications responsibility matrix.*

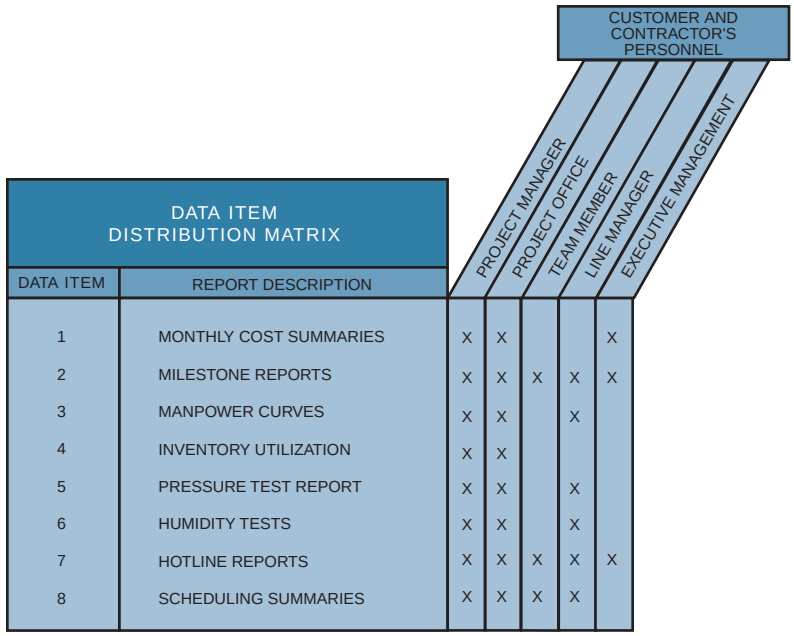
You may have no choice but to permit this, but you should make sure that the customer understands that:

- Functional employees cannot make commitments for additional work or resources.
- Functional employees give their own opinion and not that of the company.
- Company policy comes through the project office.

Figures 5–4 and 5–5 are examples of modified LRCs. Figure 5–4 is used to show the distribution of data items, and Figure 5–5 identifies the skills distribution in the project office.

The responsibility matrix attempts to answer such questions as: "Who has signature authority?" "Who must be notified?" "Who can make the decision?" The questions can only be answered by clear definitions of authority, responsibility, and accountability:

- *Authority* is the right of an individual to make the necessary decisions required to achieve his objectives or responsibilities.
- *Responsibility* is the assignment for completion of a specific event or activity.
- *Accountability* is the acceptance of success or failure.



DATA ITEM DISTRIBUTION MATRIX

DATA ITEM	REPORT DESCRIPTION	PROJECT MANAGER	PROJECT OFFICE	TEAM MEMBER	LINE MANAGER	EXECUTIVE MANAGEMENT
1	MONTHLY COST SUMMARIES	X	X			X
2	MILESTONE REPORTS	X	X	X	X	X
3	MANPOWER CURVES	X	X		X	
4	INVENTORY UTILIZATION	X	X			
5	PRESSURE TEST REPORT	X	X		X	
6	HUMIDITY TESTS	X	X		X	
7	HOTLINE REPORTS	X	X	X	X	X
8	SCHEDULING SUMMARIES	X	X	X	X	

FIGURE 5–4. Data distribution matrix.

The linear responsibility chart, although a valuable tool for management, does have a weakness in that it does not describe how people interact within the program. The LRC must be considered with the organization for a full understanding of how interactions between individuals and organizations take place. As described by Karger and Murdick, the LRC has merit[7]:

> Obviously the chart has weaknesses, of which one of the larger ones is that it is a mechanical aid. Just because it says that something is a fact does not make it true. It is very difficult to discover, except generally, exactly what occurs in a company—and with whom. The chart tries to express in specific terms relationships that cannot always be delineated so clearly; moreover, the degree to which it can be done depends on the specific situation. This is the difference between the formal and informal organizations mentioned. Despite this, the Linear Responsibility Chart is one of the best devices for organization analysis known to the authors.

Linear responsibility charts can result from customer-imposed requirements above and beyond normal operations. For example, the customer may require as part of its quality control that a specific engineer supervise and approve all testing of a certain item or that another individual approve all data released to the customer over and above program office

7. D. W. Karger and R. G. Murdick, *Managing Engineering and Research* (New York: Industrial Press, 1963), p. 89.

FUNCTIONAL AREAS OF EXPERTISE / PROJECT TEAM	ABLE, J.	BAKER, P.	COOK, D.	DIRK, L.	EASLEY, P.	FRANKLIN, W.	GREEN, C.	HENRY, L.	IMHOFF, R.	JULES, C.	KLEIN, W.	LEDGER, D.	MAYER, O.	NEWTON, A.	OLIVER, G.	PRATT, L.
ADMINISTRATIVE MANAGEMENT		a				a		a			a	a			a	
COST CONTROL		b	b		b	b	b				b	b		b	b	
ECONOMIC ANALYSIS	c			c				c	c				c			c
ENERGY SYSTEMS		d	d		d		d			d			d		d	d
ENVIRONMENTAL IMPACT ASSESSMENT	e	e	e						e		e		e			
INDUSTRIAL ENGINEERING	f				f					f						
INSTRUMENTATION	g			g		g					g				g	
PIPING AND DESIGN LAYOUT	h		h		h	h				h			h			
PLANNING AND SCHEDULING		i		i	i			i				i		i		i
PROJECT MANAGEMENT	j			j		j					j				j	
PROJECT REPORTING		k	k		k			k	k			k		k		k
QUALITY CONTROL		l	l			l	l	l	l							
SITE EVALUATION		m				m			m	m				m		
SPECIFICATION PREPARATION			n	n			n				n		n			n
SYSTEM DESIGN		o	o		o		o	o		o		o			o	

FIGURE 5–5. Personal skills matrix.

approval. Such customer requirements necessitate LRCs and can cause disruptions and conflicts within an organization.

Several key factors affect the delegation of authority and responsibility, both from upper-level management to project management and from project management to functional management. These key factors include:

- The maturity of the project management function
- The size, nature, and business base of the company
- The size and nature of the project
- The life cycle of the project
- The capabilities of management at all levels

Once agreement has been reached as to the project manager's authority and responsibility, the results must be documented to clearly delineate his role in regard to:

- His focal position
- Conflict between the project manager and functional managers
- Influence to cut across functional and organizational lines
- Participation in major management and technical decisions
- Collaboration in staffing the project
- Control over allocation and expenditure of funds
- Selection of subcontractors
- Rights in resolving conflicts
- Voice in maintaining integrity of the project team
- Establishment of project plans
- Providing a cost-effective information system for control
- Providing leadership in preparing operational requirements
- Maintaining prime customer liaison and contact
- Promoting technological and managerial improvements
- Establishment of project organization for the duration
- Cutting red tape

Perhaps the best way to document the project manager's authority is through the project charter, which is one of the three methods, shown in Figure 5–6, by which project managers attain authority. Documenting the project manager's authority is necessary because:

- All interfacing must be kept as simple as possible.
- The project manager must have the authority to "force" functional managers to depart from existing standards and possibly incur risk.
- The project manager must gain authority over those elements of a program that are not under his control. This is normally achieved by earning the respect of the individuals concerned.
- The project manager should not attempt to fully describe the exact authority and responsibilities of his project office personnel or team members. Instead, he should encourage problem-solving rather than role definition.

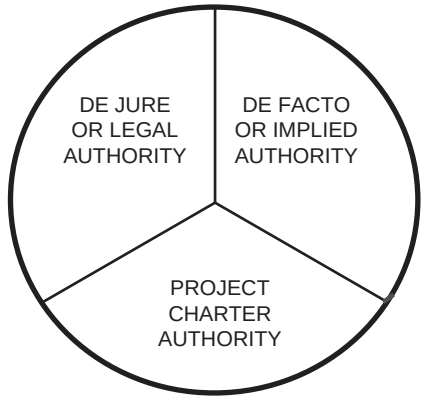


FIGURE 5–6. Types of project authority.

5.4 INTERPERSONAL INFLUENCES

PMBOK® Guide, 4th Edition
9.1.2 Human Resource Planning
Tools and Techniques

There exist a variety of relationships (although they are not always clearly definable) between power and authority. These relationships are usually measured by "relative" decision power as a function of the authority structure, and are strongly dependent on the project organizational form.

Consider the following statements made by project managers:

- "I've had good working relations with department X. They like me and I like them. I can usually push through anything ahead of schedule."
- "I know it's contrary to department policy, but the test must be conducted according to these criteria or else the results will be meaningless" (remark made to a team member by a research scientist who was temporarily promoted to project management for an advanced state-of-the-art effort).

Project managers are generally known for having a lot of delegated authority but very little formal power. They must, therefore, get jobs done through the use of interpersonal influences. There are five such interpersonal influences:

- *Legitimate power:* the ability to gain support because project personnel perceive the project manager as being officially empowered to issue orders.
- *Reward power:* the ability to gain support because project personnel perceive the project manager as capable of directly or indirectly dispensing valued organizational rewards (i.e., salary, promotion, bonus, future work assignments).
- *Penalty power:* the ability to gain support because the project personnel perceive the project manager as capable of directly or indirectly dispensing penalties that they wish to avoid. Penalty power usually derives from the same source as reward power, with one being a necessary condition for the other.

- *Expert power:* the ability to gain support because personnel perceive the project manager as possessing special knowledge or expertise (that functional personnel consider as important).
- *Referent power:* the ability to gain support because project personnel feel personally attracted to the project manager or his project.

Expert and referent power are examples of personal power that comes from the personal qualities or characteristics to which team members are attracted. Legitimate, reward,

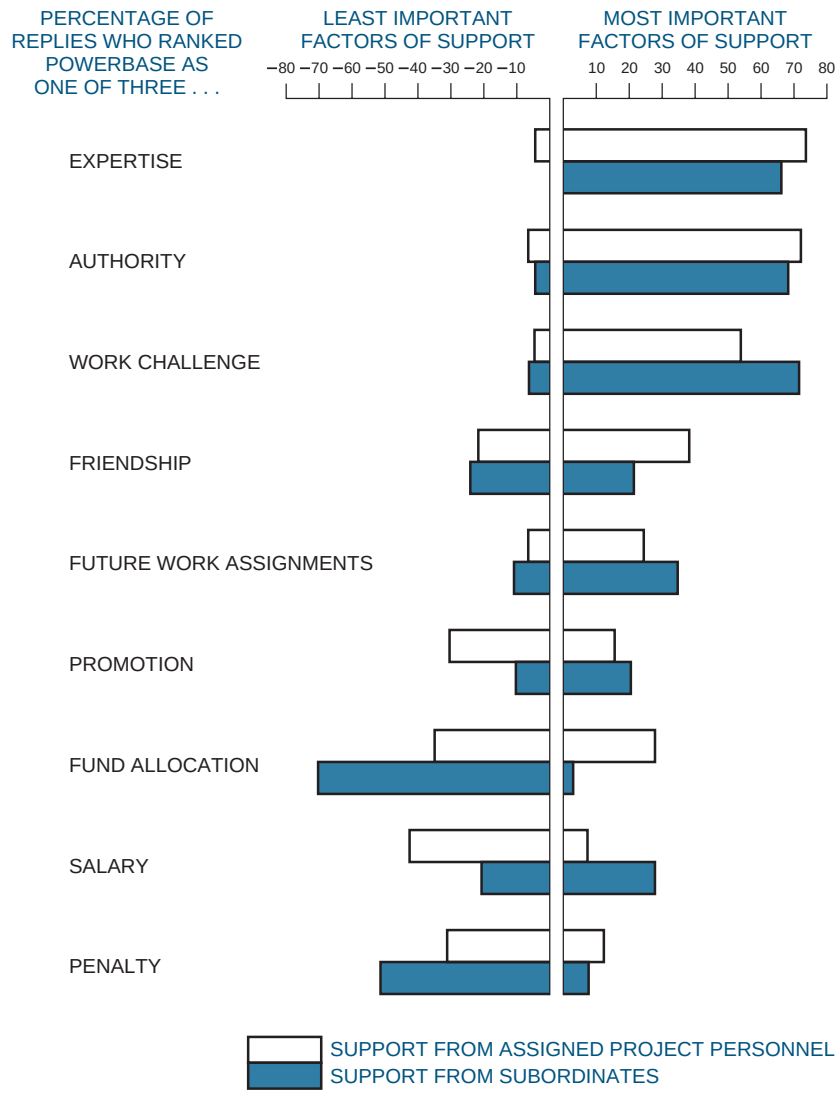


FIGURE 5–7. Significance of factors of support to project management. *Source: Seminar in Project Management Workbook,* © 1979 by Hans J. Thamhain. Reproduced by permission.

and penalty power are often referred to as examples of position power, which is directly related to one's position within the organization. Line managers generally possess a great amount of position power. But in a project environment, position power may be difficult to achieve. According to Magenau and Pinto[8]:

> Within the arena of project management, the whole issue of position power becomes more problematic. Project managers in many organizations operate outside the standard functional hierarchy. While that position allows them a certain freedom of action without direct oversight, it has some important concomitant disadvantages, particularly as they pertain to positional power. First, because cross-functional relationships between the project manager and other functional departments can be ill-defined, project managers discover rather quickly that they have little or no legitimate power to simply force their decisions through the organizational system. Functional departments usually do not have to recognize the rights of the project managers to interfere with functional responsibilities; consequently, novice project managers hoping to rely on positional power to implement their projects are quickly disabused.
>
> As a second problem with the use of positional power, in many organizations, project managers have minimal authority to reward team members who, because they are temporary subordinates, maintain direct ties and loyalties to their functional departments. In fact, project managers may not even have the opportunity to complete a performance evaluation on these temporary team members. Likewise, for similar reasons, project managers may have minimal authority to punish inappropriate behavior. Therefore, they may discover that they have the ability to neither offer the carrot nor threaten the stick. As a result, in addition to positional power, it is often necessary that effective project managers seek to develop their personal power bases.

The following six situations are examples of referent power (the first two are also reward power):

- The employee might be able to get personal favors from the project manager.
- The employee feels that the project manager is a winner and the rewards will be passed down to the employee.
- The employee and the project manager have strong ties, such as the same foursome for golf.
- The employee likes the project manager’s manner of treating people.
- The employee wants identification with a specific product or product line.
- The employee has personal problems and believes that he can get empathy or understanding from the project manager.

Figure 5–7 shows how project managers perceive their influence style.

Like relative power, interpersonal influences can be identified with various project organizational forms as to their relative value. This is shown in Figure 5–8.

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8. John M. Magenau, and Jeffrey K. Pinto, “Power, Influence, and Negotiation in Project Management,” Peter W. G. Morris and Jeffrey Pinto, eds., *Project Organization and Project Management Competencies* (Wiley, 2007), p. 91. Reprinted by permission of John Wiley.

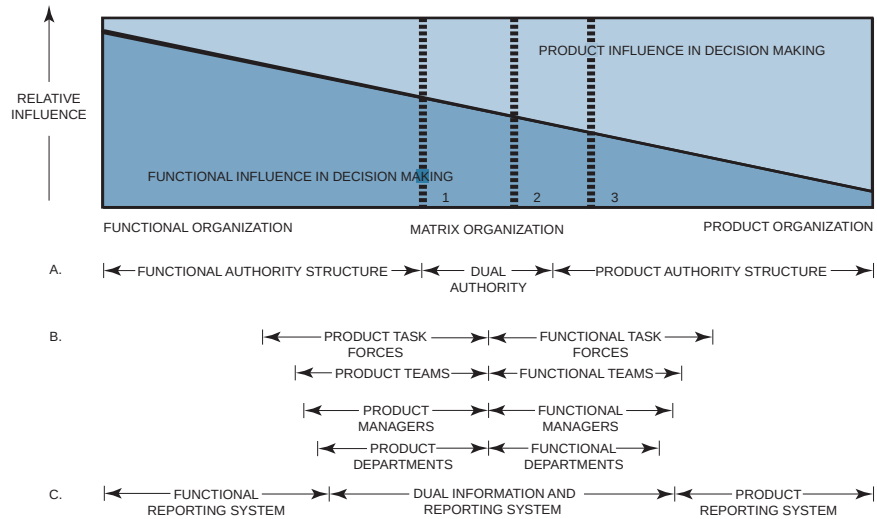

FIGURE 5–8. The range of alternatives. *Source:* Jay R. Galbraith, "Matrix Organization Designs." Reprinted with permission from *Business Horizons*, February 1971, p. 37. Copyright © 1971 by the Board of Trustees at Indiana University.

For any temporary management structure to be effective, there must exist a rational balance of power between functional and project management. Unfortunately, a balance of equal power is often impossible to obtain because each project is inherently different from others, and the project managers possess different leadership abilities.

Achievement of this balance is a never-ending challenge for management. If time and cost constraints on a project cannot be met, the project influence in decision-making increases, as can be seen in Figure 5–8. If the technology or performance constraints need reappraisal, then the functional influence in decision-making will dominate.

Regardless of how much authority and power a project manager develops over the course of the project, the ultimate factor in his ability to get the job done is usually his leadership style. Developing bonds of trust, friendship, and respect with the functional workers can promote success.

5.5 BARRIERS TO PROJECT TEAM DEVELOPMENT

PMBOK® Guide, 4th Edition
9.3 Develop Project Team

Most people within project-driven and non–project-driven organizations have differing views of project management. Table 5–1 compares the project and functional viewpoints of project management. These differing views can create severe barriers to successful project management operations.

The understanding of barriers to project team building can help in developing an environment conducive to effective teamwork. The following barriers are typical for many project environments.

TABLE 5–1. COMPARISON OF THE FUNCTIONAL AND THE PROJECT VIEWPOINTS

Phenomena	Project Viewpoint	Functional Viewpoint
Line–staff organizational dichotomy	Vestiges of the hierarchical model remain: the line functions are placed in a support position. A web of authority and responsibility exists.	Line functions have direct responsibility for accomplishing the objectives; line commands, and staff advises.
Scalar principle	Elements of the vertical chain exist, but prime emphasis is placed on horizontal and diagonal work flow. Important business is conducted as the legitimacy of the task requires.	The chain of authority relationships is from superior to subordinate throughout the organization. Central, crucial, and important business is conducted up and down the vertical hierarchy.
Superior–subordinate relationship	Peer-to-peer, manager-to-technical expert, associate-to-associate, etc., relationships are used to conduct much of the salient business.	This is the most important relationship; if kept healthy, success will follow. All important business is conducted through a pyramiding structure of superiors and subordinates
Organizational objectives	Management of a project becomes a joint venture of many relatively independent organizations. Thus, the objective becomes multilateral.	Organizational objectives are sought by the parent unit (an assembly of suborganizations) working within its environment. The objective is unilateral.
Unity of direction	The project manager manages across functional and organizational lines to accomplish a common interorganizational objective.	The general manager acts as the one head for a group of activities having the same plan.
Parity of authority and responsibility	Considerable opportunity exists for the project manager's responsibility to exceed his authority. Support people are often responsible to other managers (functional) for pay, performance reports, promotions, etc.	Consistent with functional management; the integrity of the superior–subordinate relationship is maintained through functional authority and advisory staff services.
Time duration	The project (and hence the organization) is finite in duration.	Tends to perpetuate itself to provide continuing facilitative support.

Source: David I. Cleland, "Project Management," in David I. Cleland and William R. King, eds., *Systems Organizations, Analysis, Management: A Book of Readings* (New York: McGraw-Hill, Inc., 1969), pp. 281–290. © 1969 by McGraw-Hill Inc. Reprinted with permission of the publisher.

Differing outlooks, priorities, and interests. A major barrier exists when team members have professional objectives and interests that are different from the project objectives. These problems are compounded when the team relies on support organizations that have different interests and priorities.

Role conflicts. Team development efforts are thwarted when role conflicts exist among the team members, such as ambiguity over who does what within the project team and in external support groups.

Project objectives/outcomes not clear. Unclear project objectives frequently lead to conflict, ambiguities, and power struggles. It becomes difficult, if not impossible, to define roles and responsibilities clearly.

Dynamic project environments. Many projects operate in a continual state of change. For example, senior management may keep changing the project scope, objectives, and resource base. In other situations, regulatory changes or client demands can drastically affect the internal operations of a project team.

Competition over team leadership. Project leaders frequently indicated that this barrier most likely occurs in the early phases of a project or if the project runs into severe problems. Obviously, such cases of leadership challenge can result in barriers to team building. Frequently, these challenges are covert challenges to the project leader's ability.

Lack of team definition and structure. Many senior managers complain that teamwork is severely impaired because it lacks clearly defined task responsibilities and reporting structures. We find this situation is most prevalent in dynamic, organizationally unstructured work environments such as computer systems and R&D projects. A common pattern is that a support department is charged with a task but no one leader is clearly delegated the responsibility. As a consequence, some personnel are working on the project but are not entirely clear on the extent of their responsibilities. In other cases, problems result when a project is supported by several departments without interdisciplinary coordination.

Team personnel selection. This barrier develops when personnel feel unfairly treated or threatened during the staffing of a project. In some cases, project personnel are assigned to a team by functional managers, and the project manager has little or no input into the selection process. This can impede team development efforts, especially when the project leader is given available personnel versus the best, hand-picked team members. The assignment of "available personnel" can result in several problems (e.g., low motivation levels, discontent, and uncommitted team members). We've found, as a rule, that the more power the project leader has over the selection of his team members, and the more negotiated agreement there is over the assigned task, the more likely it is that team-building efforts will be fruitful.

Credibility of project leader. Team-building efforts are hampered when the project leader suffers from poor credibility within the team or from other managers. In such cases, team members are often reluctant to make a commitment to the project or the leader. Credibility problems may come from poor managerial skills, poor technical judgments, or lack of experience relevant to the project.

Lack of team member commitment. Lack of commitment can have several sources. For example, the team members having professional interests elsewhere, the feeling of insecurity that is associated with projects, the unclear nature of the rewards that may be forthcoming upon successful completion, and intense interpersonal conflicts within the team can all lead to lack of commitment.

Lack of team member commitment may result from suspicious attitudes existing between the project leader and a functional support manager, or between two team members from two warring functional departments. Finally, low commitment levels are likely to occur when a "star" on a team "demands" too much effort from other team members or too much attention from the team leader. One team leader put it this way: "A lot of teams have their prima donnas and you learn to live and function with them. They can be critical to overall success. But some stars can be so demanding on everyone that they'll kill the team's motivation."

Communication problems. Not surprisingly, poor communication is a major enemy to effective team development. Poor communication exists on four major levels: problems of communication among team members, between the project leader and the team members, between the project team and top management, and between the project leaders and the client. Often the problem is caused by team members simply not keeping others informed on key project developments. Yet the "whys" of poor communication patterns are far more difficult to determine. The problem can result from low motivation levels, poor morale, or carelessness. It was also discovered that poor communication patterns between the team and support groups result in severe team-building problems, as does poor communication with the client. Poor communication practices often lead to unclear objectives and poor project control, coordination, and work flow.

Lack of senior management support. Project leaders often indicate that senior management support and commitment is unclear and subject to waxing and waning over the project life cycle. This behavior can result in an uneasy feeling among team members and lead to low levels of enthusiasm and project commitment. Two other common problems are that senior management often does not help set the right environment for the project team at the outset, nor do they give the team timely feedback on their performance and activities during the life of the project.

Project managers who are successfully performing their role not only recognize these barriers but also know when in the project life cycle they are most likely to occur. Moreover, these managers take preventive actions and usually foster a work environment that is conducive to effective teamwork. The effective team builder is usually a social architect who understands the interaction of organizational and behavior variables and can foster a climate of active participation and minimal conflict. This requires carefully developed skills in leadership, administration, organization, and technical expertise on the project. However, besides the delicately balanced management skills, the project manager's sensitivity to the basic issues underlying each barrier can help to increase success in developing an effective project team. Specific suggestions for team building are advanced in Table 5–2.

5.6 SUGGESTIONS FOR HANDLING THE NEWLY FORMED TEAM

A major problem faced by many project leaders is managing the anxiety that usually develops when a new team is formed. The anxiety experienced by team members is normal and predictable, but is a barrier to getting the team quickly focused on the task.

TABLE 5–2. BARRIERS TO EFFECTIVE TEAM BUILDING AND SUGGESTED HANDLING APPROACHES

Barrier	Suggestions for Effectively Managing Barriers (How to Minimize or Eliminate Barriers)
Differing outlooks, priorities, interests, and judgments of team members	Make effort early in the project life cycle to discover these conflicting differences. Fully explain the scope of the project and the rewards that may be forthcoming on successful project completion. Sell "team" concept and explain responsibilities. Try to blend individual interests with the overall project objectives.
Role conflicts	As early in a project as feasible, ask team members where they see themselves fitting into the project. Determine how the overall project can best be divided into subsystems and subtasks (e.g., the work breakdown structure). Assign/negotiate roles. Conduct regular status review meetings to keep team informed on progress and watch for unanticipated role conflicts over the project's life.
Project objectives/outcomes not clear	Assure that all parties understand the overall and interdisciplinary project objectives. Clear and frequent communication with senior management and the client becomes critically important. Status review meetings can be used for feedback. Finally, a proper team name can help to reinforce the project objectives.
Dynamic project environments	The major challenge is to stabilize external influences. First, key project personnel must work out an agreement on the principal project direction and "sell" this direction to the total team. Also educate senior management and the customer on the detrimental consequences of unwarranted change. It is critically important to forecast the "environment" within which the project will be developed. Develop contingency plans.
Competition over team leadership	Senior management must help establish the project manager's leadership role. On the other hand, the project manager needs to fulfill the leadership expectations of team members. Clear role and responsibility definition often minimizes competition over leadership.
Lack of team definition and structure	Project leaders need to sell the team concept to senior management as well as to their team members. Regular meetings with the team will reinforce the team notion as will clearly defined tasks, roles, and responsibilities. Also, visibility in memos and other forms of written media as well as senior management and client participation can unify the team.
Project personnel selection	Attempt to negotiate the project assignments with potential team members. Clearly discuss with potential team members the importance of the project, their role in it, what rewards might result on completion, and the general "rules of the road" of project management. Finally, if team members remain uninterested in the project, then replacement should be considered.
Credibility of project leader	Credibility of the project leader among team members is crucial. It grows with the image of a sound decision-maker in both general management and relevant technical expertise. Credibility can be enhanced by the project leader's relationship to other key managers who support the team's efforts.

(*continues*)

TABLE 5–2. BARRIERS TO EFFECTIVE TEAM BUILDING AND SUGGESTED HANDLING APPROACHES (*Continued*)

Barrier	Suggestions for Effectively Managing Barriers (How to Minimize or Eliminate Barriers)
Lack of team member commitment	Try to determine lack of team member commitment early in the life of the project and attempt to change possible negative views toward the project. Often, insecurity is a major reason for the lack of commitment; try to determine why insecurity exists, then work on reducing the team members' fears. Conflicts with other team members may be another reason for lack of commitment. It is important for the project leader to intervene and mediate the conflict quickly. Finally, if a team member's professional interests lie elsewhere, the project leader should examine ways to satisfy part of the team member's interests or consider replacement.
Communication problems	The project leader should devote considerable time communicating with individual team members about their needs and concerns. In addition, the leader should provide a vehicle for timely sessions to encourage communications among the individual team contributors. Tools for enhancing communications are status meetings, reviews, schedules, reporting system, and colocation. Similarly, the project leader should establish regular and thorough communications with the client and senior management. Emphasis is placed on written and oral communications with key issues and agreements in writing.
Lack of senior management support	Senior management support is an absolute necessity for dealing effectively with interface groups and proper resource commitment. Therefore, a major goal for project leaders is to maintain the continued interest and commitment of senior management in their projects. We suggest that senior management become an integral part of project reviews. Equally important, it is critical for senior management to provide the proper environment for the project to function effectively. Here the project leader needs to tell management at the onset of the program what resources are needed. The project manager's relationship with senior management and ability to develop senior management support is critically affected by his own credibility and the visibility and priority of his project.

This anxiety may come from several sources. For example, if the team members have never worked with the project leader, they may be concerned about his leadership style. Some team members may be concerned about the nature of the project and whether it will match their professional interests and capabilities, or help or hinder their career aspirations. Further, team members can be highly anxious about life-style/work-style disruptions. As one project manager remarked, "Moving a team member's desk from one side of the room to the other can sometimes be just about as traumatic as moving someone from Chicago to Manila."

Another common concern among newly formed teams is whether there will be an equitable distribution of the workload among team members and whether each member is capable of pulling his own weight. In some newly formed teams, members not only must do their own work, but also must train other team members. Within reason this is bearable, but when it becomes excessive, anxiety increases.

Certain steps taken early in the life of a team can minimize the above problems. First, we recommend that the project leader talk with each team member one-to-one about the following:

1. What the objectives are for the project.
2. Who will be involved and why.
3. The importance of the project to the overall organization or work unit.
4. Why the team member was selected and assigned to the project. What role he will perform.
5. What rewards might be forthcoming if the project is successfully completed.
6. What problems and constraints are likely to be encountered.
7. The rules of the road that will be followed in managing the project (e.g., regular status review meetings).
8. What suggestions the team member has for achieving success.
9. What the professional interests of the team member are.
10. What challenge the project will present to individual members and the entire team.
11. Why the team concept is so important to project management success and how it should work.

Dealing with these anxieties and helping team members feel that they are an integral part of the team can yield rich dividends. First, as noted in Figure 5–9, team members are more likely to openly share their ideas and approaches. Second, it is more likely that the team will be able to develop effective decision-making processes. Third, the team is likely

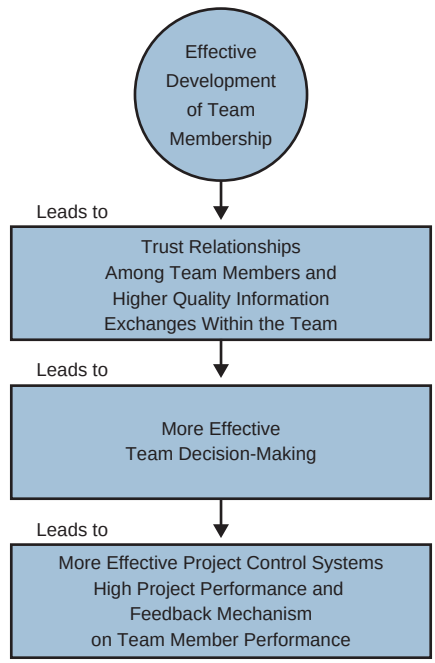

FIGURE 5–9. Team-building outcomes.

to develop more effective project control procedures, including those traditionally used to monitor project performance (PERT/CPM, networking, work breakdown structures, etc.) and those in which team members give feedback to each other regarding performance.

5.7 TEAM BUILDING AS AN ONGOING PROCESS

While proper attention to team building is critical during early phases of a project, it is a never-ending process. The project manager is continually monitoring team functioning and performance to see what corrective action may be needed to prevent or correct various team problems. Several barometers (summarized in Table 5–3) provide good clues of potential team dysfunctioning. First, noticeable changes in performance levels for the team and/or for individual team members should always be investigated. Such changes can be symptomatic of more serious problems (e.g., conflict, lack of work integration, communication problems, and unclear objectives). Second, the project leader and team members must be aware of the changing energy levels of team members. These changes, too, may signal more serious problems or that the team is tired and stressed. Sometimes changing the work pace or taking time off can reenergize team members. Third, verbal and nonverbal clues from team members may be a source of information on team functioning. It is important to hear the needs and concerns of team members (verbal clues) and to observe how they act in carrying out their responsibilities (nonverbal clues). Finally, detrimental behavior of one team member toward another can be a signal that a problem within the team warrants attention.

We highly recommend that project leaders hold regular meetings to evaluate overall team performance and deal with team functioning problems. The focus of these meetings can be directed toward "what we are doing well as a team" and "what areas need our team's attention." This approach often brings positive surprises in that the total team is informed

TABLE 5–3. EFFECTIVENESS–INEFFECTIVENESS INDICATORS

The Effective Team's Likely Characteristics	The Ineffective Team's Likely Characteristics
• High performance and task efficiency • Innovative/creative behavior • Commitment • Professional objectives of team members coincident with project requirements • Team members highly interdependent, interface effectively • Capacity for conflict resolution, but conflict encouraged when it can lead to beneficial results • Effective communication • High trust levels • Results orientation • Interest in membership • High energy levels and enthusiasm • High morale • Change orientation	• Low performance • Low commitment to project objectives • Unclear project objectives and fluid commitment levels from key participants • Unproductive gamesmanship, manipulation of others, hidden feelings, conflict avoidance at all costs • Confusion, conflict, inefficiency • Subtle sabotage, fear, disinterest, or foot-dragging • Cliques, collusion, isolation of members • Lethargy/unresponsiveness

of progress in diverse project areas (e.g., a breakthrough in technology development, a subsystem schedule met ahead of the original target, or a positive change in the client's behavior toward the project). After the positive issues have been discussed the review session should focus on actual or potential problem areas. The meeting leader should ask each team member for his observations and then open the discussion to ascertain how significant the problems really are. Assumptions should, of course, be separated from the facts of each situation. Next, assignments should be agreed on for best handling these problems. Finally, a plan for problem follow-up should be developed. The process should result in better overall performance and promote a feeling of team participation and high morale.

5.8 DYSFUNCTIONS OF A TEAM

In a pure line organization, line managers may have the luxury of "time" to build up relationships with their subordinates and provide slow guidance on how the employees should function on teams. But in a project environment, time is a constraint, and the project manager must act or react quickly to get the desired teamwork.

Understanding the dysfunctions of a team, and being able to correct the problems quickly, is essential in a project environment. Patrick Lencioni has authored a best-selling text describing the five most common dysfunctions of a team. In his text, he describes the five dysfunctions as[9]:

- Absence of trust
- Fear of conflict
- Lack of commitment
- Avoidance of accountability
- Inattention to results

In his text, he identifies the differences between the teams that have these dysfunctions and those that do not possess them:

- Members of a team with an absence of trust…
  - Conceal their weakness and mistakes from one another
  - Hesitate to ask for help or provide constructive feedback
  - Hesitate to offer help outside their own area of responsibility
  - Jump to conclusions about intentions and aptitudes of others without attempting to clarify them
  - Failing to recognize and tap into another's skills and experiences
  - Waste time and energy managing their behaviors for effect
  - Hold grudges
  - Dread meetings and find reasons to avoid spending time together

9. P. Lencioni, *The Five Dysfunctions of a Team* (New York: Jossey-Bass, 2002), pp. 197–218. Reprinted by permission of John Wiley.

- Members of trusting teams…
  - Admit weaknesses and mistakes
  - Ask for help
  - Accept questions and input about their areas of responsibility
  - Give one another the benefit of the doubt before arriving at a negative conclusion
  - Take risks in offering feedback and assistance
  - Appreciate and tap into one another's skills and experiences
  - Focus time and energy on important issues, not politics
  - Offer and accept apologies without hesitation
  - Look forward to meetings and their opportunities to work as a group

- Teams that fear conflict…
  - Have boring meetings
  - Create environments where back-channel politics and personal attacks thrive
  - Ignore controversial topics that are critical to team success
  - Fail to tap into all the opinions and perspectives of team members
  - Waste time and energy with posturing and interpersonal risk management

- Teams that engage in conflict…
  - Have lively, interesting meetings
  - Extract and exploit the ideas of all team members
  - Solve real problems quickly
  - Minimize politics
  - Put critical topics on the table for discussion

- A team that fails to commit…
  - Creates ambiguity among the team about direction and priorities
  - Watches windows and opportunities closly due to excessive analysis and unnecessary delay
  - Breeds lack of confidence and fear of failure
  - Revisits discussions and decisions again and again
  - Encourages second-guessing among team members

- A team that commits…
  - Creates clarity around direction and priorities
  - Aligns the entire team around common objectives
  - Develops an ability to learn from mistakes
  - Takes advantage of opportunities before competitors do
  - Moves forward without hesitation
  - Changes direction without hesitation or guilt

- A team that avoids accountability…
  - Creates resentment among team members who have different standards or performance
  - Encourages mediocrity
  - Misses deadlines and key deliverables
  - Places an undue burden on the team leader as the sole source of discipline

- A team that holds one another accountable…
  - Ensures that poor performers feel pressure to improve
  - Identifies potential problems quickly by questioning one another's approaches without hesitation
  - Establishes respect among team members who are held to the same high standards
  - Avoids excessive bureaucracy around performance management and corrective action

- A team that is not focused on results…
  - Stagnates/fails to grow
  - Rarely defeats competitors
  - Loses achievement-oriented employees
  - Encourages team members to focus on their own careers and individual goals
  - Is easily distracted

- A team that focuses on collective results…
  - Retains achievement-oriented employees
  - Minimizes individualistic behavior
  - Enjoys success and suffers failure acutely
  - Benefits from individuals who subjugate their own goals/interests for the good of the team
  - Avoids distractions

Another item that can lead to dysfunctional behavior among team members is when the project manager and team do not have the same shared values. According to Kouzes and Posner[10]:

> Shared values are the foundations for building productive and genuine working relationships. Although credible leaders honor the diversity of their many constituencies, they also stress their common values. Leaders build on agreement. They don't try to get everyone to be in accord on everything — this goal is unrealistic, perhaps even impossible. Moreover, to achieve it would negate the very advantages of diversity. But to take a first step, and then a second, and then a third, people must have some common core of understanding. After all, if there's no agreement about values, then what exactly is the leader — and everyone else — going to model? If disagreements over fundamental values continue, the result is intense conflict, false expectations, and diminished capacity.

Kouzes and Posner also show, through their own research, that shared values can make a difference:

- They foster strong feelings of personal effectiveness
- They promote high levels of company loyalty

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10. James M. Kouzes and Barry Z. Posner, *The Leadership Challenge*, 4th ed. (New York: Jossey-Bass, 2007), pp. 60, 62.

- They facilitate consensus about key organizational goals and stakeholders
- They encourage ethical behavior
- They promote strong norms about working hard and caring
- They reduce levels of job stress and tension
- They foster pride in the company
- They facilitate understanding about job expectations
- They foster teamwork and esprit de corps

5.9 LEADERSHIP IN A PROJECT ENVIRONMENT

Leadership can be defined as a style of behavior designed to integrate both the organizational requirements and one's personal interests into the pursuit of some objective. All managers have some sort of leadership responsibility. If time permits, successful leadership techniques and practices can be developed.

Leadership is composed of several complex elements, the three most common being:

- The person leading
- The people being led
- The situation (i.e., the project environment)

Project managers are often selected or not selected because of their leadership styles. The most common reason for not selecting an individual is his inability to balance the technical and managerial project functions. Wilemon and Cicero have defined four characteristics of this type of situation[11]:

- The greater the project manager's technical expertise, the higher his propensity to overinvolve himself in the technical details of the project.
- The greater the project manager's difficulty in delegating technical task responsibilities, the more likely it is that he will overinvolve himself in the technical details of the project (depending on his ability to do so).
- The greater the project manager's interest in the technical details of the project, the more likely it is that he will defend the project manager's role as one of a technical specialist.
- The lower the project manager's technical expertise, the more likely it is that he will overstress the nontechnical project functions (administrative functions).

11. D. L. Wilemon and John P. Cicero, "The Project Manager: Anomalies and Ambiguities," *Academy of Management Journal*, Vol. 13, pp. 269–282, 1970.

There have been several surveys to determine what leadership techniques are best. The following are the results of a survey by Richard Hodgetts[12]:

- Human relations–oriented leadership techniques
  - "The project manager must make all the team members feel that their efforts are important and have a direct effect on the outcome of the program."
  - "The project manager must educate the team concerning what is to be done and how important its role is."
  - "Provide credit to project participants."
  - "Project members must be given recognition and prestige of appointment."
  - "Make the team members feel and believe that they play a vital part in the success (or failure) of the team."
  - "By working extremely closely with my team I believe that one can win a project loyalty while to a large extent minimizing the frequency of authority-gap problems."
  - "I believe that a great motivation can be created just by knowing the people in a personal sense. I know many of the line people better than their own supervisor does. In addition, I try to make them understand that they are an indispensable part of the team."
  - "I would consider the most important technique in overcoming the authority-gap to be understanding as much as possible the needs of the individuals with whom you are dealing and over whom you have no direct authority."
- Formal authority–oriented leadership techniques
  - "Point out how great the loss will be if cooperation is not forthcoming."
  - "Put all authority in functional statements."
  - "Apply pressure beginning with a tactful approach and minimum application warranted by the situation and then increasing it."
  - "Threaten to precipitate high-level intervention and do it if necessary."
  - "Convince the members that what is good for the company is good for them."
  - "Place authority on full-time assigned people in the operating division to get the necessity work done."
  - "Maintain control over expenditures."
  - "Utilize implicit threat of going to general management for resolution."
  - "It is most important that the team members recognize that the project manager has the charter to direct the project."

5.10 LIFE-CYCLE LEADERSHIP

PMBOK® Guide, 4th Edition
9.3 Develop Project Team

In the opinion of the author, Hersey and Blanchard developed the best model for analyzing leadership in a project management environment. Over the years the model has been expanded by Paul Hersey and is shown

12. Richard M. Hodgetts, "Leadership Techniques in Project Organizations," Academy of Management Journal, Vol. 11, pp. 211–219, 1968.

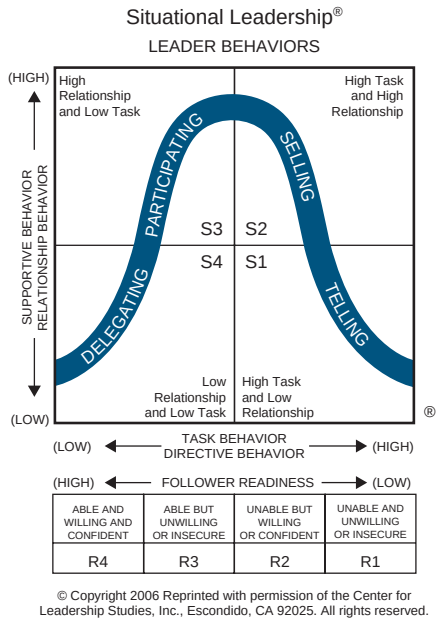

FIGURE 5–10. Expanded Situational Leadership Model. Adapted from Paul Hersey, *Situational Selling* (Escondido, CA: Center for Leadership Studies, 1985), p. 35. Reproduced by permission of the Center for Leadership Studies.®

in Figure 5–10 as the Situational Leadership® Model. The model contends that there are four basic leadership styles and that to use them most effectively entails matching the most appropriate leadership style to the readiness of the follower. Readiness is defined as job-related experience, willingness to accept job responsibility, and desire to achieve. It's about not only *doing* a good job but also *wanting* to do a good job. Most importantly though is the concept that this is a situational model. This is critical because it means that the same person can be more ready to perform one task than they are to do another and that the style a leader uses will have to change accordingly to be the most effective and successful at influencing the desired behaviors in that person.

Referring to Figure 5–10, suppose that a subordinate was not performing a certain task and showed through his or her behavior every indication of not wanting to (R1). According to the model, the leadership style that has the highest probability of successfully and effectively getting that person to perform is one that involves high amounts of structured task behavior that could be generally described as directive in nature (S1). This would entail telling a subordinate who, what, when, where, and how to go about performing the particular task. It would also be appropriate in this style to acknowledge steps taken in the right direction as far as performance is concerned, but this type of relationship behavior must match the magnitude of the steps being taken or the subordinate may be left with the false impression that his or her current level of performance is in fact acceptable. Some have

gone so far as to equate this "telling" leadership style with the purely task-orientated behavior of an autocratic approach where the leader's main concern is the accomplishment of objective, often with very little concern for the employees or their feelings. An autocratic leader by his or her nature is very forceful and relies heavily on his or her own abilities and judgment often at the expense of other people's opinions. Note, however, in Figure 5–10 that the bell curve in the model does not go all the way to zero, indicating some relationship behavior present in this style that increases appropriately as the level of performance does.

As shown in Figure 5–10, suppose that an employee was beginning to perform the task in question but wasn't yet doing so at a sustained and acceptable level even though he or she really seemed to want to do a good job (R2). The leadership style with the highest probability of successfully and effectively influencing the desired behavior from this employee rests in quadrant S2. This employee needs everything from the leader. The employee needs structure to keep him or her on track and support not only to build the foundations of trust that help him or her continue to develop but also to give the big picture of how personal actions contribute to the success of the team. This is where the leader shares the "why" behind the behaviors in which he or she is asking the subordinate to engage.

At some point, one would hope that subordinates would begin performing the task in question at a sustained and acceptable level (R3). When this takes place, the follower is no longer in need of being told who, what, when, where and how to do the task but rather seeks autonomy and freedom as a reward for their good performance. They desire more of a collegial relationship with their superior that reflects the fact that they have arrived, but they will also be insecure about completely letting go of the involvement from the leader that made them feel so secure in the past. For a leader, the appropriate style for this readiness level would be S3. It would entail engaging in relationship behavior that gets followes to admit from their own mouths that they are indeed performing at a sustained and acceptable level and that they don't really need the leader to be so intricately involved in the process. For some this step occurs quickly, for others, they never make the leap. They must learn to have confidence in themselves and their abilities, and the leader's job at this point is to help with that process through the use of relationship behaviors that avoid making those followers feel more insecure. This means that the followers must trust the leader, and they can earn that trust by doing things like taking calculated risks that not only allow the followers small wins but also allows them to learn from their mistakes without being beaten up for them. It's a fine line the leader walks. They must be supportive without being an enabler.

Some leaders are blessed with followers who not only perform at a high and sustained level but are totally and rightfully confident about their ability to do so (R4). In such an instance, the appropriate leadership style rests in quadrant S4. It involves leadership behaviors such as monitoring and observing, which are characterized by low amounts of task and relationship-oriented behaviors. The leader is kept informed of both the good and bad in a timely manner from a person at this readiness level but is not the decision-maker. Responsibility lies with the subordinate who takes ownership of their actions and expects the leader to spend his or her energy obtaining resources for them and protecting or shielding them from other influences in the organization that could impede their performance.

Let's see where some common leadership style descriptors fall within the model.

- **Democratic or Participative Leadership:** This leadership style encourages workers to communicate with one another and get involved with decision-making either by himself or herself or with assistance of the project manager. A great deal of authority is delegated to the team members, and they are encouraged to take an active role in the management of the project. The leadership style is often found in quadrant S3 with some spill over as the manager becomes less involved in the process into quadrant S4.
- **Laissez-Faire Leadership:** With the leadership style, the project manger turns things over to the workers. This can feel like abandonment to the subordinates if they are not both performing at a high level and willing to do so. The project manager may make an occasional appearance with this style just to see how things are going, but for the main part there is no active involvement by the project manager. This leadership style is found in quadrant S4.
- **Autocratic Leadership:** With this leadership style, the project manager focuses very heavily upon the task, with little concern for the workers. With autocratic

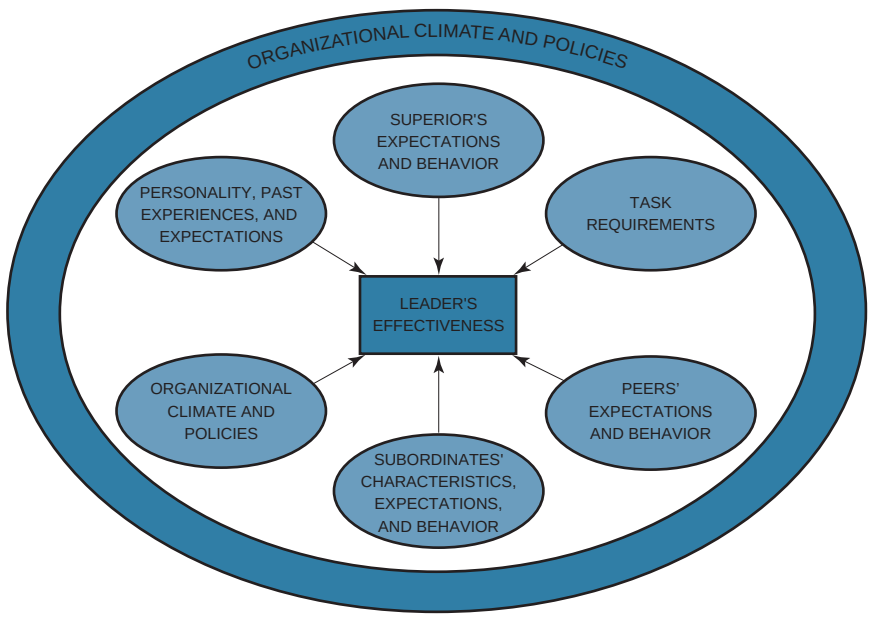

FIGURE 5–11. Personality and situational factors that influence effective leadership. *Source:* James A. F. Stoner, *Management*, 2nd ed. (Englewood Cliffs, New Jersey: Prentice-Hall Inc., 1982). Used by permission.

leadership, all authority is in the hands of the project manager and the project manager has the final say in any and all decisions. This leadership style is found in quadrant S1.

This type of situational approach to leadership is extremely important to project managers because it implies that effective leadership must be both dynamic and flexible rather than static and rigid (see Figure 5–11). Effective leaders recognize that when it comes to human behavior, there is no one best way that fits all circumstances. They need both task and relationship behavior to be able to be their most effective. Thankfully, it doesn't have to be a perfect match to work. Sometimes close is good enough, and sometimes a project manager's followers are willing to let them demonstrate a less than appropriate style because that manager has taken the time to earn their trust or perhaps even warned them of the necessity of going there when a crisis occurs. Just be wary of "living" in this mode because it may be the leader causing the crisis and the only fire needing to be put out could end up being the leader.

In pure project management, the situation is even more complex. It is not enough to have a different leadership style for each team member. Remember that any one person is more ready to do some tasks than others. For example, they may be really good at training others but detest and avoid report writing. That person's leader will have to use a different style depending on which task they are asking their follower to perform. To illustrate this graphically, the quadrants in Figure 5–10 should be three-dimensional, with the third axis being the life cycle phase of the project. In other words, the leadership is dependent not only on the situation, but also on the life-cycle phase of the project.

5.11 ORGANIZATIONAL IMPACT

In most companies, whether or not project-oriented, the impact of management emphasis on the organization is well known. In the project environment there also exists a definite impact due to leadership emphasis. The leadership emphasis is best seen by employee contributions, organizational order, employee performance, and the project manager's performance:

- Contributions from People
  - A good project manager encourages active cooperation and responsible participation. The result is that both good and bad information is contributed freely.
  - A poor project manager maintains an atmosphere of passive resistance with only responsive participation. This results in information being withheld.
- Organizational Order
  - A good project manager develops policy and encourages acceptance. A low price is paid for contributions.
  - A poor project manager goes beyond policies and attempts to develop procedures and measurements. A high price is normally paid for contributions.

- Employee Performance
  - A good project manager keeps people informed and satisfied (if possible) by aligning motives with objectives. Positive thinking and cooperation are encouraged. A good project manager is willing to give more responsibility to those willing to accept it.
  - A poor project manager keeps people uninformed, frustrated, defensive, and negative. Motives are aligned with incentives rather than objectives. The poor project manager develops a "stay out of trouble" atmosphere.
- Performance of the Project Manager
  - A good project manager assumes that employee misunderstandings can and will occur, and therefore blames himself. A good project manager constantly attempts to improve and be more communicative. He relies heavily on moral persuasion.
  - A poor project manager assumes that employees are unwilling to cooperate and therefore blames subordinates. The poor project manager demands more through authoritarian attitudes and relies heavily on material incentives.

Management emphasis also impacts the organization. The following four categories show this management emphasis resulting for both good and poor project management:

- Management Problem-Solving
  - A good project manager performs his own problem-solving at the level for which he is responsible through delegation of problem-solving responsibilities.
  - A poor project manager will do subordinate problem-solving in known areas. For areas that he does not know, he requires that his approval be given prior to idea implementation.
- Organizational Order
  - A good project manager develops, maintains, and uses a single integrated management system in which authority and responsibility are delegated to the subordinates. In addition, he knows that occasional slippages and overruns will occur, and simply tries to minimize their effect.
  - A poor project manager delegates as little authority and responsibility as possible, and runs the risk of continual slippages and overruns. A poor project manager maintains two management information systems: one informal system for himself and one formal (eyewash) system simply to impress his superiors.
- Performance of People
  - A good project manager finds that subordinates willingly accept responsibility, are decisive in attitude toward the project, and are satisfied.
  - A poor project manager finds that his subordinates are reluctant to accept responsibility, are indecisive in their actions, and seem frustrated.

- Performance of the Project Manager
  - A good project manager assumes that his key people can "run the show." He exhibits confidence in those individuals working in areas in which he has no expertise, and exhibits patience with people working in areas where he has a familiarity. A good project manager is never too busy to help his people solve personal or professional problems.
  - A poor project manager considers himself indispensable, is overcautious with work performed in unfamiliar areas, and becomes overly interested in work he knows. A poor project manager is always tied up in meetings.

5.12 EMPLOYEE–MANAGER PROBLEMS

The two major problem areas in the project environment are the "who has what authority and responsibility" question, and the resulting conflicts associated with the individual at the project–functional interface. Almost all project problems in some way or another involve these two major areas. Other problem areas found in the project environment include:

- The pyramidal structure
- Superior–subordinate relationships
- Departmentalization
- Scalar chain of command
- Organizational chain of command
- Power and authority
- Planning goals and objectives
- Decision-making
- Reward and punishment
- Span of control

The two most common employee problems involve the assignment and resulting evaluation processes. Personnel assignments were discussed in Chapter 4. In summary:

- People should be assigned to tasks commensurate with their skills.
- Whenever possible, the same person should be assigned to related tasks.
- The most critical tasks should be assigned to the most responsible people.

The evaluation process in a project environment is difficult for an employee at the functional–project interface, especially if hostilities develop between the functional and project managers. In this situation, the interfacing employee almost always suffers owing to a poor rating by either the project manager or his supervisor. Unless the employee continually keeps his superior abreast of his performance and achievements, the supervisor must rely solely on the input (often flawed) received from project office personnel.

Three additional questions must be answered with regard to employee evaluation:

- Of what value are job descriptions?
- How do we maintain wage and salary grades?
- Who provides training and development, especially under conditions where variable manloading can exist?

If each project is, in fact, different from all others, then it becomes an almost impossible task to develop accurate job descriptions. In many cases, wage and salary grades are functions of a unit manning document that specifies the number, type, and grade of all employees required on a given project. Although this might be a necessity in order to control costs, it also is difficult to achieve because variable manloading changes project priorities. Variable manloading creates several difficulties for project managers, especially if new employees are included. Project managers like to have seasoned veterans assigned to their activities because there generally does not exist sufficient time for proper and close supervision of the training and development of new employees. Functional managers, however, contend that the training has to be accomplished on someone's project, and sooner or later all project managers must come to this realization.

On the manager level, the two most common problems involve personal values and conflicts. Personal values are often attributed to the "changing of the guard." New managers have a different sense of values from that of the older, more experienced managers. Miner identifies some of these personal values attributed to new managers[13]:

- Less trust, especially of people in positions of authority.
- Increased feelings of being controlled by external forces and events, and thus belief that they cannot control their own destinies. This is a kind of change that makes for less initiation of one's own activities and a greater likelihood of responding in terms of external pressures. There is a sense of powerlessness, although not necessarily a decreased desire for power.
- Less authoritarian and more negative attitudes toward persons holding positions of power.
- More independence, often to the point of rebelliousness and defiance.
- More freedom, less control in expressing feelings, impulses, and emotions.
- Greater inclination to live in the present and to let the future take care of itself.
- More self-indulgence.
- Moral values that are relative to the situation, less absolute, and less tied to formal religion.
- A strong and increasing identification with their peer and age groups, with the youth culture.

13. John B. Miner, "The OD-Management Development Conflict." Reprinted with permission from *Business Horizons*, December 1973, p. 32. Copyright © 1973 by the Board of Trustees at Indiana University.

- Greater social concern and greater desire to help the less fortunate.
- More negative attitude toward business, the management role in particular. A professional position is clearly preferred to managing.
- A desire to contribute less to an employing organization and to receive more from the organization.

Previously, we defined one of the attributes of a project manager as liking risks. Unfortunately, the amount of risk that today's managers are willing to accept varies not only with their personal values but also with the impact of current economic conditions and top management philosophies. If top management views a specific project as vital for the growth of the company, then the project manager may be directed to assume virtually no risks during the execution of the project. In this case the project manager may attempt to pass all responsibility to higher or lower management claiming that "his hands are tied." Wilemon and Cicero identify problems with risk identification[14]:

- The project manager's anxiety over project risk varies in relation to his willingness to accept final responsibility for the technical success of his project. Some project managers may be willing to accept full responsibility for the success or failure of their projects. Others, by contrast, may be more willing to share responsibility and risk with their superiors.
- The greater the length of stay in project management, the greater the tendency for project managers to remain in administrative positions within an organization.
- The degree of anxiety over professional obsolescence varies with the length of time the project manager spends in project management positions.

The amount of risk that managers will accept also varies with age and experience. Older, more experienced managers tend to take few risks, whereas the younger, more aggressive managers may adopt a risk-lover policy in hopes of achieving a name for themselves.

Conflicts exist at the project–functional interface regardless of how hard we attempt to structure the work. According to Cleland and King, this interface can be defined by the following relationships[15]:

- Project Manager
  - *What* is to be done?
  - *When* will the task be done?
  - *Why* will the task be done?
  - *How much* money is available to do the task?
  - *How well* has the total project been done?

14. D. L. Wilemon and John P. Cicero, "The Project Manager: Anomalies and Ambiguities," *Academy of Management Journal*, Vol. 13, 1970, pp. 269–282.

15. From David I. Cleland and William Richard King, *Systems Analysis and Project Management* (New York: McGraw-Hill), p. 237.

- Functional Manager
  - *Who* will do the task?
  - *Where* will the task be done?
  - *How* will the task be done?
  - *How well* has the functional input been integrated into the project?

The result of these differing views is inevitable conflict between the functional and project manager, as described by William Killian[16]:

> The conflicts revolve about items such as project priority, manpower costs, and the assignment of functional personnel to the project manager. Each project manager will, of course, want the best functional operators assigned to his project. In addition to these problems, the accountability for profit and loss is much more difficult in a matrix organization than in a project organization. Project managers have a tendency to blame overruns on functional managers, stating that the cost of the function was excessive. Whereas functional managers have a tendency to blame excessive costs on project managers with the argument that there were too many changes, more work required than defined initially, and other such arguments.

Major conflicts can also arise during problem resolution sessions because the time constraints imposed on the project often prevent both parties from taking a logical approach. One of the major causes of prolonged problem-solving is a lack of pertinent information. The following information should be reported by the project manager[17]:

- The problem
- The cause
- The expected impact on schedule, budget, profit, or other pertinent area
- The action taken or recommended and the results expected of that action
- What top management can do to help

5.13 MANAGEMENT PITFALLS

The project environment offers numerous opportunities for project managers and team members to get into trouble. Common types of management pitfalls are:

- Lack of self-control (knowing oneself)
- Activity traps
- Managing versus doing
- People versus task skills

16. William P. Killian, "Project Management—Future Organizational Concepts," *Marquette Business Review,* Vol. 2, 1971, pp. 90–107.

17. Russell D. Archibald, *Managing High-Technology Programs and Projects* (New York: Wiley, 1976), p. 230.

- Ineffective communications
- Time management
- Management bottlenecks

Knowing oneself, especially one's capabilities, strengths, and weaknesses, is the first step toward successful project management. Too often, managers will assume that they are jacks-of-all-trades, will "bite off more than they can chew," and then find that insufficient time exists for training additional personnel.

The following lines illustrate self-concept:

Four Men
It chanced upon a winter's night
Safe sheltered from the weather.
The board was spread for only one,
Yet four men dined together.
There sat the man I meant to be
In glory, spurred and booted.
And close beside him, to the right
The man I am reputed.
The man I think myself to be
His seat was occupying
Hard by the man I really am
To hold his own was trying.
And all beneath one roof we met
Yet none called his fellow brother
No sign of recognition passed
They knew not one another.
Author unknown

Activity traps result when the means become the end, rather than the means to achieve the end. The most common activity traps are team meetings, customer–technical interchange meetings, and the development of special schedules and charts that cannot be used for customer reporting but are used to inform upper-level management of project status. Sign-off documents are another activity trap and managers must evaluate whether all this paperwork is worth the effort.

We previously defined a characteristic of poor leadership as the inability to obtain a balance between management functions and technical functions. This can easily develop into an activity trap where the individual becomes a doer rather than a manager. Unfortunately, there often exists a very fine line between managing and doing. As an example, consider a project manager who was asked by one of his technical people to make a telephone call to assist him in solving a problem. Simply making the phone call is doing work that should be done by the project team members or even the functional manager. However, if the person being called requires that someone in absolute authority be included in the conversation, then this can be considered managing instead of doing.

There are several other cases where one must become a doer in order to be an effective manager and command the loyalty and respect of subordinates. Assume a special situation where you must schedule subordinates to work overtime on holidays or weekends.

By showing up at the plant during these times, just to make a brief appearance, you can create a better working atmosphere and understanding with the subordinates.

Another major pitfall is the decision to utilize either people skills or task skills. Is it better to utilize subordinates with whom you can obtain a good working relationship or to employ highly skilled people simply to get the job done? Obviously, the project manager would like nothing better than to have the best of both worlds, but this is not always possible. Consider the following situations:

- There is a task that will take three weeks to complete. John has worked for you before, but not on such a task as this. John, however, understands how to work with you. Paul is very competent but likes to work alone. He can get the job done within constraints. Should you employ people or task skills? (Would your answer change if the task were three months instead of three weeks?)
- There exist three tasks, each one requiring two months of work. Richard has the necessary people skills to handle all three tasks, but he will not be able to do so as efficiently as a technical specialist. The alternate choice is to utilize three technical specialists.

Based on the amount of information given, the author prefers task skills so as not to hinder the time or performance constraints on the project. Generally speaking, for long-duration projects that require constant communications with the customer, it might be better to have permanently assigned employees who can perform a variety of tasks. Customers dislike seeing a steady stream of new faces.

It is often said that a good project manager must be willing to work sixty to eighty hours a week to get the job done. This might be true if he is continually fighting fires or if budgeting constraints prevent employing additional staff. The major reason, however, is the result of ineffective time management. Prime examples might include the continuous flow of paperwork, unnecessary meetings, unnecessary phone calls, and acting as a tour guide for visitors.

- To be effective, the project manager must establish time management rules and then ask himself four questions:
  - What am I doing that I don't have to be doing at all?
  - What am I doing that can be done better by someone else?
  - What am I doing that could be done sufficiently well by someone else?
  - Am I establishing the right priorities for my activities?
- Rules for time management
  - Conduct a time analysis (time log)
  - Plan solid blocks for important things
  - Classify your activities
  - Establish priorities
  - Establish opportunity cost on activities
  - Train your system (boss, subordinate, peers)
  - Practice delegation
  - Practice calculated neglect
  - Practice management by exception
  - Focus on opportunities—not on problems

5.14 COMMUNICATIONS

PMBOK® Guide, 4th Edition
Chapter 10 Project Communications Management

Effective project communications ensure that we get the right information to the right person at the right time and in a cost-effective manner. Proper communication is vital to the success of a project. Typical definitions of effective communication include:

- An exchange of information
- An act or instance of transmitting information
- A verbal or written message
- A technique for expressing ideas effectively
- A process by which meanings are exchanged between individuals through a common system of symbols

The communications environment can be regarded as a network of channels. Most channels are two-way channels. The number of two-way channels, N, can be calculated from the formula

$$N = \frac{X(X - 1)}{2}$$

In this formula, X represents the number of people communicating with each other. For example, if four people are communicating (i.e., $X = 4$), then there are six two-way channels.

When a breakdown in communications occurs, disaster follows, as Figure 5–12 demonstrates.

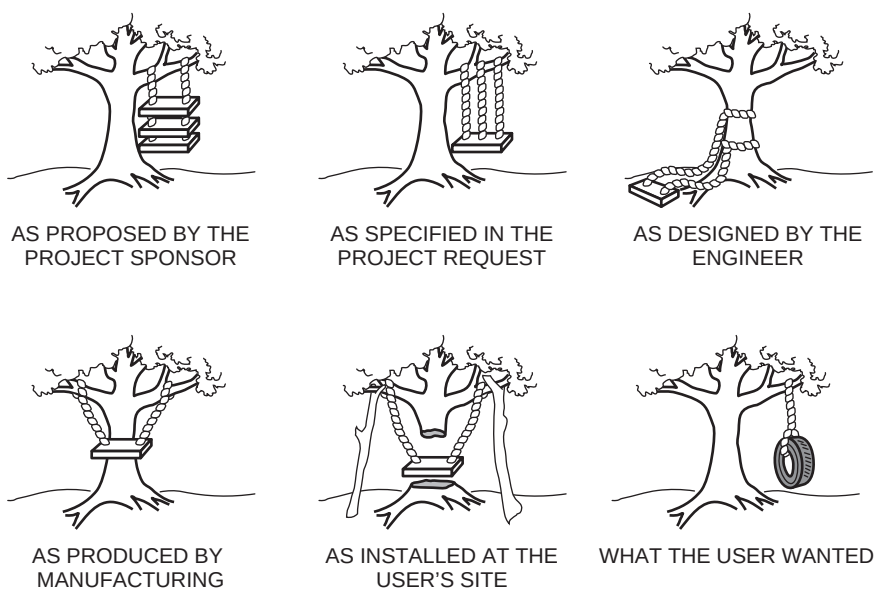

FIGURE 5–12. A breakdown in communications. (Source unknown)

Figures 5–13 and 5–14 show typical communications patterns. Some people consider Figure 5–13 "politically incorrect" because project managers should not be identified as talking "down" to people. Most project managers communicate laterally, whereas line managers communicate vertically downward to subordinates. Figure 5–15 shows the complete communication model. The screens or barriers are from one's perception, personality, attitudes, emotions, and prejudices.

PMBOK® Guide, 4th Edition
Figure 10–8 Basic Communication Model

- *Perception barriers* occur because individuals can view the same message in different ways. Factors influencing perception include the individual's level of education and region of experience. Perception problems can be minimized by using words that have precise meaning.
- *Personality and interests*, such as the likes and dislikes of individuals, affect communications. People tend to listen carefully to topics of interest but turn a deaf ear to unfamiliar or boring topics.
- *Attitudes, emotions, and prejudices* warp our sense of interpretation. Individuals who are fearful or have strong love or hate emotions will tend to protect themselves by distorting the communication process. Strong emotions rob individuals of their ability to comprehend.

Typical barriers that affect the encoding process include:

- Communication goals
- Communication skills

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10.2 Communications Planning

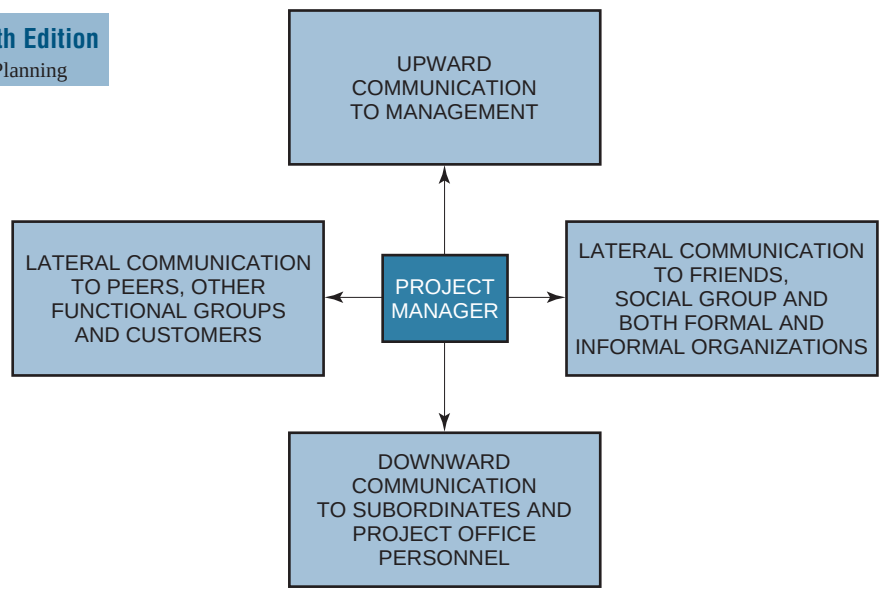

FIGURE 5–13. Communication channels. *Source:* D. I. Cleland and H. Kerzner, *Engineering Team Management* (Melbourne, Florida: Krieger, 1986), p. 39.

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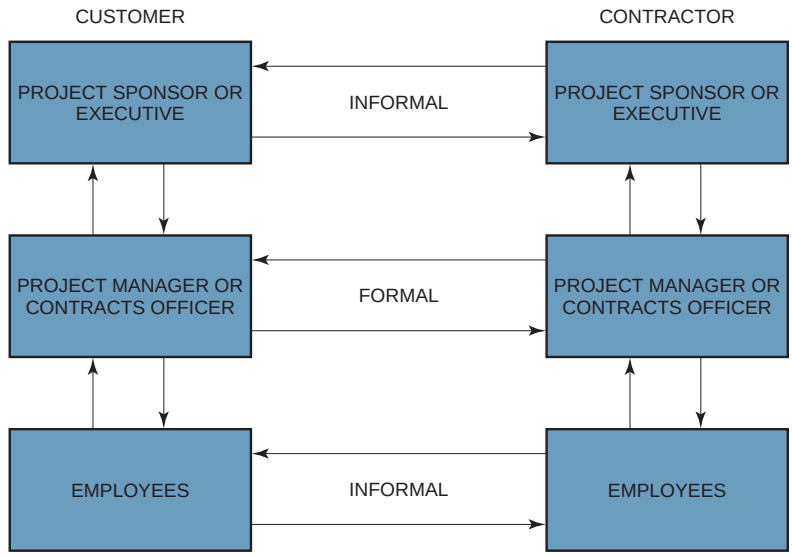

FIGURE 5–14. Customer communications. *Source:* D. I. Cleland and H. Kerzner, *Engineering Team Management* (Melbourne, Florida: Krieger, 1986), p. 64.

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10.3 Information Distribution
10.4.2 Communications Skills

- Frame of reference
- Sender credibility
- Needs
- Personality and interests
- Interpersonal sensitivity

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Figure 10–8 Basic Communication Model

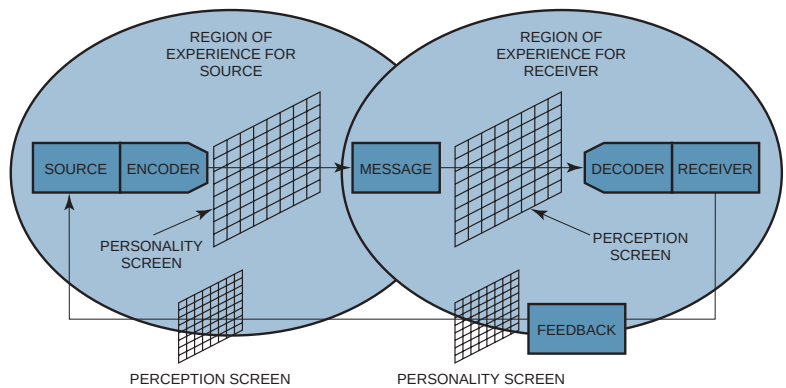

FIGURE 5–15. Total communication process. *Source:* D. I. Cleland and H. Kerzner, *Engineering Team Management* (Melbourne, Florida: Krieger, 1986), p. 46.

- Attitude, emotion, and self-interest
- Position and status
- Assumptions (about receivers)
- Existing relationships with receivers

Typical barriers that affect the decoding process include:

- Evaluative tendency
- Preconceived ideas
- Communication skills
- Frame of reference
- Needs
- Personality and interest
- Attitudes, emotion, and self-interest
- Position and status
- Assumptions about sender
- Existing relationship with sender
- Lack of responsive feedback
- Selective listening

The receiving of information can be affected by the way the information is received. The most common ways include:

- Hearing activity
- Reading skills
- Visual activity
- Tactile sensitivity
- Olfactory sensitivity
- Extrasensory perception

The communications environment is controlled by both the internal and external forces, which can act either individually or collectively. These forces can either assist or restrict the attainment of project objectives.

Typical internal factors include:

- Power games
- Withholding information
- Management by memo
- Reactive emotional behavior
- Mixed messages
- Indirect communications
- Stereotyping
- Transmitting partial information
- Blocking or selective perception

Typical external factors include:

- The business environment
- The political environment
- The economic climate
- Regulatory agencies
- The technical state-of-the-art

The communications environment is also affected by:

- Logistics/geographic separation
- Personal contact requirements
- Group meetings
- Telephone
- Correspondence (frequency and quantity)
- Electronic mail

Noise tends to distort or destroy the information within the message. Noise results from our own personality screens, which dictate the way we present the message, and perception screens, which may cause us to "perceive" what we thought was said. Noise therefore can cause ambiguity:

- Ambiguity causes us to hear what we want to hear.
- Ambiguity causes us to hear what the group wants.
- Ambiguity causes us to relate to past experiences without being discriminatory.

In a project environment, a project manager may very well spend 90 percent or more of his or her time communicating. Typical functional applications include:

- Providing project direction
  - Decision-making
  - Authorizing work
  - Directing activities
  - Negotiating
  - Reporting (including briefings)
- Attending meetings
- Overall project management
- Marketing and selling
- Public relations
- Records management
  - Minutes
  - Memos/letters/newsletters
  - Reports
  - Specifications
  - Contract documents

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10.3.3 Information Distribution
10.3.3 Outputs

Project managers are required to provide briefings for both internal and external customers. Visual aids can greatly enhance a presentation. Their advantages include:

- Enlivening a presentation, which helps to capture and hold the interest of an audience.
- Adding a visual dimension to an auditory one, which permits an audience to perceive a message through two separate senses, thereby strengthening the learning process.
- Spelling out unfamiliar words by presenting pictures, diagrams, or objects, and by portraying relations graphically, which helps in introducing material that is difficult or new.
- Remaining in view much longer than oral statements can hang in the air, which can serve the same purpose as repetition in acquainting an audience with the unfamiliar and bringing back listeners who stray from the presentation.

Meetings can be classified according to their frequency of occurrence:

- The daily meeting where people work together on the same project with a common objective and reach decisions informally by general agreement.
- The weekly or monthly meeting where members work on different but parallel projects and where there is a certain competitive element and greater likelihood that the chairman will make the final decision himself or herself.
- The irregular, occasional, or special-project meeting, composed of people whose normal work does not bring them into contact and whose work has little or no relationship to that of the others. They are united only by the project the meeting exists to promote and motivated by the desire that the project succeed. Though actual voting is uncommon, every member effectively has a veto.

There are three types of written media used in organizations:

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- Individually oriented media: These include letters, memos, and reports.
- Legally oriented media: These include contracts, agreements, proposals, policies, directives, guidelines, and procedures.
- Organizationally oriented media: These include manuals, forms, and brochures.

Because of the time spent in a communications mode, the project manager may very well have as his or her responsibility the process of *communications management.* Communications management is the formal or informal process of conducting or supervising the exchange of information either upward, downward, laterally or diagonally. There appears to be a direct correlation between the project manager's ability to manage the communications process and project performance.

The communications process is more than simply conveying a message; it is also a source for control. Proper communications let the employees in on the act because

employees need to know and understand. Communication must convey both information and motivation. The problem, therefore, is how to communicate. Below are six simple steps:

- Think through what you wish to accomplish.
- Determine the way you will communicate.
- Appeal to the interest of those affected.
- Give playback on ways others communicate to you.
- Get playback on what you communicate.
- Test effectiveness through reliance on others to carry out your instructions.

Knowing how to communicate does not guarantee that a clear message will be generated. There are techniques that can be used to improve communications. These techniques include:

- Obtaining feedback, possibly in more than one form
- Establishing multiple communications channels
- Using face-to-face communications if possible
- Determining how sensitive the receiver is to your communications
- Being aware of symbolic meaning such as expressions on people's faces
- Communicating at the proper time
- Reinforcing words with actions
- Using a simple language
- Using redundancy (i.e., saying it two different ways) whenever possible

With every effort to communicate there are always barriers. The barriers include:

- Receiver hearing what he wants to hear. This results from people doing the same job so long that they no longer listen.
- Sender and receiver having different perceptions. This is vitally important in interpreting contractual requirements, statements of work, and proposal information requests.
- Receiver evaluating the source before accepting the communications.
- Receiver ignoring conflicting information and doing as he pleases.
- Words meaning different things to different people.
- Communicators ignoring nonverbal cues.
- Receiver being emotionally upset.

The scalar chain of command can also become a barrier with regard to in-house communications. The project manager must have the authority to go to the general manager or counterpart to communicate effectively. Otherwise, filters can develop and distort the final message.

Three important conclusions can be drawn about communications techniques and barriers:

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- Don't ssume that the message you sent will be received in the form you sent it.
- The swiftest and most effective communications take place among people with common points of view. The manager who fosters good relationships with his associates will have little difficulty in communicating with them.
- Communications must be established early in the project.

In a project environment, communications are often filtered. There are several reasons for the filtering of upward communications:

- Unpleasantness for the sender
- Receiver cannot obtain information from any other source
- To embarrass a superior
- Lack of mobility or status for the sender
- Insecurity
- Mistrust

Communication is also listening. Good project managers must be willing to listen to their employees, both professionally and personally. The advantages of listening properly are that:

- Subordinates know you are sincerely interested
- You obtain feedback
- Employee acceptance is fostered.

The successful manager must be willing to listen to an individual's story from beginning to end, without interruptions, and to see the problem through the eyes of the subordinate. Finally, before making a decision, the manager should ask the subordinate for his solutions to the problem.

Project managers should ask themselves four questions:

- Do I make it easy for employees to talk to me?
- Am I sympathetic to their problems?
- Do I attempt to improve human relations?
- Do I make an extra effort to remember names and faces?

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The project manager's communication skills and personality screen often dictates the communication style. Typical communication styles include:

- Authoritarian: gives expectations and specific guidance
- Promotional: cultivates team spirit
- Facilitating: gives guidance as required, noninterfering

TABLE 5–4. COMMUNICATIONS POLICY

Program Manager	Functional Manager	Relationship
The program manager utilizes existing authorized communications media to the maximum extent rather than create new ones.		Communications up, down, and laterally are essential elements to the success of programs in a multiprogram organization, and to the morale and motivation of supporting functional organizations. In principle, communication from the program manager should be channeled through the program team member to functional managers.
Approves program plans, subdivided work description, and/or work authorizations, and schedules defining specific program requirements.	Assures his organization's compliance with all such program direction received.	Program definition must be within the scope of the contract as expressed in the program plan and work breakdown structure.
Signs correspondence that provides program direction to functional organizations. Signs correspondence addressed to the customer that pertains to the program except that which has been expressly assigned by the general manager, the function organizations, or higher management in accordance with division policy.	Assures his organization's compliance with all such program direction received. Functional manager provides the program manager with copies of all "Program" correspondence released by his organization that may affect program performance. Ensures that the program manager is aware of correspondence with unusual content, on an exception basis, through the cognizant program team member or directly if such action is warranted by the gravity of the situation.	In the program manager's absence, the signature authority is transferred upward to his reporting superior unless an acting program manager has been designated. Signature authority for correspondence will be consistent with established division policy.
Reports program results and accomplishments to the customer and to the general manager, keeping them informed of significant problems and events.	Participates in program reviews, being aware of and prepared in matters related to his functional specialty. Keeps his line or staff management and cognizant program team member informed of significant problems and events relating to any program in which his personnel are involved.	Status reporting is the responsibility of functional specialists. The program manager utilizes the specialist organizations. The specialists retain their own channels to the general manager but must keep the program manager informed.

- Conciliatory: friendly and agreeable, builds compatible team
- Judicial: uses sound judgment
- Ethical: honest, fair, by the book
- Secretive: not open or outgoing (to project detriment)
- Disruptive: breaks apart unity of group, agitator
- Intimidating: "tough guy," can lower morale
- Combative: eager to fight or be disagreeable

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Chapter 10
10.3 Performance Reporting

Team meetings are often used to exchange valuable and necessary information. The following are general guides for conducting more effective meetings:

- Start on time. If you wait for people, you reward tardy behavior.
- Develop agenda "objectives." Generate a list and proceed; avoid getting hung up on the order of topics.
- Conduct one piece of business at a time.
- Allow each member to contribute in his own way. Support, challenge, and counter; view differences as helpful; dig for reasons or views.
- Silence does not always mean agreement. Seek opinions: "What's your opinion on this, Peggy?"
- Be ready to confront the verbal member: "Okay, we've heard from Mike on this matter; now how about some other views?"
- Test for readiness to make a decision.
- Make the decision.
- Test for commitment to the decision.
- Assign roles and responsibilities (only after decision-making).
- Agree on follow-up or accountability dates.
- Indicate the next step for this group.
- Set the time and place for the next meeting.
- End on time.
- Ask yourself if the meeting was necessary.

Many times, company policies and procedures can be established for the development of communications channels. Table 5–4 illustrates such communications guidelines.

5.15 PROJECT REVIEW MEETINGS

Project review meetings are necessary to show that progress is being made on a project. There are three types of review meetings:

- Project team review meetings
- Executive management review meetings
- Customer project review meetings

Most projects have weekly, bimonthly, or monthly meetings in order to keep the project manager and his team informed about the project's status. These meetings are flexible and should be called only if they will benefit the team.

Executive management has the right to require monthly status review meetings. However, if the project manager believes that other meeting dates are better (because they occur at a point where progress can be identified), then he should request them.

Customer review meetings are often the most critical and most inflexibly scheduled. Project managers must allow time to prepare handouts and literature well in advance of the meeting.

5.16 PROJECT MANAGEMENT BOTTLENECKS

Poor communications can easily produce communications bottlenecks. The most common bottleneck occurs when all communications between the customer and the parent organization must flow through the project office. Requiring that all information pass through the project office may be necessary but slows reaction times. Regardless of the qualifications of the project office members, the client always fears that the information he receives will be "filtered" prior to disclosure.

Customers not only like firsthand information, but also prefer that their technical specialists be able to communicate directly with the parent organization's technical specialists. Many project managers dislike this arrangement, for they fear that the technical specialists may say or do something contrary to project strategy or thinking. These fears can be allayed by telling the customer that this situation will be permitted if, and only if, the customer realizes that the remarks made by the technical specialists do not, in any way, shape, or form, reflect the position of the project office or company.

For long-duration projects the customer may require that the contractor have an established customer representative office in the contractor's facilities. The idea behind this is

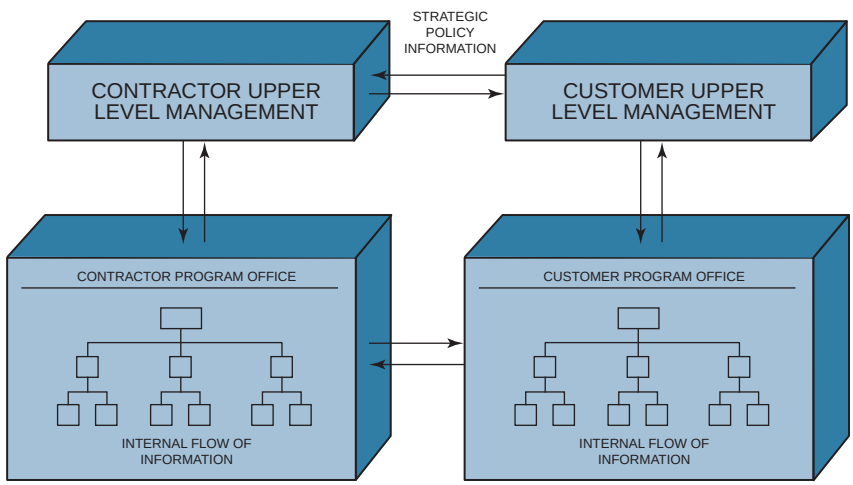

FIGURE 5–16. Information flow pattern from contractor program office.

sound in that all information to the customer must flow through the customer's project office at the contractor's facility. This creates a problem in that it attempts to sever direct communications channels between the customer and contractor project managers. The result is the establishment of a local project office to satisfy contractual requirements, while actual communications go from customer to contractor as though the local project office did not exist. This creates an antagonistic local customer project office.

Another bottleneck occurs when the customer's project manager considers himself to be in a higher position than the contractor's project manager and, therefore, seeks some higher authority with which to communicate. Project managers who seek status can often jeopardize the success of the project by creating rigid communications channels.

Figure 5–16 identifies why communications bottlenecks such as these occur. There almost always exist a minimum of two paths for communications flow to and from the customer, which can cause confusion.

5.17 COMMUNICATION TRAPS

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10.2.2 Communications Planning

Projects are run by communications. The work is defined by the communications tool known as the work breakdown structure. Actually, this is the easy part of communications, where everything is well defined. Unfortunately, project managers cannot document everything they wish to say or relate to other people, regardless of the level in the company. The worst possible situation occurs when an outside customer loses faith in the contractor. When a situation of mistrust prevails, the logical sequence of events would be:

- More documentation
- More interchange meetings
- Customer representation on your site

In each of these situations, the project manager becomes severely overloaded with work. This situation can also occur in-house when a line manager begins to mistrust a project manager, or vice versa. There may suddenly appear an exponential increase in the flow of paperwork, and everyone is writing "protection" memos. Previously, everything was verbal.

Communication traps occur most frequently with customer–contractor relationships. The following are examples of this:

- Phase I of the program has just been completed successfully. The customer, however, was displeased because he had to wait three weeks to a month after all tests were completed before the data were presented. For Phase II, the customer is insisting that his people be given the raw data at the same time your people receive it.
- The customer is unhappy with the technical information that is being given by the project manager. As a result, he wants his technical people to be able to communicate with your technical people on an individual basis without having to go through the project office.
- You are a subcontractor to a prime contractor. The prime contractor is a little nervous about what information you might present during a technical interchange

meeting where the customer will be represented, and therefore wants to review all material before the meeting.
- Functional employees are supposed to be experts. In front of the customer (or even your top management) an employee makes a statement that you, the project manager, do not believe is completely true or accurate.
- On Tuesday morning, the customer's project manager calls your project manager and asks him a question. On Tuesday afternoon, the customer's project engineer calls your project engineer and asks him the same question.

Communication traps can also occur between the project office and line managers. Below are several examples:

- The project manager holds too many or too few team meetings.
- People refuse to make decisions, and ultimately the team meetings are flooded with agenda items that are irrelevant.
- Last month, Larry completed an assignment as an assistant project manager on an activity where the project manager kept him continuously informed as to project status. Now, Larry is working for a different project manager who tells him only what he needs to know to get the job done.

In a project environment, the line manager is not part of any project team; otherwise he would spend forty hours per week simply attending team meetings. Therefore, how does the line manager learn of the true project status? Written memos will not do it. The information must come firsthand from either the project manager or the assigned functional employee. Line managers would rather hear it from the project manager because line employees have the tendency to censor bad news from the respective line manager. Line managers must be provided true status by the project office.

Sometimes, project managers expect too much from their employees during problem-solving or brainstorming sessions, and communications become inhibited. There are several possible causes for having unproductive team meetings:

- Because of superior–subordinate relationships (i.e., pecking orders), creativity is inhibited.
- All seemingly crazy or unconventional ideas are ridiculed and eventually discarded. Contributors do not wish to contribute anything further.
- Meetings are dominated by upper-level management personnel.
- Many people are not given adequate notification of meeting time and subject matter.

5.18 PROVERBS AND LAWS

Below are twenty project management proverbs that show you what can go wrong[18]:

- You cannot produce a baby in one month by impregnating nine women.
- The same work under the same conditions will be estimated differently by ten different estimators or by one estimator at ten different times.

18. Source unknown.

- The most valuable and least used word in a project manager's vocabulary is "NO."
- You can con a sucker into committing to an unreasonable deadline, but you can't bully him into meeting it.
- The more ridiculous the deadline, the more it costs to try to meet it.
- The more desperate the situation, the more optimistic the situatee.
- Too few people on a project can't solve the problems—too many create more problems than they solve.
- You can freeze the user's specs but he won't stop expecting.
- Frozen specs and the abominable snowman are alike: They are both myths, and they both melt when sufficient heat is applied.
- The conditions attached to a promise are forgotten, and the promise is remembered.
- What you don't know hurts you.
- A user will tell you anything you ask about—nothing more.
- Of several possible interpretations of a communication, the least convenient one is the only correct one.
- What is not on paper has not been said.
- No major project is ever installed on time, within budget, with the same staff that started it.
- Projects progress quickly until they become 90 percent complete; then they remain at 90 percent complete forever.
- If project content is allowed to change freely, the rate of change will exceed the rate of progress.
- No major system is ever completely debugged; attempts to debug a system inevitably introduce new bugs that are even harder to find.
- Project teams detest progress reporting because it vividly demonstrates their lack of progress.
- Parkinson and Murphy are alive and well—in your project.

There are thousands of humorous laws covering all subjects, including economics, general business, engineering, management, and politics. The list below shows some of these laws that are applicable to project management:

- **Abbott's Admonitions**
  1. If you have to ask, you're not entitled to know.
  2. If you don't like the answer, you shouldn't have asked the question.
- **Acheson's Rule of the Bureaucracy:** A memorandum is written not to inform the reader but to protect the writer.
- **Anderson's Law:** I have yet to see any problem, however complicated, which, when you looked at it in the right way, did not become still more complicated.
- **Benchley's Law:** Anyone can do any amount of work provided it isn't the work he or she is supposed to be doing at that moment.
- **Bok's Law:** If you think education is expensive—try ignorance.
- **Boling's Postulate:** If you're feeling good, don't worry. You'll get over it.
- **Brook's First Law:** Adding manpower to a late software project makes it later.

- **Brook's Second Law:** Whenever a system becomes completely defined, some damn fool discovers something which either abolishes the system or expands it beyond recognition.
- **Brown's Law of Business Success:** Our customer's paperwork is profit. Our own paperwork is loss.
- **Chisholm's Second Law:** When things are going well, something will go wrong.
  Corollaries
  1. When things just can't get any worse, they will.
  2. Anytime things appear to be going better, you have overlooked something.
- **Cohn's Law:** The more time you spend reporting what you are doing, the less time you have to do anything. Stability is achieved when you spend all your time doing nothing but reporting on the nothing you are doing.
- **Connolly's Law of Cost Control:** The price of any product produced for a government agency will be not less than the square of the initial firm fixed-price contract.
- **Cooke's Law:** In any decisive situation, the amount of relevant information available is inversely proportional to the importance of the decision.
- **Mr. Cooper's Law:** If you do not understand a particular word in a piece of technical writing, ignore it. The piece will make perfect sense without it.
- **Cornuelle's Law:** Authority tends to assign jobs to those least able to do them.
- **Courtois's Rule:** If people listened to themselves more often, they'd talk less.
- **First Law of Debate:** Never argue with a fool. People might not know the difference.
- **Donsen's Law:** The specialist learns more and more about less and less until, finally, he or she knows everything about nothing; whereas the generalist learns less and less about more and more until, finally, he knows nothing about everything.
- **Douglas's Law of Practical Aeronautics:** When the weight of the paperwork equals the weight of the plane, the plane will fly.
- **Dude's Law of Duality:** Of two possible events, only the undesired one will occur.
- **Economists' Laws**
  1. What men learn from history is that men do not learn from history.
  2. If on an actuarial basis there is a 50–50 chance that something will go wrong, it will actually go wrong nine times out of ten.
- **Old Engineer's Law:** The larger the project or job, the less time there is to do it.
- **Nonreciprocal Laws of Expectations**
  1. Negative expectations yield negative results.
  2. Positive expectations yield negative results.
- **Fyffe's Axiom:** The problem-solving process will always break down at the point at which it is possible to determine who caused the problem.
- **Golub's Laws of Computerdom**
  1. Fuzzy project objectives are used to avoid the embarrassment of estimating the corresponding costs.
  2. A carelessly planned project takes three times longer to complete than expected; a carefully planned project takes only twice as long.
  3. The effort required to correct the course increases geometrically with time.
  4. Project teams detest weekly progress reporting because it so vividly manifests their lack of progress.

- **Gresham's Law:** Trivial matters are handled promptly; important matters are never resolved.
- **Hoare's Law of Large Programs:** Inside every large program is a small program struggling to get out.
- **Issawi's Law of Cynics:** Cynics are right nine times out of ten; what undoes them is their belief that they are right ten times out of ten.
- **Johnson's First Law:** When any mechanical contrivance fails, it will do so at the most inconvenient possible time.
- **Malek's Law:** Any simple idea will be worded in the most complicated way.
- **Patton's Law:** A good plan today is better than a perfect plan tomorrow.
- **Peter's Prognosis:** Spend sufficient time in confirming the need and the need will disappear.
- **Law of Political Erosion:** Once the erosion of power begins, it has a momentum all its own.
- **Pudder's Law:** Anything that begins well ends badly. Anything that begins badly ends worse.
- **Putt's Law:** Technology is dominated by two types of people—those who understand what they do not manage and those who manage what they do not understand.
- **Truman's Law:** If you cannot convince them, confuse them.
- **Von Braun's Law of Gravity:** We can lick gravity, but sometimes the paperwork is overwhelming.

5.19 HUMAN BEHAVIOR EDUCATION

If there is a weakness in some of the project management education programs, it lies in the area of human behavior education. The potential problem is that there is an abundance of courses on planning, scheduling, and cost control but not very many courses on behavioral sciences that are directly applicable to a project management environment. All too often, lectures on human behavior focus upon application of the theories and principles based upon a superior (project manager) to subordinate (team member) relationship. This approach fails because:

- Team members can be at a higher pay grade than the project manager.
- The project manager most often has little overall authority.
- The project manager most often has little formal reward power.
- Team members may be working on multiple projects at the same time.
- Team members may receive conflicting instructions from the project managers and their line manager.
- Because of the project's duration, the project manager may not have the time necessary to adequately know the people on the team on a personal basis.
- The project manager may not have any authority to have people assigned to the project team or removed.

Topics that managers and executives believe should be covered in more depth in the behavioral courses include:

- Conflict management with all levels of personnel
- Facilitation management
- Counseling skills
- Mentorship skills
- Negotiation skills
- Communication skills with all stakeholders
- Presentation skills

The problem may emanate from the limited number of textbooks on human behavior applications directly applicable to the project management environment. One of the best books in the marketplace was written by Steven Flannes and Ginger Levin.[19] The book stresses application of project management education by providing numerous examples from the authors' project management experience.

5.20 MANAGEMENT POLICIES AND PROCEDURES

Although project managers have the authority and responsibility to establish project policies and procedures, they must fall within the general guidelines established by top management. Table 5–5 identifies sample top-management guidelines. Guidelines can also be established for planning, scheduling, controlling, and communications.

5.21 STUDYING TIPS FOR THE PMI® PROJECT MANAGEMENT CERTIFICATION EXAM

This section is applicable as a review of the principles to support the knowledge areas and domain groups in the PMBOK® Guide. This chapter addresses:

- Human Resources Management
- Communications Management
- Closure

19. Steven W. Flannes and Ginger Levin, *People Skills for Project Managers* (Vienna, VA: Management Concepts, 2001).

TABLE 5–5. PROJECT GUIDELINES

Program Manager	Functional Manager	Relationship
The program manager is responsible for overall program direction, control, and coordination; and is the principal contact with the program management of the customer.	The functional organization managers are responsible for supporting the program manager in the performance of the contract(s) and in accordance with the terms of the contract(s) and are accountable to their cognizant managers for the total performance.	The program manager determines what will be done: he obtains, through the assigned program team members, the assistance and concurrence of the functional support organizations in determining the definitive requirements and objectives of the program.
To achieve the program objectives, the program manager utilizes the services of the functional organizations in accordance with the prescribed division policies and procedures affecting the functional organizations.		The functional organizations determine *how* the work will be done.
The program manager establishes program and technical policy as defined by management policy.	The functional support organizations perform all work within their functional areas for all programs within the cost, schedule, quality, and specifications established by contract for the program so as to assist the program manager in achieving the program objectives.	The program manager operates within prescribed division policies and procedures except where requirements of a particular program necessitate deviations or modifications as approved by the general manager. The functional support organizations provide strong, aggressive support to the program managers.
The program manager is responsible for the progress being made as well as the effectiveness of the total program.	The functional support organization management seeks out or initiates innovations, methods, improvements, or other means that will enable that function to better schedule commitments, reduce cost, improve quality, or otherwise render exemplary performance as approved by the program manager.	The program manager relies on the functional support program team members for carrying out specific program assignments.
Integrates research, development, production, procurement, quality assurance, product support, test, and financial and contractual aspects.		Program managers and the functional support program team members are jointly responsible for ensuring that unresolved conflicts between requirements levied on functional organizations by different program managers are brought to the attention of management.
Approves detailed performance specifications, pertinent physical characteristics, and functional design criteria to meet the program's development or operational requirements.		
Ensures preparation of, and approves, overall plan, budgets, and work statements essential to the integration of system elements.		
Directs the preparation and maintenance of a time, cost, and performance schedule to ensure the orderly progress of the program.		

Coordinates and approves subcontract work statement, schedules, contract type, and price for major “buy” items.

Coordinates and approves vendor evaluation and source selections in conjunction with procurement representative to the program team.

Program decision authority rests with the program manager for all matters relating to his assigned program, consistent with division policy and the responsibilities assigned by the general manager.

Program managers do not make decisions that are the responsibility of the functional support organizations as defined in division policies and procedures and/or as assigned by the general manager.

Functional organization managers do not request decisions of a program manager that are not within the program manager’s delineated authority and responsibility and that do not affect the requirements of the program.

Functional organizations do not make program decisions that are the responsibility of the program manager.

Joint participation in problem solution is essential to providing satisfactory decisions that fulfill overall program and company objectives, and is accomplished by the program manager and the assigned program team members.

In arriving at program decisions, the program manager obtains the assistance and concurrence of cognizant functional support managers, through the cognizant program team member, since they are held accountable for their support of each program and for overall division functional performance.

Understanding the following principles is beneficial if the reader is using this text to study for the PMP® Certification Exam:

- How the various management theories relate to project management
- Various leadership styles
- Different types of power
- Different types of authority
- Need to document authority
- Contributions of Maslow, McGregor, Herzberg, and Ouchi
- Importance of human resources management in project management
- Need to clearly identify each team member's role and responsibility
- Various ways to motivate team members
- That both the project manager and the team are expected to solve their own problems
- That team development is an ongoing process throughout the project life cycle
- Barriers to encoding and decoding
- Need for communication feedback
- Various communication styles
- Types of meetings

In Appendix C, the following Dorale Products mini–case study is applicable:

- Dorale Products (I) [Human Resources and Communications Management]

The following multiple-choice questions will be helpful in reviewing the principles of this chapter:

1. Which of the following is not one of the sources of authority for a project manager?
A. Project charter
B. Job description for a project manager
C. Delegation from senior management
D. Delegation from subordinates

2. Which form of power do project managers that have a command of technology and are leading R&D projects most frequently use?
A. Reward power
B. Legitimate power
C. Expert power
D. Referent power

3. If a project manager possesses penalty (or coercive) power, he or she most likely also possesses:
A. Reward power
B. Legitimate power
C. Expert power
D. Referent power

4. A project manager with a history of success in meeting deliverables and in working with team members would most likely possess a great deal of:
A. Reward power
B. Legitimate power

C. Expert power
D. Referent power

5. Most project managers are motivated by which level of Maslow's hierarchy of human needs?
A. Safety
B. Socialization
C. Self-esteem
D. Self-actualization

6. You have been placed in charge of a project team. The majority of the team members have less than two years of experience working on project teams and most of the people have never worked with you previously. The leadership style you would most likely select would be:
A. Telling
B. Selling
C. Participating
D. Delegating

7. You have been placed in charge of a new project team and are fortunate to have been assigned the same people that worked for you on your last two projects. Both previous proj-ects were very successful and the team performed as a high-performance team. The leadership style you would most likely use on the new project would be:
A. Telling
B. Selling
C. Participating
D. Delegating

8. Five people are in attendance in a meeting and are communicating with one another. How many two-way channels of communication are present?
A. 4
B. 5
C. 10
D. 20

9. A project manager provides a verbal set of instructions to two team members on how to perform a specific test. Without agreeing or disagreeing with the project manager, the two employees leave the project manager's office. Later, the project manager discovers that the tests were not conducted according to his instructions. The most probable cause of failure would be:
A. Improper encoding
B. Improper decoding
C. Improper format for the message
D. Lack of feedback on instructions

10. A project manager that allows workers to be actively involved with the project manager in making decisions would be using which leadership style.
A. Passive
B. Participative/democratic
C. Autocratic
D. Laissez-faire

11. A project manager that dictates all decisions and does not allow for any participation by the workers would be using which leadership style.

A. Passive
B. Participative/democratic
C. Autocratic
D. Laissez-faire

12. A project manager that allows the team to make virtually all of the decisions without any involvement by the project manager would be using which leadership style.
A. Passive
B. Participative/democratic
C. Autocratic
D. Laissez-faire

ANSWERS

1. D
2. C
3. A
4. D
5. D
6. A
7. D
8. C
9. D
10. B
11. C
12. D

PROBLEMS

5–1 A project manager finds that he does not have direct reward power over salaries, bonuses, work assignments, or project funding for members of the project team with whom he interfaces. Does this mean that he is totally deficient in reward power? Explain your answer.

5–2 For each of the remarks made below, what types of interpersonal influences could exist?

a. "I've had good working relations with department X. They like me and I like them. I can usually push through anything ahead of schedule."
b. A research scientist was temporarily promoted to project management for an advanced state-of-the-art effort. He was overheard making the following remark to a team member: "I know it's contrary to department policy, but the test must be conducted according to these criteria or else the results will be meaningless."

5–3 Do you agree or disagree that scientists and engineers are likely to be more creative if they feel that they have sufficient freedom in their work? Can this condition backfire?

5–4 Should the amount of risk and uncertainty in the project have a direct bearing on how much authority is granted to a project manager?

5–5 Some projects are directed by project managers who have only monitoring authority. These individuals are referred to as influence project managers. What kind of projects would be under their control? What organizational structure might be best for this?

5–6 As a project nears termination, the project manager may find that the functional people are more interested in finding a new role for themselves than in giving their best to the current situation. How does this relate to Maslow's hierarchy of needs, and what should the project manager do?

5–7 Richard M. Hodgetts ("Leadership Techniques in the Project Organization," *Academy of Management Journal*, June 1968, pp. 211–219) conducted a survey on aerospace, chemical, construction, and state government workers as to whether they would rate the following leadership techniques as very important, important, or not important:

- Negotiation
- Personality and/or persuasive ability
- Competence
- Reciprocal favors

How do you think each industry answered the questionnaires?

5–8 In a project environment, time is a constraint rather than a luxury, and this creates a problem for the project manager who has previously never worked with certain team members. Some people contend that the project manager must create some sort of test to measure, early on, the ability of people to work together as a team.

Is such a test possible for people working in a project environment? Are there any project organizational forms that would be conducive for such testing?

5–9 Project managers consider authority and funding as being very important in gaining support. Functional personnel, however, prefer friendship and work assignments. How can these two outlooks be related to the theories of Maslow and McGregor?

5–10 On large projects, some people become experts at planning while others become experts at implementation. Planners never seem to put on another hat and see the problems of the people doing the implementation whereas the people responsible for implementation never seem to understand the problems of the planners. How can this problem be resolved on a continuous basis?

5–11 What kind of working relationships would result if the project manager had more reward power than the functional managers?

5–12 For each of the following remarks, state the possible situation and accompanying assumptions that you would make.

a. "A good project manager should manage by focusing on keeping people happy."
b. "A good project manager must be willing to manage tension."
c. "The responsibility for the success or failure rests with upper-level management. This is their baby."
d. Remarks by functional employee: "What if I fail on this project? What can he (the project manager) do to me?"

5–13 Can each of the following situations lead to failure?

a. Lack of expert power
b. Lack of referent power
c. Lack of reward and punishment power
d. Not having sufficient authority

5–14 One of your people comes into your office and states that he has a technical problem and would like your assistance by making a phone call.

a. Is this managing or doing?
b. Does your answer depend on who must be called? (That is, is it possible that authority relationships may have to be considered?)

5–15 On the LRC, can we structure the responsibility column to primary and secondary responsibilities?

5–16 Discuss the meaning of each of the two poems listed below:

We shall have to evolve
Problem solvers galore
Since each problem they solve
Creates ten problems more.
Author unknown

Jack and Jill went up the hill
To fetch a pail of water
Jack fell down and broke his crown
And Jill came tumbling after.

Jack could have avoided this awful lump
By seeking alternative choices
Like installing some pipe and a great big pump
And handing Jill the invoices.[20]

5–17 What is the correct way for a project manager to invite line managers to attend team meetings?

5–18 Can a project manager sit and wait for things to happen, or should he cause things to happen?

5–19 The company has just hired a fifty-four-year-old senior engineer who holds two masters degrees in engineering disciplines. The engineer is quite competent and has worked well as a loner for the past twenty years. This same engineer has just been assigned to the R&D phase of your project. You, as project manager or project engineer, must make sure that this engineer works as a team member with other functional employees, not as a loner. How do you propose to accomplish this? If the individual persists in wanting to be a loner, should you fire him?

20. Stacer Holcomb, OSD (SA), as quoted in *The C/E Newsletter,* publication of the cost effectiveness section of the Operations Research Society of America, Vol. 2, No. 1, January 1967.

5–20 Suppose the linear responsibility chart is constructed with the actual names of the people involved, rather than just their titles. Should this chart be given to the customer?

5–21 How should a functional manager handle a situation where the project manager:

a. Continually cries wolf concerning some aspect of the project when, in fact, the problem either does not exist or is not as severe as the project manager makes it out to be?
b. Refuses to give up certain resources that are no longer needed on the project?

5–22 How do you handle a project manager or project engineer who continually tries to "bite off more than he can chew?" If he were effective at doing this, at least temporarily, would your answer change?

5–23 A functional manager says that he has fifteen people assigned to work on your project next week (according to the project plan and schedule). Unfortunately, you have just learned that the prototype is not available and that these fifteen people will have nothing to do. Now what? Who is at fault?

5–24 Manpower requirements indicate that a specific functional pool will increase sharply from eight to seventeen people over the next two weeks and then drop back to eight people. Should you question this?

5–25 Below are several sources from which legal authority can be derived. State whether each source provides the project manager with sufficient authority from which he can effectively manage the project.

a. The project or organizational charter
b. The project manager's position in the organization
c. The job description and specifications for project managers
d. Policy documents
e. The project manager's "executive" rank
f. Dollar value of the contract
g. Control of funds

5–26 Is this managing or doing?[21]

MANAGING	DOING	
_____	_____	1. Making a call with one of your people to assist him in solving a technical problem.
_____	_____	2. Signing a check to approve a routine expenditure.
_____	_____	3. Conducting the initial screening interview of a job applicant.
_____	_____	4. Giving one of your experienced people your solution to a new problem without first asking for his recommendation.
_____	_____	5. Giving your solution to a recurring problem that one of your new people has just asked you about.
_____	_____	6. Conducting a meeting to explain to your people a new procedure.

21. From Raymond O. Leon, *Manage More by Doing Less* (New York: McGraw-Hill), p. 4. Copyright © 1971 by McGraw-Hill, Inc., New York. Used with permission of McGraw-Hill Book Company.

_____	_____	7. Phoning a department to request help in solving a problem that one of your people is trying to solve.
_____	_____	8. Filling out a form to give one of your people a pay increase.
_____	_____	9. Explaining to one of your people why he is receiving a merit pay increase.
_____	_____	10. Deciding whether to add a position.
_____	_____	11. Asking one of your people what he thinks about an idea you have that will affect your people.
_____	_____	12. Transferring a desirable assignment from employee A to employee B because employee A did not devote the necessary effort.
_____	_____	13. Reviewing regular written reports to determine your people's progress toward their objectives.
_____	_____	14. Giving a regular progress report by phone to your supervisor.
_____	_____	15. Giving a tour to an important visitor from outside of your organization.
_____	_____	16. Drafting an improved layout of facilities.
_____	_____	17. Discussing with your key people the extent to which they should use staff services during the next year.
_____	_____	18. Deciding what your expense-budget request will be for your area of responsibility.
_____	_____	19. Attending a professional or industrial meeting to learn detailed technical developments.
_____	_____	20. Giving a talk on your work activities to a local community group.

5–27 Below are three broad statements describing the functions of management. For each statement, are we referring to upper-level management, project management, or functional management?

a. Acquire the best available assets and try to improve them.
b. Provide a good working environment for all personnel.
c. Make sure that all resources are applied effectively and efficiently such that all constraints are met, if possible.

5–28 Decide whether you agree or disagree that, in the management of people, the project manager:

- Must convert mistakes into learning experiences.
- Acts as the lubricant that eases the friction (i.e., conflicts) between the functioning parts.

5–29 Functional employees are supposed to be the experts. A functional employee makes a statement that the project manager does not believe is completely true or accurate. Should the project manager support the team member? If so, for how long? Does your answer depend on to whom the remarks are being addressed, such as upper-level management or the customer? At what point should a project manager stop supporting his team members?

5–30 Below are four statements: two statements describe a function, and two others describe a purpose. Which statements refer to project management and which refer to functional management?

- Function
  - Reduce or eliminate uncertainty
  - Minimize and assess risk
- Purpose
  - Create the environment (using transformations)
  - Perform decision-making in the transformed environment

5–31 Manager A is a department manager with thirty years of experience in the company. For the last several years, he has worn two hats and acted as both project manager and functional manager on a variety of projects. He is an expert in his field. The company has decided to incorporate formal project management and has established a project management department. Manager B, a thirty-year-old employee with three years of experience with the company, has been assigned as project manager. In order to staff his project, manager B has requested from manager A that manager C (a personal friend of manager B) be assigned to the project as the functional representative. Manager C is twenty-six years old and has been with the company for two years. Manager A agrees to the request and informs manager C of his new assignment, closing with the remarks, "This project is yours all the way. I don't want to have anything to do with it. I'll be too busy with paperwork as the result of our new organizational structure. Just send me a memo once in a while telling me what's happening."

During the project kickoff meeting it became obvious to both manager B and manager C that the only person with the necessary expertise was manager A. Without the support of manager A, the time duration for project completion could be expected to double.

This situation is ideal for role playing. Put yourself in the place of managers A, B, and C and discuss the reasons for your actions. How can this problem be overcome? How do you get manager A to support the project? Who should inform upper-level management of this situation? When should upper-level management be informed? Would any of your answers change if manager B and manager C were not close friends?

5–32 Is it possible for a product manager to have the same degree of tunnel vision that a project manager has? If so, under what circumstances?

5–33 Your company has a policy that employees can participate in an educational tuition reimbursement program, provided that the degree obtained will benefit the company and that the employee's immediate superior gives his permission. As a project manager, you authorize George, your assistant project manager who reports directly to you, to take courses leading to an MBA degree.

Midway through your project, you find that overtime is required on Monday and Wednesday evenings, the same two evenings that George has classes. George cannot change the evenings that his classes are offered. You try without success to reschedule the overtime to early mornings or other evenings. According to company policy, the project office must supervise all overtime. Since the project office consists of only you and George, you must perform the overtime if George does not. How should you handle this situation? Would your answer change if you thought that George might leave the company after receiving his degree?

5–34 Establishing good interface relationships between the project manager and functional manager can take a great deal of time, especially during the conversion from a traditional to a project organizational form. Below are five statements that represent the different stages in the development of a good interface relationship. Place these statements in the proper order and discuss the meaning of each one.

a. The project manager and functional manager meet face-to-face and try to work out the problem.
b. Both the project and functional managers deny that any problems exist between them.
c. The project and functional managers begin formally and informally to anticipate the problems that can occur.
d. Both managers readily admit responsibility for several of the problems.
e. Each manager blames the other for the problem.

5–35 John is a functional support manager with fourteen highly competent individuals beneath him. John's main concern is performance. He has a tendency to leave scheduling and cost problems up to the project managers. During the past two months, John has intermittently received phone calls and casual visits from upper-level management and senior executives asking him about his department's costs and schedules on a variety of projects. Although he can answer almost all of the performance questions, he has experienced great difficulty in responding to time and cost questions. John is a little apprehensive that if this situation continues, it may affect his evaluation and merit pay increase. What are John's alternatives?

5–36 Projects have a way of providing a "chance for glory" for many individuals. Unfortunately, they quite often give the not-so-creative individual an opportunity to demonstrate his incompetence. Examples would include the designer who always feels that he has a better way of laying out a blueprint, or the individual who intentionally closes a door when asked to open it, or vice versa. How should a project manager handle this situation? Would your answer change if the individual were quite competent but always did the opposite just to show his individuality? Should these individuals be required to have close supervision? If close supervision is required, should it be the responsibility of the functional manager, the project office, or both?

5–37 Are there situations in which a project manager can wait for long-term changes instead of an immediate response to actions?

5–38 Is it possible for functional employees to have performed a job so long or so often that they no longer listen to the instructions given by the project or functional managers?

5–39 On Tuesday morning, the customer's project manager calls the subcontractor's project manager and asks him a question. On Tuesday afternoon, the customer's project engineer calls the contractor's project engineer and asks him the same question. How do you account for this? Could this be "planned" by the customer?

5–40 Below are eight common methods that project and functional employees can use to provide communications:

a. Counseling sessions
b. Telephone conversation
c. Individual conversation
d. Formal letter
e. Project office memo
f. Project office directive
g. Project team meeting
h. Formal report

For each of the following actions, select one and only one means of communication from the above list that you would utilize in accomplishing the action:

1. Defining the project organizational structure to functional managers
2. Defining the project organizational structure to team members
3. Defining the project organizational structure to executives
4. Explaining to a functional manager the reasons for conflict between his employee and your assistant project managers
5. Requesting overtime because of schedule slippages
6. Reporting an employee's violation of company policy

7. Reporting an employee's violation of project policy
8. Trying to solve a functional employee's grievance
9. Trying to solve a project office team member's grievance
10. Directing employees to increase production
11. Directing employees to perform work in a manner that violates company policy
12. Explaining the new indirect project evaluation system to project team members
13. Asking for downstream functional commitment of resources
14. Reporting daily status to executives or the customer
15. Reporting weekly status to executives or the customer
16. Reporting monthly or quarterly status to executives or the customer
17. Explaining the reason for the cost overrun
18. Establishing project planning guidelines
19. Requesting a vice president to attend your team meeting
20. Informing functional managers of project status
21. Informing functional team members of project status
22. Asking a functional manager to perform work not originally budgeted for
23. Explaining customer grievances to your people
24. Informing employees of the results of customer interchange meetings
25. Requesting that a functional employee be removed from your project because of incompetence

5–41 Last month, Larry completed an assignment as chief project engineering on project X. It was a pleasing assignment. Larry, and all of the other project personnel, were continually kept informed (by the project manager) concerning all project activities. Larry is now working for a new project manager who tells his staff only what they have to know in order to get their job done. What can Larry do about this situation? Can this be a good situation?

5–42 Phase I of a program has just been completed successfully. The customer, however, was displeased because he always had to wait three weeks to a month after all tests were complete before data were supplied by the contractor.

For Phase II of the program, the customer is requiring that advanced quality control procedures be adhered to. This permits the customer's quality control people to observe all testing and obtain all of the raw data at the same time the contractor does. Is there anything wrong with this arrangement?

5–43 You are a subcontractor to company Z, who in turn is the prime contractor to company Q. Before any design review or technical interchange meeting, company Z requires that they review all material to be presented both in-house and with company Q prior to the meeting. Why would a situation such as this occur? Is it beneficial?

5–44 Referring to Problem 5–43, during contract negotiations between company Q and company Z, you, as project manager for the subcontractor, are sitting in your office when the phone rings. It is company Q requesting information to support its negotiation position. Should you provide the information?

5–45 How does a project manager find out if the project team members from the functional departments have the authority to make decisions?

5–46 One of your functional people has been assigned to perform a certain test and document the results. For two weeks you "hound" this individual only to find out that he is continually procrastinating on work in another program. You later find out from one of his co-workers that he hates to write. What should you do?

5–47 During a crisis, you find that all of the functional managers as well as the team members are writing letters and memos to you, whereas previously everything was verbal. How do you account for this?

5–48 Below are several problems that commonly occur in project organizations. State, if possible, the effect that each problem could have on communications and time management:

a. People tend to resist exploration of new ideas.
b. People tend to mistrust each other in temporary management situations.
c. People tend to protect themselves.
d. Functional people tend to look at day-to-day activities rather than long-range efforts.
e. Both functional and project personnel often look for individual rather than group recognition.
f. People tend to create win-or-lose positions.

5–49 How can executives obtain loyalty and commitments from horizontal and vertical personnel in a project organizational structure?

5–50 What is meant by polarization of communications? What are the most common causes?

5–51 Many project managers contend that project team meetings are flooded with agenda items, many of which may be irrelevant. How do you account for this?

5–52 Paul O. Gaddis ("The Project Manager," *Harvard Business Review,* May–June 1959, p. 90, copyright © 1959 by the President and Fellows of Harvard College. All rights reserved) has stated that:

> In learning to manage a group of professional employees, the usual boss–subordinate relationship must be modified. Of special importance, the how—the details or methods of work performance by a professional employee—should be established by the employee. It follows that he must be given the facts necessary to permit him to develop a rational understanding of the why of tasks assigned to him.

How would you relate this information to the employee?

5–53 The customer has asked to have a customer representative office set up in the same building as the project office. As project manager, you put the customer's office at the opposite end of the building from where you are, and on a different floor. The customer states that he wants his office next to yours. Should this be permitted, and, if so, under what conditions?

5–54 During an interchange meeting from the customer, one of the functional personnel makes a presentation stating that he personally disagrees with the company's solution to the particular problem under discussion and that the company is "all wet" in its approach. How do you, as a project manager, handle this situation?

5–55 Do you agree or disagree with the statement that documenting results "forces" people to learn?

5–56 Should a project manager encourage the flow of problems to him? If yes, should he be selective in which ones to resolve?

5–57 Is it possible for a project manager to hold too few project review meetings?

5–58 If all projects are different, should there exist a uniform company policies and procedures manual?

5–59 Of the ten items below, which are considered as part of directing and which are controlling?

a. Supervising
b. Communicating
c. Delegating
d. Evaluating
e. Measuring
f. Motivating
g. Coordinating
h. Staffing
i. Counseling
j. Correcting

5–60 Which of the following items is not considered to be one of the seven Ms of management?

a. Manpower
b. Money
c. Machines
d. Methods
e. Materials
f. Minutes
g. Mission

5–61 Match the following leadership styles (source unknown):

1. Management by inaction _____
2. Management by detail _____
3. Management by invisibility _____
4. Management by consensus _____
5. Management by manipulation _____
6. Management by rejection _____
7. Management by survival _____
8. Management by depotism _____
9. Management by creativity _____
10. Management by leadership _____

_____ a. Has an executive who manages with flair, wisdom, and vision. He listens to his people, prods them, and leads them.

_____ b. Grows out of fear and anxiety.

_____ c. Can be fair or unfair, effective or ineffective, legitimate or illegitimate. Some people are manipulators of others for power. People are not puppets.

_____ d. Is the roughly negative style. Executive always has ideas; devil's advocate. Well-prepared proponents can win—so such a boss can be stimulating.

_____ e. Has an executive who needs every conceivable fact; is methodical and orderly; often is timid, inappropriate, or late.

_____ f. Is good as long as it is based on reality. The executive has a trained instinct.

_____ g. Has an executive who will do anything to survive—the jungle fighter. If it is done constructively, the executive will build instead of destroy.

_____ h. Is totalitarian. There are no clashes of ideas. The organization moves. Creative people flee. Employees always know who is boss.

_____ i. Has an executive who is not around, has good subordinates, and works in an office, offstage.

_____ j. Can be important in dealing with the unknown (R&D projects). Subordinates are independent and powerful. This style could be a substitute for decision-making. It is important for setting policy.

CASE STUDIES

THE TROPHY PROJECT

The ill-fated Trophy Project was in trouble right from the start. Reichart, who had been an assistant project manager, was involved with the project from its conception. When the Trophy Project was accepted by the company, Reichart was assigned as the project manager. The program schedules started to slip from day one, and expenditures were excessive. Reichart found that the functional managers were charging direct labor time to his project but working on their own "pet" projects. When Reichart complained of this, he was told not to meddle in the functional manager's allocation of resources and budgeted expenditures. After approximately six months, Reichart was requested to make a progress report directly to corporate and division staffs.

Reichart took this opportunity to bare his soul. The report substantiated that the project was forecasted to be one complete year behind schedule. Reichart's staff, as supplied by the line managers, was inadequate to stay at the required pace, let alone make up any time that had already been lost. The estimated cost at completion at this interval showed a cost overrun of at least 20 percent. This was Reichart's first opportunity to tell his story to people who were in a position to correct the situation. The result of Reichart's frank, candid evaluation of the Trophy Project was very predictable. Nonbelievers finally saw the light, and the line managers realized that they had a role to play in the completion of the project. Most of the problems were now out in the open and could be corrected by providing adequate staffing and resources. Corporate staff ordered immediate remedial action and staff support to provide Reichart a chance to bail out his program.

The results were not at all what Reichart had expected. He no longer reported to the project office; he now reported directly to the operations manager. Corporate staff's interest in the

project became very intense, requiring a 7:00 A.M. meeting every Monday morning for complete review of the project status and plans for recovery. Reichart found himself spending more time preparing paperwork, reports, and projections for his Monday morning meetings than he did administering the Trophy Project. The main concern of corporate was to get the project back on schedule. Reichart spent many hours preparing the recovery plan and establishing manpower requirements to bring the program back onto the original schedule.

Group staff, in order to closely track the progress of the Trophy Project, assigned an assistant program manager. The assistant program manager determined that a sure cure for the Trophy Project would be to computerize the various problems and track the progress through a very complex computer program. Corporate provided Reichart with twelve additional staff members to work on the computer program. In the meantime, nothing changed. The functional managers still did not provide adequate staff for recovery, assuming that the additional manpower Reichart had received from corporate would accomplish that task.

After approximately $50,000 was spent on the computer program to track the problems, it was found that the program objectives could not be handled by the computer. Reichart discussed this problem with a computer supplier and found that $15,000 more was required for programming and additional storage capacity. It would take two months for installation of the additional storage capacity and the completion of the programming. At this point, the decision was made to abandon the computer program.

Reichart was now a year and a half into the program with no prototype units completed. The program was still nine months behind schedule with the overrun projected at 40 percent of budget. The customer had been receiving his reports on a timely basis and was well aware of the fact that the Trophy Project was behind schedule. Reichart had spent a great deal of time with the customer explaining the problems and the plan for recovery. Another problem that Reichart had to contend with was that the vendors who were supplying components for the project were also running behind schedule.

One Sunday morning, while Reichart was in his office putting together a report for the client, a corporate vice president came into his office. “Reichart,” he said, “in any project I look at the top sheet of paper and the man whose name appears at the top of the sheet is the one I hold responsible. For this project your name appears at the top of the sheet. If you cannot bail this thing out, you are in serious trouble in this corporation.” Reichart did not know which way to turn or what to say. He had no control over the functional managers who were creating the problems, but he was the person who was being held responsible.

After another three months the customer, becoming impatient, realized that the Trophy Project was in serious trouble and requested that the division general manager and his entire staff visit the customer’s plant to give a progress and “get well” report within a week. The division general manager called Reichart into his office and said, “Reichart, go visit our customer. Take three or four functional line people with you and try to placate him with whatever you feel is necessary.” Reichart and four functional line people visited the customer and gave a four-and-a-half-hour presentation defining the problems and the progress to that point. The customer was very polite and even commented that it was an excellent presentation, but the content was totally unacceptable. The program was still six to eight months late, and the customer demanded progress reports on a weekly basis. The customer made arrangements to assign a representative in Reichart’s department to be “on-site” at the project on a daily basis and to interface with Reichart and his staff as required. After this turn of events, the program became very hectic.

The customer representative demanded constant updates and problem identification and then became involved in attempting to solve these problems. This involvement created many changes in the program and the product in order to eliminate some of the problems. Reichart had trouble with the customer and did not agree with the changes in the program. He expressed

his disagreement vocally when, in many cases, the customer felt the changes were at no cost. This caused a deterioration of the relationship between client and producer.

One morning Reichart was called into the division general manager's office and introduced to Mr. "Red" Baron. Reichart was told to turn over the reins of the Trophy Project to Red immediately. "Reichart, you will be temporarily reassigned to some other division within the corporation. I suggest you start looking outside the company for another job." Reichart looked at Red and asked, "Who did this? Who shot me down?"

Red was program manager on the Trophy Project for approximately six months, after which, by mutual agreement, he was replaced by a third project manager. The customer reassigned his local program manager to another project. With the new team the Trophy Project was finally completed one year behind schedule and at a 40 percent cost overrun.

LEADERSHIP EFFECTIVENESS (A)

Instructions This tabulation form on page 270 is concerned with a comparison of personal supervisory styles. Indicate your preference to the two alternatives after each item by writing appropriate figures in the blanks. Some of the alternatives may seem equally attractive or unattractive to you. Nevertheless, please attempt to choose the alternative that is relatively more characteristic of you. For each question given, you have three (3) points that you may distribute in any of the following combinations:

A. If you agree with alternative (a) and disagree with (b), write 3 in the top blank and 0 in bottom blank.
   a. 3
   b. 0

B. If you agree with (b) and disagree with (a), write:
   a. 0
   b. 3

C. If you have a slight preference for (a) over (b), write:
   a. 2
   b. 1

D. If you have a slight preference for (b) over (a), write:
   a. 1
   b. 2

Important—Use only the combinations shown above. Try to relate each item to your own personal experience. Please make a choice from every pair of alternatives.

1. On the job, a project manager should make a decision and . . .
   a. _____ tell his team to carry it out.
   b. _____ "tell" his team about the decision and then try to "sell" it.

2. After a project manager has arrived at a decision . . .
   a. _____ he should try to reduce the team's resistance to his decision by indicating what they have to gain.
   b. _____ he should provide an opportunity for his team to get a fuller explanation of his ideas.
3. When a project manager presents a problem to his subordinates . . .
   a. _____ he should get suggestions from them and then make a decision.
   b. _____ he should define it and request that the group make a decision.
4. A project manager . . .
   a. _____ is paid to make all the decisions affecting the work of his team.
   b. _____ should commit himself in advance to assist in implementing whatever decision his team selects when they are asked to solve a problem.
5. A project manager should . . .
   a. _____ permit his team an opportunity to exert some influence on decisions but reserve final decisions for himself.
   b. _____ participate with his team in group decision-making but attempt to do so with a minimum of authority.
6. In making a decision concerning the work situation, a project manager should . . .
   a. _____ present his decision and ideas and engage in a "give-and-take" session with his team to allow them to fully explore the implications of the decision.
   b. _____ present the problem to his team, get suggestions, and then make a decision.
7. A good work situation is one in which the project manager . . .
   a. _____ "tells" his team about a decision and then tries to "sell" it to them.
   b. _____ calls his team together, presents a problem, defines the problem, and requests they solve the problem with the understanding that he will support their decision(s).
8. A well-run project will include . . .
   a. _____ efforts by the project manager to reduce the team's resistance to his decisions by indicating what they have to gain from them.
   b. _____ "give-and take" sessions to enable the project manager and team to explore more fully the implications of the project manager's decisions.
9. A good way to deal with people in a work situation is . . .
   a. _____ to present problems to your team as they arise, get suggestions, and then make a decision.
   b. _____ to permit the team to make decisions, with the understanding that the project manager will assist in implementing whatever decision they make.

10. A good project manager is one who takes . . .

    a. _____ the responsibility for locating problems and arriving at solutions, then tries to persuade his team to accept them.

    b. _____ the opportunity to collect ideas from his team about problems, then he makes his decision.

11. A project manager . . .

    a. _____ should make the decisions in his organization and tell his team to carry them out.

    b. _____ should work closely with his team in solving problems, and attempt to do so with a minimum of authority.

12. To do a good job, a project manager should . . .

    a. _____ present solutions for his team's reaction.

    b. _____ present the problem and collect from the team suggested solutions, then make a decision based on the best solution offered.

13. A good method for a project manager is . . .

    a. _____ to "tell" and then try to "sell" his decision.

    b. _____ to define the problem for his team, then pass them the right to make decisions.

14. On the job, a project manager . . .

    a. _____ need not give consideration to what his team will think or feel about his decisions.

    b. _____ should present his decisions and engage in a "give-and-take" session to enable everyone concerned to explore, more fully, the implications of the decisions.

15. A project manager . . .

    a. _____ should make all decisions himself.

    b. _____ should present the problem to his team, get suggestions, and then make a decision.

16. It is good . . .

    a. _____ to permit the team an opportunity to exert some influence on decisions, but the project manager should reserve final decisions for himself.

    b. _____ for the project manager to participate with his team in group decision-making with as little authority as possible.

17. The project manager who gets the most from his team is the one who . . .

    a. _____ exercises direct authority.

    b. _____ seeks possible solutions from them and then makes a decision.

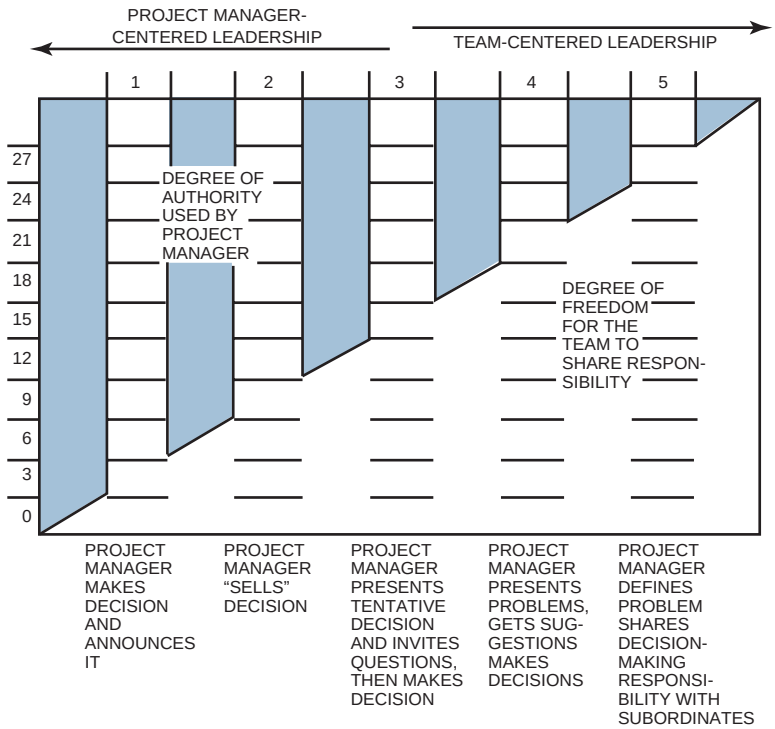
18. An effective project manager should . . .
    a. _____ make the decisions on his project and tell his team to carry them out.
    b. _____ make the decisions and then try to persuade his team to accept them.

19. A good way for a project manager to handle work problems is to . . .
    a. _____ implement decisions without giving any consideration to what his team will think or feel.
    b. _____ permit the team an opportunity to exert some influence on decisions but reserve the final decision for himself.

20. Project managers . . .
    a. _____ should seek to reduce the team's resistance to their decisions by indicating what they have to gain from them.
    b. _____ should seek possible solutions from their team when problems arise and then make a decision from the list of alternatives.

LEADERSHIP QUESTIONNAIRE
Tabulation Form

	1	2	3	4	5
1	____ a	____ b			
2		____ a	____ b		
3				____ a	____ b
4	____ a				____ b
5			____ a		____ b
6			____ a	____ b	
7		____ a			____ b
8		____ a	____ b		
9				____ a	____ b
10	____ a		____ b		
11	____ a				____ b
12			____ a	____ b	
13		____ a			____ b
14	____ a		____ b		
15	____ a			____ b	
16			____ a		____ b
17	____ a			____ b	
18	____ a	____ b			
19	____ a		____ b		
20		____ a		____ b	
TOTAL	____	____	____	____	____



LEADERSHIP EFFECTIVENESS (B)

The Project

PMBOK® Guide, 4th Edition
Chapter 9 Human Resources Management
Chapter 10 Communications Management
Domain of Professional Responsibility

Your company has just won a contract for an outside customer. The contract is for one year, broken down as follows: R&D: six months; prototype testing: one month; manufacturing: five months. In addition to the risks involved in the R&D stage, both your management and the customer have stated that there will be absolutely no trade-offs on time, cost, or performance.

When you prepared the proposal six months ago, you planned and budgeted for a full-time staff of five people, in addition to the functional support personnel. Unfortunately, due to limited resources, your staff (i.e., the project office) will be as follows:

Tom: An excellent engineer, somewhat of a prima donna, but has worked very well with you on previous projects. You specifically requested Tom and were fortunate to have him assigned, although your project is not regarded as a high priority. Tom is recognized as both a technical leader and expert, and is considered as perhaps the best engineer in the company. Tom will be full-time for the duration of the project.

Bob: Started with the company a little over a year ago, and may be a little "wet behind the ears." His line manager has great expectations for him in the future but, for the time being, wants you to give him on-the-job-training as a project office team member. Bob will be full-time on your project.

Carol: She has been with the company for twenty years and does an acceptable job. She has never worked on your projects before. She is full-time on the project.

George: He has been with the company for six years, but has never worked on any of your projects. His superior tells you that he will be only half-time on your project until he finishes a crash job on another project. He should be available for full-time work in a month or two. George is regarded as an outstanding employee.

Management informs you that there is nobody else available to fill the fifth position. You'll have to spread the increased workload over the other members. Obviously, the customer may not be too happy about this.

In each situation that follows, circle the best answer. The grading system will be provided later.

Remember: These staff individuals are "dotted" to you and "solid" to their line manager, although they are in your project office.

Situation 1: The project office team members have been told to report to you this morning. They have all received your memo concerning the time and place of the kickoff meeting. However, they have not been provided any specific details concerning the project except that the project will be at least one year in duration. For your company, this is regarded as a long-term project. A good strategy for the meeting would be:

A. The team must already be self-motivated or else they would not have been assigned. Simply welcome them and assign homework.
B. Motivate the employees by showing them how they will benefit: esteem, pride, self-actualization. Minimize discussion on specifics.
C. Explain the project and ask them for their input. Try to get them to identify alternatives and encourage group decision-making.
D. Identify the technical details of the project: the requirements, performance standards, and expectations.

Situation 2: You give the team members a copy of the winning proposal and a "confidential" memo describing the assumptions and constraints you considered in developing the proposal. You tell your team to review the material and be prepared to perform detailed planning at the meeting you have scheduled for the following Monday. During Monday's planning meeting, you find that Tom (who has worked with you before) has established a take-charge role and has done some of the planning that should have been the responsibility of other team members. You should:

A. Do nothing. This may be a beneficial situation. However, you may wish to ask if the other project office members wish to review Tom's planning.
B. Ask each team member individually how he or she feels about Tom's role. If they complain, have a talk with Tom.
C. Ask each team member to develop his or her own schedules and then compare results.
D. Talk to Tom privately about the long-term effects of his behavior.

Situation 3: Your team appears to be having trouble laying out realistic schedules that will satisfy the customer's milestones. They keep asking you pertinent questions and seem to be making the right decisions, but with difficulty.

A. Do nothing. If the team is good, they will eventually work out the problem.
B. Encourage the team to continue but give some ideas as to possible alternatives. Let them solve the problem.

C. Become actively involved and help the team solve the problem. Supervise the planning until completion.
D. Take charge yourself and solve the problem for the team. You may have to provide continuous direction.

Situation 4: Your team has taken an optimistic approach to the schedule. The functional managers have reviewed the schedules and have sent your team strong memos stating that there is no way that they can support your schedules. Your team's morale appears to be very low. Your team expected the schedules to be returned for additional iterations and trade-offs, but not with such harsh words from the line managers. You should:

A. Take no action. This is common to these types of projects and the team must learn to cope.
B. Call a special team meeting to discuss the morale problem and ask the team for recommendations. Try to work out the problem.
C. Meet with each team member individually to reinforce his or her behavior and performance. Let members know how many other times this has occurred and been resolved through trade-offs and additional iterations. State your availability to provide advice and support.
D. Take charge and look for ways to improve morale by changing the schedules.

Situation 5: The functional departments have begun working, but are still criticizing the schedules. Your team is extremely unhappy with some of the employees assigned out of one functional department. Your team feels that these employees are not qualified to perform the required work. You should:

A. Do nothing until you are absolutely sure (with evidence) that the assigned personnel cannot perform as needed.
B. Sympathize with your team and encourage them to live with this situation until an alternative is found.
C. Assess the potential risks with the team and ask for their input and suggestions. Try to develop contingency plans if the problem is as serious as the team indicates.
D. Approach the functional manager and express your concern. Ask to have different employees assigned.

Situation 6: Bob's performance as a project office team member has begun to deteriorate. You are not sure whether he simply lacks the skills, cannot endure the pressure, or cannot assume part of the additional work that resulted from the fifth position in the project being vacant. You should:

A. Do nothing. The problem may be temporary and you cannot be sure that there is a measurable impact on the project.
B. Have a personal discussion with Bob, seek out the cause, and ask him for a solution.
C. Call a team meeting and discuss how productivity and performance are decreasing. Ask the team for recommendations and hope Bob gets the message.
D. Interview the other team members and see if they can explain Bob's actions lately. Ask the other members to assist you by talking to Bob.

Situation 7: George, who is half-time on your project, has just submitted for your approval his quarterly progress report for your project. After your signature has been attained, the report is sent to senior management and the customer. The report is marginally acceptable and not at all what you would have expected from George. George apologizes to you for the report and blames it on his other project, which is in its last two weeks. You should:

A. Sympathize with George and ask him to rewrite the report.
B. Tell George that the report is totally unacceptable and will reflect on his ability as a project office team member.
C. Ask the team to assist George in redoing the report since a bad report reflects on everyone.
D. Ask one of the other team members to rewrite the report for George.

Situation 8: You have completed the R&D stage of your project and are entering phase II: prototype testing. You are entering month seven of the twelve-month project. Unfortunately, the results of phase I R&D indicate that you were too optimistic in your estimating for phase II and a schedule slippage of at least two weeks is highly probable. The customer may not be happy. You should:

A. Do nothing. These problems occur and have a way of working themselves out. The end date of the project can still be met.
B. Call a team meeting to discuss the morale problem resulting from the slippage. If morale is improved, the slippage may be overcome.
C. Call a team meeting and seek ways of improving productivity for phase II. Hopefully, the team will come up with alternatives.
D. This is a crisis and you must exert strong leadership. You should take control and assist your team in identifying alternatives.

Situation 9: Your rescheduling efforts have been successful. The functional managers have given you adequate support and you are back on schedule. You should:

A. Do nothing. Your team has matured and is doing what they are paid to do.
B. Try to provide some sort of monetary or nonmonetary reward for your team (e.g., management-granted time off or a dinner team meeting).
C. Provide positive feedback/reinforcement for the team and search for ideas for shortening phase III.
D. Obviously, your strong leadership has been effective. Continue this role for the phase III schedule.

Situation 10: You are now at the end of the seventh month and everything is proceeding as planned. Motivation appears high. You should:

A. Leave well enough alone.
B. Look for better ways to improve the functioning of the team. Talk to them and make them feel important.
C. Call a team meeting and review the remaining schedules for the project. Look for contingency plans.
D. Make sure the team is still focusing on the goals and objectives of the project.

Situation 11: The customer unofficially informs you that his company has a problem and may have to change the design specifications before production actually begins. This would be a catastrophe for your project. The customer wants a meeting at your plant within the next seven days. This will be the customer's first visit to your plant. All previous meetings were informal and at the customer's facilities, with just you and the customer. This meeting will be formal. To prepare for the meeting, you should:

A. Make sure the schedules are updated and assume a passive role since the customer has not officially informed you of his problem.
B. Ask the team to improve productivity before the customer's meeting. This should please the customer.
C. Call an immediate team meeting and ask the team to prepare an agenda and identify the items to be discussed.
D. Assign specific responsibilities to each team member for preparation of handout material for the meeting.

Situation 12: Your team is obviously not happy with the results of the customer interface meeting because the customer has asked for a change in design specifications. The manufacturing plans and manufacturing schedules must be developed anew. You should:

A. Do nothing. The team is already highly motivated and will take charge as before.
B. Reemphasize the team spirit and encourage your people to proceed. Tell them that nothing is impossible for a good team.
C. Roll up your shirt sleeves and help the team identify alternatives. Some degree of guidance is necessary.
D. Provide strong leadership and close supervision. Your team will have to rely on you for assistance.

Situation 13: You are now in the ninth month. While your replanning is going on (as a result of changes in the specifications), the customer calls and asks for an assessment of the risks in cancelling this project right away and starting another one. You should:

A. Wait for a formal request. Perhaps you can delay long enough for the project to finish.
B. Tell the team that their excellent performance may result in a follow-on contract.
C. Call a team meeting to assess the risks and look for alternatives.
D. Accept strong leadership for this and with *minimum*, if any, team involvement.

Situation 14: One of the functional managers has asked for your evaluation of all of his functional employees currently working on your project (excluding project office personnel). Your project office personnel appear to be working more closely with the functional employees than you are. You should:

A. Return the request to the functional manager since this is not part of your job description.
B. Talk to each team member individually, telling them how important their input is, and ask for their evaluations.
C. As a team, evaluate each of the functional team members, and try to come to some sort of agreement.
D. Do not burden your team with this request. You can do it yourself.

Situation 15: You are in the tenth month of the project. Carol informs you that she has the opportunity to be the project leader for an effort starting in two weeks. She has been with the company for twenty years and this is her first opportunity as a project leader. She wants to know if she can be released from your project. You should:

A. Let Carol go. You do not want to stand in the way of her career advancement.
B. Ask the team to meet in private and conduct a vote. Tell Carol you will abide by the team vote.
C. Discuss the problem with the team since they must assume the extra workload, if necessary. Ask for their input into meeting the constraints.
D. Counsel her and explain how important it is for her to remain. You are already shorthanded.

Situation 16: Your team informs you that one of the functional manufacturing managers has built up a brick wall around his department and all information requests must flow through him. The brick wall has been in existence for two years. Your team members are having trouble with status reporting, but always get the information after catering to the functional manager. You should:

A. Do nothing. This is obviously the way the line manager wants to run his department. Your team is getting the information they need.
B. Ask the team members to use their behavioral skills in obtaining the information.
C. Call a team meeting to discuss alternative ways of obtaining the information.
D. Assume strong leadership and exert your authority by calling the line manager and asking for the information.

Situation 17: The executives have given you a new man to replace Carol for the last two months of the project. Neither you nor your team have worked with this man before. You should:

A. Do nothing. Carol obviously filled him in on what he should be doing and what is involved in the project.
B. Counsel the new man individually, bring him up to speed, and assign him Carol's work.
C. Call a meeting and ask each member to explain his or her role on the project to the new man.
D. Ask each team member to talk to this man as soon as possible and help him come on board. Request that individual conversations be used.

Situation 18: One of your team members wants to take a late-afternoon course at the local college. Unfortunately, this course may conflict with his workload. You should:

A. Postpone your decision. Ask the employee to wait until the course is offered again.
B. Review the request with the team member and discuss the impact on his performance.
C. Discuss the request with the team and ask for the team's approval. The team may have to cover for this employee's workload.
D. Discuss this individually with each team member to make sure that the task requirements will still be adhered to.

Situation 19: Your functional employees have used the wrong materials in making a production run test. The cost to your project was significant, but absorbed in a small "cushion" that you saved for emergencies such as this. Your team members tell you that the test will be rerun without any slippage of the schedule. You should:

A. Do nothing. Your team seems to have the situation well under control.
B. Interview the employees that created this problem and stress the importance of productivity and following instructions.
C. Ask your team to develop contingency plans for this situation should it happen again.
D. Assume a strong leadership role for the rerun test to let people know your concern.

Situation 20: All good projects must come to an end, usually with a final report. Your project has a requirement for a final report. This final report may very well become the basis for follow-on work. You should:

A. Do nothing. Your team has things under control and knows that a final report is needed.
B. Tell your team that they have done a wonderful job and there is only one more task to do.
C. Ask your team to meet and provide an outline for the final report.
D. You must provide some degree of leadership for the final report, at least the structure. The final report could easily reflect on your ability as a manager.

Fill in the table below. The answers appear in Appendix B.

Situation	*Answer*	*Points*		*Situation*	*Answer*	*Points*
1				11		
2				12		
3				13		
4				14		
5				15		
6				16		
7				17		
8				18		
9				19		
10				20		
					Total	

MOTIVATIONAL QUESTIONNAIRE

On the next several pages, you will find forty statements concerning what motivates you and how you try to motivate others. Beside each statement, circle the number that corresponds to your opinion. In the example below, the choice is "Slightly Agree."

–3	Strongly Disagree
–2	Disagree
–1	Slightly Disagree
0	No Opinion
(+1)	Slightly Agree
+2	Agree
+3	Strongly Agree

Part 1

The following twenty statements involve *what motivates you.* Please rate each of the statements as honestly as possible. Circle the rating that you think is correct, *not* the one you think the instructor is looking for:

1. My company pays me a reasonable salary for the work that I do.	−3	−2	−1	0	+1	+2	+3
2. My company believes that every job that I do can be considered as a challenge.	−3	−2	−1	0	+1	+2	+3
3. The company provides me with the latest equipment (i.e., hardware, software, etc.) so I can do my job effectively.	−3	−2	−1	0	+1	+2	+3
4. My company provides me with recognition for work well done.	−3	−2	−1	0	+1	+2	+3
5. Seniority on the job, job security, and vested rights are provided by the company.	−3	−2	−1	0	+1	+2	+3
6. Executives provide managers with feedback of strategic or long-range information that may affect the manager's job.	−3	−2	−1	0	+1	+2	+3
7. My company provides off-hour clubs and organizations so that employees can socialize, as well as sponsoring social events.	−3	−2	−1	0	+1	+2	+3
8. Employees are allowed to either set their own work/performance standards or to at least approve/review standards set for them by management.	−3	−2	−1	0	+1	+2	+3

9. Employees are encouraged to maintain membership in professional societies and/or attend seminars and symposiums on work related subjects.	−3	−2	−1	0	+1	+2	+3
10. The company often reminds me that the only way to have job security is to compete effectively in the marketplace.							
11. Employees who develop a reputation for "excellence" are allowed to further enhance their reputation, if job related.	−3	−2	−1	0	+1	+2	+3
12. Supervisors encourage a friendly, cooperative working environment for employees.	−3	−2	−1	0	+1	+2	+3
13. My company provides me with a detailed job description, identifying my role and responsibilities.	−3	−2	−1	0	+1	+2	+3
14. My company gives *automatic* wage wage and salary increases for the employees.	−3	−2	−1	0	+1	+2	+3
15. My company gives me the opportunity to do what I do best.	−3	−2	−1	0	+1	+2	+3
16. My job gives me the opportunity to be truly creative, to the point where I can solve complex problems.	−3	−2	−1	0	+1	+2	+3
17. My efficiency and effectiveness is improving because the company provided me with better physical working conditions (i.e., lighting, low noise, temperature, restrooms, etc.)	−3	−2	−1	0	+1	+2	+3
18. My job gives me constant self-development.	−3	−2	−1	0	+1	+2	+3
19. Our supervisors have feelings for employees rather than simply treating them as "inanimate tools."	−3	−2	−1	0	+1	+2	+3
20. Participation in the company's stock option/retirement plan is available to employees.	−3	−2	−1	0	+1	+2	+3

Part 2

Statements 21–40 involve how project managers motivate team members. Again, it is important that your ratings honestly reflect the way you think that *you*, as project manager, try to motivate employees. Do *not* indicate the way others or the instructor might recommend motivating the employees. Your thoughts are what are important in this exercise.

21. Project managers should encourage employees to take advantage of company benefits such as stock option plans and retirement plans.	−3	−2	−1	0	+1	+2	+3
22. Project managers should make sure that team members have a good work environment (i.e., heat, lighting, low noise, restrooms, cafeteria, etc.).	−3	−2	−1	0	+1	+2	+3
23. Project managers should assign team members work that can enhance each team member's reputation.	−3	−2	−1	0	+1	+2	+3
24. Project managers should create a relaxed, cooperative environment for the team members.	−3	−2	−1	0	+1	+2	+3
25. Project managers should *continually* remind the team that job security is a function of competitiveness, staying within constraints, and good customer relations.	−3	−2	−1	0	+1	+2	+3
26. Project managers should try to convince team members that each new assignment is a challenge.	−3	−2	−1	0	+1	+2	+3
27. Project managers should be willing to reschedule activities, if possible, around the team's company and out-of-company social functions.	−3	−2	−1	0	+1	+2	+3
28. Project managers should continually remind employees of how they will benefit, monetarily, by successful performance on your project.	−3	−2	−1	0	+1	+2	+3

29. Project managers should be willing to "pat people on the back" and provide recognition where applicable.	−3	−2	−1	0	+1	+2	+3
30. Project managers should encourage the team to maintain constant self-development with each assignment.	−3	−2	−1	0	+1	+2	+3
31. Project managers should allow team members to set their own standards, where applicable.	−3	−2	−1	0	+1	+2	+3
32. Project managers should assign work to functional employees according to seniority on the job.	−3	−2	−1	0	+1	+2	+3
33. Project managers should allow team members to use the informal, as well as formal, organization to get work accomplished.	−3	−2	−1	0	+1	+2	+3
34. As a project manager, I would like to control the salaries of the full-time employees on my project.	−3	−2	−1	0	+1	+2	+3
35. Project managers should share information with the team. This includes project information that may not be directly applicable to the team member's assignment.	−3	−2	−1	0	+1	+2	+3
36. Project managers should encourage team members to be creative and to solve their own problems.	−3	−2	−1	0	+1	+2	+3
37. Project managers should provide detailed job descriptions for team members, outlining the team member's role and responsibility.	−3	−2	−1	0	+1	+2	+3
38. Project managers should give each team member the opportunity to do what the team member can do best.	−3	−2	−1	0	+1	+2	+3
39. Project managers should be willing to interact informally with the team members and get to know them, as long as there exists sufficient time on the project.	−3	−2	−1	0	+1	+2	+3
40. Most of the employees on my project earn a salary commensurate with their abilities.	−3	−2	−1	0	+1	+2	+3

Part 1 Scoring Sheet (What Motivates You?)

Place your answers (the numerical values you circled) to questions 1–20 in the corresponding spaces in the chart below.

Basic Needs		*Safety Needs*		*Belonging Needs*	
#1	_____	#5	_____	#7	_____
#3	_____	#10	_____	#9	_____
#14	_____	#13	_____	#12	_____
#17	_____	#20	_____	#19	_____
Total	_____	Total	_____	Total	_____

Esteem/Ego Needs		*Self-Actualization Needs*	
#4	_____	#2	_____
#6	_____	#15	_____
#8	_____	#16	_____
#11	_____	#18	_____
Total	_____	Total	_____

Transfer your total score in each category to the table on page 283 by placing an "X" in the appropriate area for motivational needs.

Part 2 Scoring Sheet (How Do You Motivate?)

Place your answers (the numerical values you circled) to questions 21–40 in the corresponding spaces in the chart below.

Basic Needs		*Safety Needs*		*Belonging Needs*	
#22	_____	#21	_____	#24	_____
#28	_____	#25	_____	#27	_____
#34	_____	#32	_____	#33	_____
#40	_____	#37	_____	#39	_____
Total	_____	Total	_____	Total	_____

Esteem/Ego Needs		*Self-Actualization Needs*	
#23	_____	#26	_____
#29	_____	#30	_____
#31	_____	#36	_____
#35	_____	#38	_____
Total	_____	Total	_____

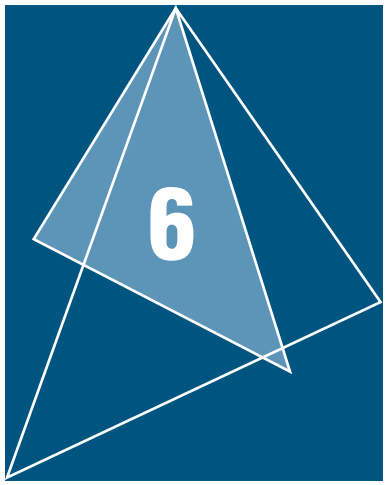
Transfer your total score in each category to the table on page 283 by placing an "X" in the appropriate area for motivational needs.

QUESTIONS 1–20

Points																								
Needs	–12	–11	–10	–9	–8	–7	–6	–5	–4	–3	–2	–1	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10	+11	+12
Self-Actualization																									
Esteem/Ego																									
Belonging																									
Safety																									
Basic																									

QUESTIONS 21–40

Points																								
Needs	–12	–11	–10	–9	–8	–7	–6	–5	–4	–3	–2	–1	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10	+11	+12
Self-Actualization																									
Esteem/Ego																									
Belonging																									
Safety																									
Basic																									



Management of Your Time and Stress

Related Case Studies (from Kerzner/*Project Management Case Studies*, 3rd Edition)	Related Workbook Exercises (from Kerzner/*Project Management Workbook and PMP®/CAPM® Exam Study Guide*, 10th Edition)	PMBOK® Guide, 4th Edition, Reference Section for the PMP® Certification Exam
• The Reluctant Workers* • Time Management Exercise	• Multiple Choice Exam	• Human Resource Management • Risk Management

6.0 INTRODUCTION

PMBOK® Guide, 4th Edition
Chaper 9 Human Resources Management
Chapter 6 Time Management

Managing projects within time, cost, and performance is easier said than done. The project management environment is extremely turbulent, and is composed of numerous meetings, report writing, conflict resolution, continuous planning and replanning, communications with the customer, and crisis management. Ideally, the effective project manager is a manager, not a doer, but in the "real world," project managers often compromise their time by doing both.

Disciplined time management is one of the keys to effective project management. It is often said that if the project manager cannot control his own time, then he will control nothing else on the project.

*Case Study also appears at end of chapter.

6.1 UNDERSTANDING TIME MANAGEMENT[1]

For most people, time is a resource that, when lost or misplaced, is gone forever. For a project manager, however, time is more of a constraint, and effective time management principles must be employed to make it a resource.

Most executives prefer to understaff projects, in the mistaken belief that the project manager will assume the additional workload. The project manager may already be heavily burdened with meetings, report preparation, internal and external communications, conflict resolution, and planning/replanning for crises. And yet, most project managers somehow manipulate their time to get the work done. Experienced personnel soon learn to delegate tasks and to employ effective time management principles. The following questions should help managers identify problem areas:

- Do you have trouble completing work within the allocated deadlines?
- How many interruptions are there each day?
- Do you have a procedure for handling interruptions?
- If you need a large block of uninterrupted time, is it available? With or without overtime?
- How do you handle drop-in visitors and phone calls?
- How is incoming mail handled?
- Do you have established procedures for routine work?
- Are you accomplishing more or less than you were three months ago? Six months ago?
- How difficult is it for you to say no?
- How do you approach detail work?
- Do you perform work that should be handled by your subordinates?
- Do you have sufficient time each day for personal interests?
- Do you still think about your job when away from the office?
- Do you make a list of things to do? If yes, is the list prioritized?
- Does your schedule have some degree of flexibility?

The project manager who can deal with these questions has a greater opportunity to convert time from a constraint to a resource.

6.2 TIME ROBBERS

The most challenging problem facing the project manager is his inability to say no. Consider the situation in which an employee comes into your office with a problem. The employee may be sincere when he says that he simply wants your advice but, more often

1. Sections 6.1, 6.2, and 6.3 are adapted from David Cleland and Harold Kerzner, *Engineering Team Management* (Melbourne, Florida: Krieger, 1986), Chapter 8.

PMBOK® Guide, 4th Edition
Chapter 6 Time Management
Chapter 11 Risk Management
1.6 General Management Knowledge and Skills

than not, the employee wants to take the monkey off of his back and put it onto yours. The employee's problem is now *your* problem.

To handle such situations, first screen out the problems with which you do not wish to get involved. Second, if the situation does necessitate your involvement, then you must make sure that when the employee leaves your office, he realizes that the problem is still his, not yours. Third, if you find that the problem will require your continued attention, remind the employee that all future decisions will be joint decisions and that the problem will still be on the employee's shoulders. Once employees realize that they cannot put their problems on your shoulders, they learn how to make their own decisions.

There are numerous time robbers in the project management environment. These include:

- Incomplete work
- A job poorly done that must be done over
- Telephone calls, mail, and email
- Lack of adequate responsibility and commensurate authority
- Changes without direct notification/explanation
- Waiting for people
- Failure to delegate, or unwise delegation
- Poor retrieval systems
- Lack of information in a ready-to-use format
- Day-to-day administration
- Union grievances
- Having to explain "thinking" to superiors
- Too many levels of review
- Casual office conversations
- Misplaced information
- Shifting priorities
- Indecision at any level
- Procrastination
- Setting up appointments
- Too many meetings
- Monitoring delegated work
- Unclear roles/job descriptions
- Executive meddling
- Budget adherence requirements
- Poorly educated customers
- Not enough proven managers
- Vague goals and objectives
- Lack of a job description
- Too many people involved in minor decision-making
- Lack of technical knowledge
- Lack of authorization to make decisions
- Poor functional status reporting
- Work overload
- Unreasonable time constraints
- Too much travel
- Lack of adequate project management tools
- Departmental "buck passing"
- Company politics
- Going from crisis to crisis
- Conflicting directives
- Bureaucratic roadblocks ("ego")
- Empire-building line managers
- No communication between sales and engineering
- Excessive paperwork
- Lack of clerical/administrative support
- Dealing with unreliable subcontractors
- Personnel not willing to take risks
- Demand for short-term results
- Lack of long-range planning
- Learning new company systems
- Poor lead time on projects
- Documentation (reports/red tape)
- Large number of projects
- Desire for perfection

- Lack of project organization
- Constant pressure
- Constant interruptions
- Shifting of functional personnel
- Lack of employee discipline
- Lack of qualified manpower

6.3 TIME MANAGEMENT FORMS

There are two basic forms that project managers and project engineers can use for practicing better time management. The first form is the "to do" pad as shown in Figure 6–1. The project manager or secretary prepares the list of things to do. The project manager then decides which activities he must perform himself and assigns the appropriate priorities.

The activities with the highest priorities are then transferred to the "daily calendar log," as shown in Figure 6–2. The project manager assigns these activities to the appropriate time blocks based on his own energy cycle. Unfilled time blocks are then used for unexpected crises or for lower-priority activities.

If there are more priority elements than time slots, the project manager may try to schedule well in advance. This is normally not a good practice, because it creates a backlog of high-priority activities. In addition, an activity that today is a "B" priority could easily become an "A" priority in a day or two. The moral here is do not postpone until tomorrow what you or your team can do today.

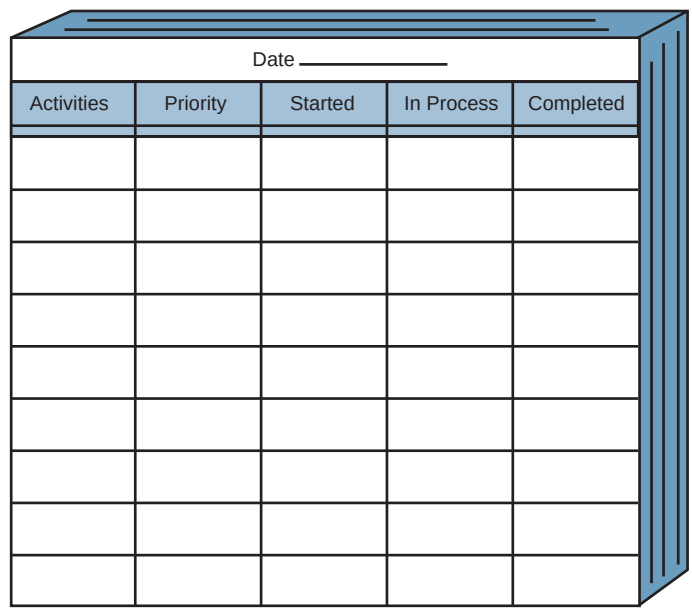


FIGURE 6–1. "To-do" pad.

Date _____

Time	Activity	Priority
8:00–9:00		
9:00–10:00		
10:00–11:00		
11:00–12:00		
12:00–1:00		
1:00–2:00		
2:00–3:00		
3:00–4:00		
4:00–5:00		

FIGURE 6–2. Daily calendar log.

6.4 EFFECTIVE TIME MANAGEMENT

There are several techniques that project managers can practice in order to make better use of their time[2]:

- Delegate.
- Follow the schedule.
- Decide fast.
- Decide who should attend.
- Learn to say no.
- Start now.
- Do the tough part first.
- Travel light.
- Work at travel stops.
- Avoid useless memos.
- Refuse to do the unimportant.
- Look ahead.
- Ask: Is this trip necessary?
- Know your energy cycle.

2. Source unknown.

- Control telephone and email time.
- Send out the meeting agenda.
- Overcome procrastination.
- Manage by exception.

As we learned in Chapter 5, the project manager, to be effective, must establish time management rules and then ask himself four questions:

- Rules for time management
  - Conduct a time analysis (time log).
  - Plan solid blocks for important things.
  - Classify your activities.
  - Establish priorities.
  - Establish opportunity cost on activities.
  - Train your system (boss, subordinate, peers).
  - Practice delegation.
  - Practice calculated neglect.
  - Practice management by exception.
  - Focus on opportunities—not on problems.
- Questions
  - What am I doing that I don't have to do at all?
  - What am I doing that can be done better by someone else?
  - What am I doing that could be done as well by someone else?
  - Am I establishing the right priorities for my activities?

6.5 STRESS AND BURNOUT

The factors that serve to make any occupation especially stressful are responsibility without the authority or ability to exert control, a necessity for perfection, the pressure of deadlines, role ambiguity, role conflict, role overload, the crossing of organizational boundaries, responsibility for the actions of subordinates, and the necessity to keep up with the information explosions or technological breakthroughs. Project managers have all of these factors in their jobs.

A project manager has his resources controlled by line management, yet the responsibilities of bringing a project to completion by a prescribed deadline are his. A project manager may be told to increase the work output, while the work force is simultaneously being cut. Project managers are expected to get work out on schedule, but are often not permitted to pay overtime. One project manager described it this way: "I have to implement plans I didn't design, but if the project fails, I'm responsible.

Project managers are subject to stress due to several different facets of their jobs. This can manifest itself in a variety of ways, such as:

1. *Being tired.* Being tired is a result of being drained of strength and energy, perhaps through physical exertion, boredom, or impatience. The definition here applies more to a short-term, rather than long-term, effect. Typical causes for feeling tired include meetings, report writing, and other forms of document preparation.

2. *Feeling depressed.* Feeling depressed is an emotional condition usually characterized by discouragement or a feeling of inadequacy. It is usually the result of a situation that is beyond the control or capabilities of the project manager. There are several sources of depression in a project environment: Management or the client considers your report unacceptable, you are unable to get timely resources assigned, the technology is not available, or the constraints of the project are unrealistic and may not be met.

3. *Being physically and emotionally exhausted.* Project managers are both managers and doers. It is quite common for project managers to perform a great deal of the work themselves, either because they consider the assigned personnel unqualified to perform the work or because they are impatient and consider themselves capable of performing the work faster. In addition, project managers often work a great deal of "self-inflicted" overtime. The most common cause of emotional exhaustion is report writing and the preparation of handouts for interchange meetings.

4. *Burned out.* Being burned out is more than just a feeling; it is a condition. Being burned out implies that one is totally exhausted, both physically and emotionally, and that rest, recuperation, or vacation time may not remedy the situation. The most common cause is prolonged overtime, or the need thereof, and an inability to endure or perform under continuous pressure and stress. Burnout can occur almost overnight, often with very little warning. The solution is almost always a change in job assignment, preferably with another company.

5. *Being unhappy.* There are several factors that produce unhappiness in project management. Such factors include highly optimistic planning, unreasonable expectations by management, management cutting resources because of a "buy-in," or simply customer demands for additional data items. A major source of unhappiness is the frustration caused by having limited authority that is not commensurate with the assigned responsibility.

6. *Feeling trapped.* The most common situation where project managers feel trapped is when they have no control over the assigned resources on the project and feel as though they are at the mercy of the line managers. Employees tend to favor the manager who can offer them the most rewards, and that is usually the line manager. Providing the project manager with some type of direct reward power can remedy the situation.

7. *Feeling worthless.* Feeling worthless implies that one is without worth or merit, that is, valueless. This situation occurs when project managers feel that they are managing projects beneath their dignity. Most project managers look forward to the death of their project right from the onset, and expect their next project to be more important, perhaps twice the cost, and more complex. Unfortunately, there are always situations where one must take a step backwards.

8. *Feeling resentful and disillusioned about people.* This situation occurs most frequently in the project manager's dealings (i.e., negotiations) with the line managers.

During the planning stage of a project, line managers often make promises concerning future resource commitments, but renege on their promises during execution. Disillusionment then occurs and can easily develop into serious conflict. Another potential source of these feelings is when line managers appear to be making decisions that are not in the best interest of the project.

9. *Feeling hopeless.* The most common source of hopelessness are R&D projects where the ultimate objective is beyond the reach of the employee or even of the state-of-the-art technology. Hopelessness means showing no signs of a favorable outcome. Hopelessness is more a result of the performance constraint than of time or cost.

10. *Feeling rejected.* Feeling rejected can be the result of a poor working relationship with executives, line managers, or clients. Rejection often occurs when people with authority feel that their options or opinions are better than those of the project manager. Rejection has a demoralizing effect on the project manager because he feels that he is the "president" of the project and the true "champion" of the company.

11. *Feeling anxious.* Almost all project managers have some degree of "tunnel vision," where they look forward to the end of the project, even when the project is in its infancy. This anxious feeling is not only to see the project end, but to see it completed successfully.

Stress is not always negative, however. Without certain amounts of stress, reports would never get written or distributed, deadlines would never be met, and no one would even get to work on time. But stress can be a powerful force resulting in illness and even fatal disease, and must be understood and managed if it is to be controlled and utilized for constructive purposes.

The mind, body, and emotions are not the separate entities they were once thought to be. One affects the other, sometimes in a positive way, and sometimes in a negative way. Stress becomes detrimental when it is prolonged beyond what an individual can comfortably handle. In a project environment, with continually changing requirements, impossible deadlines, and each project being considered as a unique entity in itself, we must ask, How much prolonged stress can a project manager handle comfortably?

The stresses of project management may seem excessive for whatever rewards the position may offer. However, the project manager who is aware of the stresses inherent in the job and knows stress management techniques can face this challenge objectively and make it a rewarding experience.

6.6 STUDYING TIPS FOR THE PMI® PROJECT MANAGEMENT CERTIFICATION EXAM

This section is applicable as a review of the principles to support the knowledge areas and domain groups in the PMBOK® Guide. This chapter addresses:

- Human Resources Management
- Risk Management
- Execution

Understanding the following principles is beneficial if the reader is using this text to study for the PMP® Certification Exam:

- How stress can affect the way that the project manager works with the team
- How stress affects the performance of team members

The following multiple-choice questions will be helpful in reviewing the principles of this chapter:

1. Which of the following leadership styles most frequently creates "additional" time robbers for a project manager?
A. Telling
B. Selling
C. Participating
D. Delegating

2. Which of the following leadership styles most frequently creates "additional" time robbers for the project team?
A. Telling
B. Selling
C. Participating
D. Delegating

3. Which of the following time robbers would a project manager most likely want to handle by himself or herself rather than through delegation to equally qualified team members?
A. Approval of procurement expenditures
B. Status reporting to a customer
C. Conflicting directives from the executive sponsor
D. Earned-value status reporting

ANSWERS

1. A

2. D

3. C

PROBLEMS

6–1 Should time robbers be added to direct labor standards for pricing out work?

6–2 Is it possible for a project manager to improve his time management skills by knowing the "energy cycle" of his people? Can this energy cycle be a function of the hour of the day, day of the week, or whether overtime is required?

CASE STUDY

THE RELUCTANT WORKERS

Tim Aston had changed employers three months ago. His new position was project manager. At first he had stars in his eyes about becoming the best project manager that his company had ever seen. Now, he wasn't sure if project management was worth the effort. He made an appointment to see Phil Davies, director of project management.

Tim Aston: "Phil, I'm a little unhappy about the way things are going. I just can't seem to motivate my people. Every day, at 4:30 P.M., all of my people clean off their desks and go home. I've had people walk out of late afternoon team meetings because they were afraid that they'd miss their car pool. I have to schedule morning team meetings."

Phil Davies: "Look, Tim. You're going to have to realize that in a project environment, people think that they come first and that the project is second. This is a way of life in our organizational form."

Tim Aston: "I've continually asked my people to come to me if they have problems. I find that the people do not think that they need help and, therefore, do not want it. I just can't get my people to communicate more."

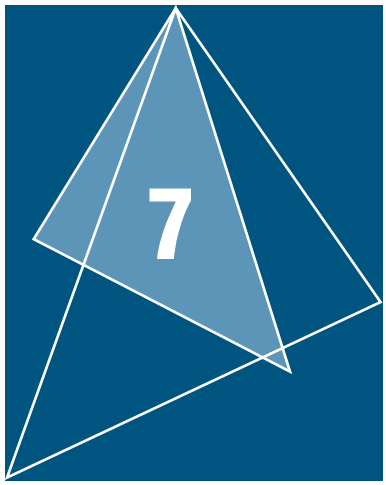
Phil Davies: "The average age of our employees is about forty-six. Most of our people have been here for twenty years. They're set in their ways. You're the first person that we've hired in the past three years. Some of our people may just resent seeing a thirty-year-old project manager."

Tim Aston: "I found one guy in the accounting department who has an excellent head on his shoulders. He's very interested in project management. I asked his boss if he'd release him for a position in project management, and his boss just laughed at me, saying something to the effect that as long as that guy is doing a good job for him, he'll never be released for an assignment elsewhere in the company. His boss seems more worried about his personal empire than he does in what's best for the company.

"We had a test scheduled for last week. The customer's top management was planning on flying in for firsthand observations. Two of my people said that they had programmed vacation days coming, and that they would not change, under any conditions. One guy was going fishing and the other guy was planning to spend a few days working with fatherless children in our community. Surely, these guys could change their plans for the test."

Phil Davies: "Many of our people have social responsibilities and outside interests. We encourage social responsibilities and only hope that the outside interests do not interfere with their jobs.

"There's one thing you should understand about our people. With an average age of forty-six, many of our people are at the top of their pay grades and have no place to go. They must look elsewhere for interests. These are the people you have to work with and motivate. Perhaps you should do some reading on human behavior."



Conflicts

Related Case Studies (from Kerzner/*Project Management Case Studies*, 3rd Edition)	Related Workbook Exercises (from Kerzner/*Project Management Workbook and PMP®/CAPM® Exam Study Guide*, 10th Edition)	PMBOK® Guide, 4th Edition, Reference Section for the PMP® Certification Exam
• Facilities Scheduling at Mayer Manufacturing* • Scheduling the Safety Lab • Telestar International* • The Problem with Priorities	• Multiple Choice Exam	• Human Resource Management

7.0 INTRODUCTION

PMBOK® Guide, 4th Edition
9.4 Manage Project Team
9.4.2.3 Conflict Management

In discussing the project environment, we have purposely avoided discussion of what may be its single most important characteristic: conflicts. Opponents of project management assert that the major reason why many companies avoid changeover to a project management organizational structure is either fear or an inability to handle the resulting conflicts. Conflicts are a way of life in a project structure and can generally occur at any level in the organization, usually as a result of conflicting objectives.

*Case Study also appears at end of chapter.

The project manager has often been described as a conflict manager. In many organizations the project manager continually fights fires and crises evolving from conflicts, and delegates the day-to-day responsibility of running the project to the project team members. Although this is not the best situation, it cannot always be prevented, especially after organizational restructuring or the initiation of projects requiring new resources.

The ability to handle conflicts requires an understanding of why they occur. Asking and answering these four questions may help handle and prevent conflicts.

- What are the project objectives and are they in conflict with other projects?
- Why do conflicts occur?
- How do we resolve conflicts?
- Is there any type of analysis that could identify possible conflicts before they occur?

7.1 OBJECTIVES

Each project must have at least one objective. The objectives of the project must be made known to all project personnel and all managers, at every level of the organization. If this information is not communicated accurately, then it is entirely possible that upper-level managers, project managers, and functional managers may all have a different interpretation of the ultimate objective, a situation that invites conflicts. As an example, company X has been awarded a $100,000 government contract for surveillance of a component that appears to be fatiguing. Top management might view the objective of this project to be discovering the cause of the fatigue and eliminating it in future component production. This might give company X a "jump" on the competition. The division manager might just view it as a means of keeping people employed, with no follow-on possibilities. The department manager can consider the objective as either another job that has to be filled, or a means of establishing new surveillance technology. The department manager, therefore, can staff the necessary positions with any given degree of expertise, depending on the importance and definition of the objective.

Project objectives must be:

- Specific, not general
- Not overly complex
- Measurable, tangible, and verifiable
- Appropriate level, challenging
- Realistic and attainable
- Established within resource bounds
- Consistent with resources available or anticipated
- Consistent with organizational plans, policies, and procedures

Some practitioners use the more simplistic approach of defining an objective by saying that the project's objective must follow the SMART rule, whereby:

- S = specific
- M = measurable
- A = attainable
- R = realistic or relevant
- T = tangible or time bound

Unfortunately, the above characteristics are not always evident, especially if we consider that the project might be unique to the organization in question. As an example, research and development projects sometimes start out general, rather than specific. Research and development objectives are reestablished as time goes on because the initial objective may not be attainable. As an example, company Y believes that they can develop a high-energy rocket-motor propellant. A proposal is submitted to the government, and, after a review period, the contract is awarded. However, as is the case with all R&D projects, there always exists the question of whether the objective is attainable within time, cost, and performance constraints. It might be possible to achieve the initial objective, but at an incredibly high production cost. In this case, the specifications of the propellant (i.e., initial objectives) may be modified so as to align them closer to the available production funds.

Many projects are directed and controlled using a management-by-objective (MBO) approach. The philosophy of management by objectives:

- Is proactive rather than reactive management
- Is results oriented, emphasizing accomplishment
- Focuses on change to improve individual and organizational effectiveness

Management by objectives is a systems approach for aligning project goals with organizational goals, project goals with the goals of other subunits of the organization, and project goals with individual goals. Furthermore, management by objectives can be regarded as a:

- Systems approach to planning and obtaining project results for an organization
- Strategy of meeting individual needs at the same time that project needs are met
- Method of clarifying what each individual and organizational unit's contribution to the project should be

Whether or not MBO is utilized, project objectives must be set.

7.2 THE CONFLICT ENVIRONMENT

In the project environment, conflicts are inevitable. However, as described in Chapter 5, conflicts and their resolution can be planned for. For example, conflicts can easily develop out of a situation where members of a group have a misunderstanding of each other's roles and responsibilities. Through documentation, such as linear responsibility charts, it is possible to establish formal organizational procedures (either at the project level or company-wide). Resolution means collaboration in which people must rely on one another. Without this, mistrust will prevail.

The most common types of conflicts involve:

- Manpower resources
- Equipment and facilities
- Capital expenditures
- Costs
- Technical opinions and trade-offs

- Priorities
- Administrative procedures
- Scheduling
- Responsibilities
- Personality clashes

Each of these conflicts can vary in relative intensity over the life cycle of a project. However, project managers believe that the most frequently occurring conflicts are over schedules but the potentially damaging conflicts can occur over personality clashes. The relative intensity can vary as a function of:

- Getting closer to project constraints
- Having only two constraints instead of three (i.e., time and performance, but not cost)
- The project life cycle itself
- The person with whom the conflict occurs

Sometimes conflict is "meaningful" and produces beneficial results. These meaningful conflicts should be permitted to continue as long as project constraints are not violated and beneficial results are being received. An example of this would be two technical specialists arguing that each has a better way of solving a problem, and each trying to find additional supporting data for his hypothesis.

Conflicts can occur with anyone and over anything. Some people contend that personality conflicts are the most difficult to resolve. Below are several situations. The reader might consider what he or she would do if placed in the situations.

- Two of your functional team members appear to have personality clashes and almost always assume opposite points of view during decision-making. They are both from the same line organization.
- Manufacturing says that they cannot produce the end-item according to engineering specifications.
- R&D quality control and manufacturing operations quality control argue as to who should perform a certain test on an R&D project. R&D postulates that it is their project, and manufacturing argues that it will eventually go into production and that they wish to be involved as early as possible.
- Mr. X is the project manager of a $65 million project of which $1 million is subcontracted out to another company in which Mr. Y is the project manager. Mr. X does not consider Mr. Y as his counterpart and continually communicates with the director of engineering in Mr. Y's company.

Ideally, the project manager should report high enough so that he can get timely assistance in resolving conflicts. Unfortunately, this is easier said than done. Therefore, proj-ect managers must plan for conflict resolution. As examples of this:

- The project manager might wish to concede on a low-intensity conflict if he knows that a high-intensity conflict is expected to occur at a later point in the project.
- Jones Construction Company has recently won a $120 million effort for a local company. The effort includes three separate construction projects, each one

beginning at the same time. Two of the projects are twenty-four months in duration, and the third is thirty-six months. Each project has its own project manager. When resource conflicts occur between the projects, the customer is usually called in.

- Richard is a department manager who must supply resources to four different projects. Although each project has an established priority, the project managers continually argue that departmental resources are not being allocated effectively. Richard now holds a monthly meeting with all four of the project managers and lets them determine how the resources should be allocated.

Many executives feel that the best way of resolving conflicts is by establishing priorities. This may be true as long as priorities are not continually shifted around. As an example, Minnesota Power and Light established priorities as:

- Level 0: no completion date
- Level 1: to be completed on or before a specific date
- Level 2: to be completed in or before a given fiscal quarter
- Level 3: to be completed within a given year

This type of technique will work as long as there are not a large number of projects in any one level.

The most common factors influencing the establishment of project priorities include:

- The technical risks in development
- The risks that the company will incur, financially or competitively
- The nearness of the delivery date and the urgency
- The penalties that can accompany late delivery dates
- The expected savings, profit increase, and return on investment
- The amount of influence that the customer possesses, possibly due to the size of the project
- The impact on other projects or product lines
- The impact on affiliated organizations

The ultimate responsibility for establishing priorities rests with top-level management. Yet even with priority establishment, conflicts still develop. David Wilemon has identified several reasons why conflicts still occur[1]:

- The greater the diversity of disciplinary expertise among the participants of a project team, the greater the potential for conflict to develop among members of the team.
- The lower the project manager's degree of authority, reward, and punishment power over those individuals and organizational units supporting his project, the greater the potential for conflict to develop.

1. David L. Wilemon, "Managing Conflict in Temporary Management Situations," *The Journal of Management Studies*, 1973, pp. 282–296.

- The less the specific objectives of a project (cost, schedule, and technical performance) are understood by the project team members, the more likely it is that conflict will develop.
- The greater the role of ambiguity among the participants of a project team, the more likely it is that conflict will develop.
- The greater the agreement on superordinate goals by project team participants, the lower the potential for detrimental conflict.
- The more the members of functional areas perceive that the implementation of a project management system will adversely usurp their traditional roles, the greater the potential for conflict.
- The lower the percent need for interdependence among organizational units supporting a project, the greater the potential for dysfunctional conflict.
- The higher the managerial level within a project or functional area, the more likely it is that conflicts will be based upon deep-seated parochial resentments. By contrast, at the project or task level, it is more likely that cooperation will be facilitated by the task orientation and professionalism that a project requires for completion.

7.3 CONFLICT RESOLUTION

PMBOK® Guide, 4th Edition
9.4.2.3 Conflict Management

Although each project within the company may be inherently different, the company may wish to have the resulting conflicts resolved in the same manner. The four most common methods are:

1. The development of company-wide conflict resolution policies and procedures
2. The establishment of project conflict resolution procedures during the early planning activities
3. The use of hierarchical referral
4. The requirement of direct contact

Many companies have attempted to develop company-wide policies and procedures for conflict resolution, but this method is often doomed to failure because each project and conflict is different. Furthermore, project managers, by virtue of their individuality, and sometimes differing amounts of authority and responsibility, prefer to resolve conflicts in their own fashion.

A second method for resolving conflicts, and one that is often very effective, is to "plan" for conflicts during the planning activities. This can be accomplished through the use of linear responsibility charts. Planning for conflict resolution is similar to the first method except that each project manager can develop his own policies, rules, and procedures.

Hierarchial referral for conflict resolution, in theory, appears as the best method because neither the project manager nor the functional manager will dominate. Under this arrangement, the project and functional managers agree that for a proper balance to exist

their common superior must resolve the conflict to protect the company's best interest. Unfortunately, this is not realistic because the common superior cannot be expected to continually resolve lower-level conflicts and it gives the impression that the functional and project managers cannot resolve their own problems.

The last method is direct contact in which conflicting parties meet face-to-face and resolve their disagreement. Unfortunately, this method does not always work and, if continually stressed, can result in conditions where individuals will either suppress the identification of problems or develop new ones during confrontation.

Many conflicts can be either reduced or eliminated by constant communication of the project objectives to the team members. This continual repetition may prevent individuals from going too far in the wrong direction.

7.4 UNDERSTANDING SUPERIOR, SUBORDINATE, AND FUNCTIONAL CONFLICTS[2]

PMBOK® Guide, 4th Edition
9.4.2.3 Conflict Management

In order for the project manager to be effective, he must understand how to work with the various employees who interface with the project. These employees include upper-level management, subordinate project team members, and functional personnel. Quite often, the project manager must demonstrate an ability for continuous adaptability by creating a different working environment with each group of employees. The need for this was shown in the previous section by the fact that the relative intensity of conflicts can vary in the life cycle of a project.

The type and intensity of conflicts can also vary with the type of employee, as shown in Figure 7–1. Both conflict causes and sources are rated according to relative conflict intensity. The data in Figure 7–1 were obtained for a 75 percent confidence level.

In the previous section we discussed the basic resolution modes for handling conflicts. The specific mode that a project manager will use might easily depend on whom the conflict is with, as shown in Figure 7–2. The data in Figure 7–2 do not necessarily show the modes that project managers would prefer, but rather identify the modes that will increase or decrease the potential conflict intensity. For example, although project managers consider, in general, that withdrawal is their least favorite mode, it can be used quite effectively with functional managers. In dealing with superiors, project managers would rather be ready for an immediate compromise than for face-to-face confrontation that could favor upper-level management.

Figure 7–3 identifies the various influence styles that project managers find effective in helping to reduce potential conflicts. Penalty power, authority, and expertise are considered as strongly unfavorable associations with respect to low conflicts. As expected, work challenge and promotions (if the project manager has the authority) are strongly favorable.

2. The majority of this section, including the figures, was adapted from *Seminar in Project Management Workbook*, © 1977 by Hans J. Thamhain. Reproduced by permission of Dr. Hans J. Thamhain.

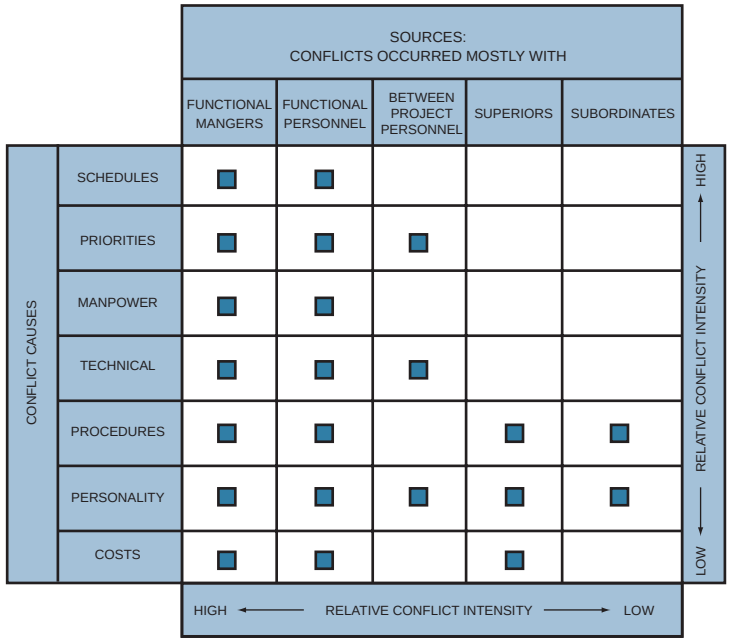


FIGURE 7–1. Relationship between conflict causes and sources.

(The figure shows only those associations which are statistically significant at the 95 percent level)

INTENSITY OF CONFLICT PERCEIVED BY PROJECT MANAGERS (P.M.)	ACTUAL CONFLICT RESOLUTION STYLE				
	FORCING	CONFRONTA-TION	COMPROMISE	SMOOTHING	WITHDRAWAL
BETWEEN P.M. AND HIS PERSONNEL	■	▲	▲	▲	■
BETWEEN P.M. AND HIS SUPERIOR		■	▲		
BETWEEN P.M. AND FUNCTIONAL SUPPORT DEPARTMENTS	■	■			▲

▲ STRONGLY FAVORABLE ASSOCIATION WITH REGARD TO LOW CONFLICT ($-\tau$)

■ STRONGLY UNFAVORABLE ASSOCIATION WITH REGARD TO LOW CONFLICT($+\tau$)

• KENDALL τ CORRELATION

FIGURE 7–2. Association between perceived intensity of conflict and mode of conflict resolution.

(The figure shows only those associated which are statistically significant at the 95 percent level)

INTENSITY OF CONFLICT PERCEIVED BY PROJECT MANAGER (P.M.)	INFLUENCE METHODS AS PERCEIVED BY PROJECT MANAGERS						
	EXPERTISE	AUTHORITY	WORK CHALLENGE	FRIENDSHIP	PROMOTION	SALARY	PENALTY
BETWEEN P.M. AND HIS PERSONNEL	■	■	▲		▲		■
BETWEEN P.M. AND HIS SUPERIOR			▲				■
BETWEEN P.M. AND FUNCTIONAL SUPPORT DEPARTMENTS		■					■

▲ STRONGLY FAVORABLE ASSOCIATION WITH REGARD TO LOW CONFLICT ($-\tau$)

■ STRONGLY UNFAVORABLE ASSOCIATION WITH REGARD TO LOW CONFLICT($+\tau$)

• KENDALL τ CORRELATION

FIGURE 7–3. Association between influence methods of project managers and their perceived conflict intensity.

7.5 THE MANAGEMENT OF CONFLICTS[3]

PMBOK® Guide, 4th Edition
9.4.2.3 Conflict Management

Good project managers realize that conflicts are inevitable, but that good procedures or techniques can help resolve them. Once a conflict occurs, the project manager must:

- Study the problem and collect all available information
- Develop a situational approach or methodology
- Set the appropriate atmosphere or climate

If a confrontation meeting is necessary between conflicting parties, then the project manager should be aware of the logical steps and sequence of events that should be taken. These include:

- Setting the climate: establishing a willingness to participate
- Analyzing the images: how do you see yourself and others, and how do they see you?
- Collecting the information: getting feelings out in the open
- Defining the problem: defining and clarifying all positions
- Sharing the information: making the information available to all
- Setting the appropriate priorities: developing working sessions for setting priorities and timetables
- Organizing the group: forming cross-functional problem-solving groups

3. See note 2.

- Problem-solving: obtaining cross-functional involvement, securing commitments, and setting the priorities and timetable
- Developing the action plan: getting commitment
- Implementing the work: taking action on the plan
- Following up: obtaining feedback on the implementation for the action plan

The project manager or team leader should also understand conflict minimization procedures. These include:

- Pausing and thinking before reacting
- Building trust
- Trying to understand the conflict motives
- Keeping the meeting under control
- Listening to all involved parties
- Maintaining a give-and-take attitude
- Educating others tactfully on your views
- Being willing to say when you were wrong
- Not acting as a superman and leveling the discussion only once in a while

Thus, the effective manager, in conflict problem-solving situations:

- Knows the organization
- Listens with understanding rather than evaluation
- Clarifies the nature of the conflict
- Understands the feelings of others
- Suggests the procedures for resolving differences
- Maintains relationships with disputing parties
- Facilitates the communications process
- Seeks resolutions

7.6 CONFLICT RESOLUTION MODES

PMBOK® Guide, 4th Edition
9.4.2.3 Conflict Management

The management of conflicts places the project manager in the precarious situation of having to select a conflict resolution mode (previously defined in Section 7.4). Based upon the situation, the type of conflict, and whom the conflict is with, any of these modes could be justified.

Confronting (or Collaborating)

With this approach, the conflicting parties meet face-to-face and try to work through their disagreements. This approach should focus more on solving the problem and less on being combative. This approach is collaboration and integration where both parties need to win. This method should be used:

- When you and the conflicting party can both get at least what you wanted and maybe more
- To reduce cost

- To create a common power base
- To attack a common foe
- When skills are complementary
- When there is enough time
- When there is trust
- When you have confidence in the other person's ability
- When the ultimate objective is to learn

Compromising

To compromise is to bargain or to search for solutions so both parties leave with some degree of satisfaction. Compromising is often the result of confrontation. Some people argue that compromise is a "give and take" approach, which leads to a "win-win" position. Others argue that compromise is a "lose-lose" position, since neither party gets everything he/she wants or needs. Compromise should be used:

- When both parties need to be winners
- When you can't win
- When others are as strong as you are
- When you haven't time to win
- To maintain your relationship with your opponent
- When you are not sure you are right
- When you get nothing if you don't
- When stakes are moderate
- To avoid giving the impression of "fighting"

Smoothing (or Accommodating)

This approach is an attempt to reduce the emotions that exist in a conflict. This is accomplished by emphasizing areas of agreement and de-emphasizing areas of disagreement. An example of smoothing would be to tell someone, "We have agreed on three of the five points and there is no reason why we cannot agree on the last two points." Smoothing does not necessarily resolve a conflict, but tries to convince both parties to remain at the bargaining table because a solution is possible. In smoothing, one may sacrifice one's own goals in order to satisfy the needs of the other party. Smoothing should be used:

- To reach an overarching goal
- To create obligation for a trade-off at a later date
- When the stakes are low
- When liability is limited
- To maintain harmony
- When any solution will be adequate
- To create goodwill (be magnanimous)
- When you'll lose anyway
- To gain time

Forcing (or Competing, Being Uncooperative, Being Assertive)

This is what happens when one party tries to impose the solution on the other party. Conflict resolution works best when resolution is achieved at the lowest possible levels. The higher up the conflict goes, the greater the tendency for the conflict to be forced, with the result being a "win-lose" situation in which one party wins at the expense of the other. Forcing should be used:

- When you are right
- When a do-or-die situation exists
- When stakes are high
- When important principles are at stake
- When you are stronger (never start a battle you can't win)
- To gain status or to gain power
- In short-term, one-shot deals
- When the relationship is unimportant
- When it's understood that a game is being played
- When a quick decision must be made

Avoiding (or Withdrawing)

Avoidance is often regarded as a temporary solution to a problem. The problem and the resulting conflict can come up again and again. Some people view avoiding as cowardice and an unwillingness to be responsive to a situation. Avoiding should be used:

- When you can't win
- When the stakes are low
- When the stakes are high, but you are not ready yet
- To gain time
- To unnerve your opponent
- To preserve neutrality or reputation
- When you think the problem will go away
- When you win by delay

7.7 STUDYING TIPS FOR THE PMI® PROJECT MANAGEMENT CERTIFICATION EXAM

This section is applicable as a review of the principles to support the knowledge areas and domain groups in the PMBOK® Guide. This chapter addresses:

- Human Resources Management
- Execution

Understanding the following principles is beneficial if the reader is using this text to study for the PMP® Certification Exam:

- Components of an objective
- What is meant by a SMART criteria for an objective
- Different types of conflicts that can occur in a project environment
- Different conflict resolution modes and when each one should be used

The following multiple-choice questions will be helpful in reviewing the principles of this chapter:

1. When talking about SMART objectives, the "S" stands for:
A. Satisfactory
B. Static
C. Specific
D. Standard

2. When talking about SMART objectives, the "A" stands for:
A. Accurate
B. Acute
C. Attainable
D. Able

3. Project managers believe that the most commonly occurring conflict is:
A. Priorities
B. Schedules
C. Personalities
D. Resources

4. The conflict that generally is the most damaging to the project when it occurs is:
A. Priorities
B. Schedules
C. Personalities
D. Resources

5. The most commonly preferred conflict resolution mode for project managers is:
A. Compromise
B. Confrontation
C. Smoothing
D. Withdrawal

6. Which conflict resolution mode is equivalent to problem-solving?
A. Compromise
B. Confrontation
C. Smoothing
D. Withdrawal

7. Which conflict resolution mode avoids a conflict temporarily rather than solving it?
A. Compromise
B. Confrontation
C. Smoothing
D. Withdrawal

ANSWERS

1. C
2. C
3. B
4. C
5. B
6. B
7. D

PROBLEMS

7–1 Is it possible to establish formal organizational procedures (either at the project level or company-wide) for the resolution of conflicts? If a procedure is established, what can go wrong?

7–2 Under what conditions would a conflict result between members of a group over misunderstandings of each other's roles?

7–3 Is it possible to have a situation in which conflicts are not effectively controlled, and yet have a decision-making process that is not lengthy or cumbersome?

7–4 If conflicts develop into a situation where mistrust prevails, would you expect activity documentation to increase or decrease? Why?

7–5 If a situation occurs that can develop into meaningful conflict, should the project manager let the conflict continue as long as it produces beneficial contributions, or should he try to resolve it as soon as possible?

7–6 Consider the following remarks made by David L. Wilemon ("Managing Conflict in Temporary Management Situations," *Journal of Management Studies*, October 1973, p. 296):

> The value of the conflict produced depends upon the effectiveness of the project manager in promoting beneficial conflict while concomitantly minimizing its potential dysfunctional aspects. A good project manager needs a "sixth sense" to indicate when conflict is desirable, what kind of conflict will be useful, and how much conflict is optimal for a given situation. In the final analysis he has the sole responsibility for his project and how conflict will impact the success or failure of his project.

Based upon these remarks, would your answer to Problem 7–5 change?

7–7 Mr. X is the project manager of a $65 million project of which $1 million is subcontracted out to another company in which Mr. Y is project manager. Unfortunately, Mr. X does not consider Mr. Y as his counterpart and continually communicates with the director of engineering in Mr. Y's company. What type of conflict is that, and how should it be resolved?

7–8 Contract negotiations can easily develop into conflicts. During a disagreement, the vice president of company A ordered his director of finance, the contract negotiator, to break off

contract negotiations with company B because the contract negotiator of company B did not report directly to a vice president. How can this situation be resolved?

7–9 For each part below there are two statements; one represents the traditional view and the other the project organizational view. Identify each one.

a. Conflict should be avoided; conflict is part of change and is therefore inevitable.
b. Conflict is the result of troublemakers and egoists; conflict is determined by the structure of the system and the relationship among components.
c. Conflict may be beneficial; conflict is bad.

7–10 Using the modes for conflict resolution defined in Section 7.6, which would be strongly favorable and strongly unfavorable for resolving conflicts between:

a. Project manager and his project office personnel?
b. Project manager and the functional support departments?
c. Project manager and his superiors?
d. Project manager and other project managers?

7–11 Which influence methods should increase and which should decrease the opportunities for conflict between the following:

- Project manager and his project office personnel?
- Project manager and the functional support departments?
- Project manager and his superiors?
- Project manager and other project managers?

7–12 Would you agree or disagree with the statement that "Conflict resolution through collaboration needs trust; people must rely on one another."

7–13 Davis and Lawrence (*Matrix*, © 1977. Adapted by permission of Pearson Education Inc., Upper Saddle River, New Jersey) identify several situations common to the matrix that can easily develop into conflicts. For each situation, what would be the recommended cure?

a. Compatible and incompatible personnel must work together
b. Power struggles break the balance of power
c. Anarchy
d. Groupitis (people confuse matrix behavior with group decision-making)
e. A collapse during economic crunch
f. Decision strangulation processes
g. Forcing the matrix organization to the lower organizational levels
h. Navel-gazing (spending time ironing out internal disputes instead of developing better working relationships with the customer)

7–14 Determine the best conflict resolution mode for each of the following situations:

a. Two of your functional team members appear to have personality clashes and almost always assume opposite points of view during decision-making.
b. R&D quality control and manufacturing operations quality control continually argue as to who should perform testing on an R&D project. R&D postulates that it's their project, and manufacturing argues that it will eventually go into production and that they wish to be involved as early as possible.

c. Two functional department managers continually argue as to who should perform a certain test. You know that this situation exists, and that the department managers are trying to work it out themselves, often with great pain. However, you are not sure that they will be able to resolve the problem themselves.

7–15 Forcing a confrontation to take place assures that action will be taken. Is it possible that, by using force, a lack of trust among the participants will develop?

7–16 With regard to conflict resolution, should it matter to whom in the organization the project manager reports?

7–17 One of the most common conflicts in an organization occurs with raw materials and finished goods. Why would finance/accounting, marketing/sales, and manufacturing have disagreements?

7–18 Explain how the relative intensity of a conflict can vary as a function of:

a. Getting closer to the actual constraints
b. Having only two constraints instead of three (i.e., time and performance, but not cost)
c. The project life cycle
d. The person with whom the conflict occurs

7–19 The conflicts shown in Figure 7–1 are given relative intensities as perceived in project-driven organizations. Would this list be arranged differently for non–project-driven organizations?

7–20 Consider the responses made by the project managers in Figures 7–1 through 7–3. Which of their choices do you agree with, and which do you disagree with? Justify your answers.

7–21 As a good project manager, you try to plan for conflict avoidance. You now have a low-intensity conflict with a functional manager and, as in the past, handle the conflict with confrontation. If you knew that there would be a high-intensity conflict shortly thereafter, would you be willing to use the withdrawal mode for the low-intensity conflict in order to lay the groundwork for the high-intensity conflict?

7–22 Jones Construction Company has recently won a $120 million effort for a local company. The effort includes three separate construction projects, each one beginning at the same time. Two of the projects are eighteen months in duration and the third one is thirty months. Each project has its own project manager. How do we resolve conflicts when each project may have a different priority but they are all for the same customer?

7–23 Several years ago, Minnesota Power and Light established priorities as follows:

Level 0: no priority
Level 1: to be completed on or before a specific date
Level 2: to be completed in or before a given fiscal quarter
Level 3: to be completed within a given year

How do you feel about this system of establishing priorities?

7–24 Richard is a department manager who must supply resources to four different projects. Although each project has an established priority, the project managers continually argue that departmental resources are not being allocated effectively. Richard has decided to have a monthly group meeting with all four of the project managers and to let them determine how the resources should be allocated. Can this technique work? If so, under what conditions?

CASE STUDIES

FACILITIES SCHEDULING AT MAYER MANUFACTURING

Eddie Turner was elated with the good news that he was being promoted to section supervisor in charge of scheduling all activities in the new engineering research laboratory. The new laboratory was a necessity for Mayer Manufacturing. The engineering, manufacturing, and quality control directorates were all in desperate need of a new testing facility. Upper-level management felt that this new facility would alleviate many of the problems that previously existed.

The new organizational structure (as shown in Exhibit 7–1) required a change in policy over use of the laboratory. The new section supervisor, on approval from his department manager, would have full authority for establishing priorities for the use of the new facility. The new policy change was a necessity because upper-level management felt that there would be inevitable conflict between manufacturing, engineering, and quality control.

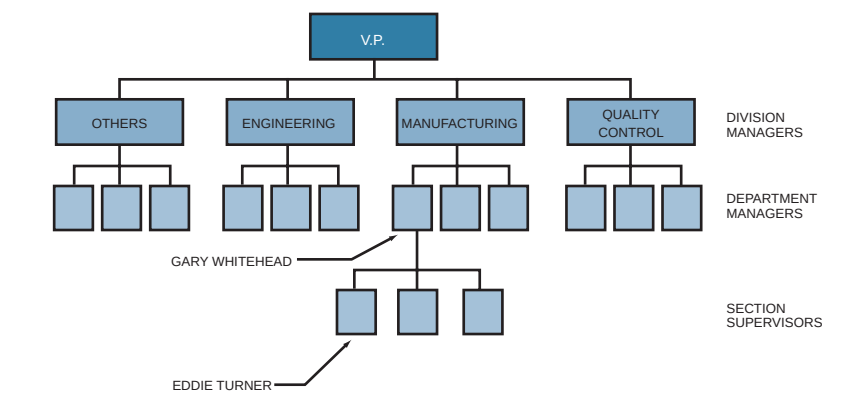
After one month of operations, Eddie Turner was finding his job impossible, so Eddie has a meeting with Gary Whitehead, his department manager.

Eddie: "I'm having a hell of a time trying to satisfy all of the department managers. If I give engineering prime-time use of the facility, then quality control and manufacturing say that I'm playing favorites. Imagine that! Even my own people say that I'm playing favorites with other directorates. I just can't satisfy everyone."

Gary: "Well, Eddie, you know that this problem comes with the job. You'll get the job done."

Eddie: "The problem is that I'm a section supervisor and have to work with department managers. These department managers look down on me like I'm their servant. If I were a department manager, then they'd show me some respect. What I'm really trying to say is that I would like you to send out the weekly memos to these department managers telling them of the new priorities. They wouldn't argue with you like they do with me. I can supply you with all the necessary information. All you'll have to do is to sign your name."

Exhibit 7–1. Mayer Manufacturing organizational structure



Gary: "Determining the priorities and scheduling the facilities is your job, not mine. This is a new position and I want you to handle it. I know you can because I selected you. I do not intend to interfere."

During the next two weeks, the conflicts got progressively worse. Eddie felt that he was unable to cope with the situation by himself. The department managers did not respect the authority delegated to him by his superiors. For the next two weeks, Eddie sent memos to Gary in the early part of the week asking whether Gary agreed with the priority list. There was no response to the two memos. Eddie then met with Gary to discuss the deteriorating situation.

Eddie: "Gary, I've sent you two memos to see if I'm doing anything wrong in establishing the weekly priorities and schedules. Did you get my memos?"

Gary: "Yes, I received your memos. But as I told you before, I have enough problems to worry about without doing your job for you. If you can't handle the work let me know and I'll find someone who can."

Eddie returned to his desk and contemplated his situation. Finally, he made a decision. Next week he was going to put a signature block under his for Gary to sign, with carbon copies for all division managers. "Now, let's see what happens," remarked Eddie.

*TELESTAR INTERNATIONAL**

On November 15, 1998, the Department of Energy Resources awarded Telestar a $475,000 contract for the developing and testing of two waste treatment plants. Telestar had spent the better part of the last two years developing waste treatment technology under its own R&D activities. This new contract would give Telestar the opportunity to "break into a new field"—that of waste treatment.

The contract was negotiated at a firm-fixed price. Any cost overruns would have to be incurred by Telestar. The original bid was priced out at $847,000. Telestar's management, however, wanted to win this one. The decision was made that Telestar would "buy in" at $475,000 so that they could at least get their foot into the new marketplace.

The original estimate of $847,000 was very "rough" because Telestar did not have any good man-hour standards, in the area of waste treatment, on which to base their man-hour projections. Corporate management was willing to spend up to $400,000 of their own funds in order to compensate the bid of $475,000.

By February 15, 1999, costs were increasing to such a point where overrun would be occurring well ahead of schedule. Anticipated costs to completion were now $943,000. The project manager decided to stop all activities in certain functional departments, one of which was structural analysis. The manager of the structural analysis department strongly opposed the closing out of the work order prior to the testing of the first plant's high-pressure pneumatic and electrical systems.

Structures Manager: "You're running a risk if you close out this work order. How will you know if the hardware can withstand the stresses that will be imposed during the test? After all, the test is scheduled for next month and I can probably finish the analysis by then."

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* Revised, 2008.

Project Manager: "I understand your concern, but I cannot risk a cost overrun. My boss expects me to do the work within cost. The plant design is similar to one that we have tested before, without any structural problems being detected. On this basis I consider your analysis unnecessary."

Structures Manager: "Just because two plants are similar does not mean that they will be identical in performance. There can be major structural deficiencies."

Project Manager: "I guess the risk is mine."

Structures Manager: "Yes, but I get concerned when a failure can reflect on the integrity of my department. You know, we're performing on schedule and within the time and money budgeted. You're setting a bad example by cutting off our budget without any real justification."

Project Manager: "I understand your concern, but we must pull out all the stops when overrun costs are inevitable."

Structures Manager: "There's no question in my mind that this analysis should be completed. However, I'm not going to complete it on my overhead budget. I'll reassign my people tomorrow. Incidentally, you had better be careful; my people are not very happy to work for a project that can be canceled immediately. I may have trouble getting volunteers next time."

Project Manager: "Well, I'm sure you'll be able to adequately handle any future work. I'll report to my boss that I have issued a work stoppage order to your department."

During the next month's test, the plant exploded. Postanalysis indicated that the failure was due to a structural deficiency.

a. Who is at fault?
b. Should the structures manager have been dedicated enough to continue the work on his own?
c. Can a functional manager, who considers his organization as strictly support, still be dedicated to total project success?

HANDLING CONFLICT IN PROJECT MANAGEMENT

The next several pages contain a six-part case study in conflict management. Read the instructions carefully on how to keep score and use the boxes in the table on page 314 as the worksheet for recording your choice and the group's choice; after the case study has been completed, your instructor will provide you with the proper grading system for recording your scores.

Part 1: Facing the Conflict

As part of his first official duties, the new department manager informs you by memo that he has changed his input and output requirements for the MIS project (on which you are the project manager) because of several complaints by his departmental employees. This is contradictory to the project plan that you developed with the previous manager and are currently working toward. The department manager states that he has already discussed this with the vice president and general manager, a man to whom both of you report, and feels that the former department manager made a poor decision and did not get

sufficient input from the employees who would be using the system as to the best system specifications. You telephone him and try to convince him to hold off on his request for change until a later time, but he refuses.

Changing the input–output requirements at this point in time will require a major revision and will set back total system implementation by three weeks. This will also affect other department managers who expect to see this system operational according to the original schedule. You can explain this to your superiors, but the increased project costs will be hard to absorb. The potential cost overrun might be difficult to explain at a later date.

At this point you are somewhat unhappy with yourself at having been on the search committee that found this department manager and especially at having recommended him for this position. You know that something must be done, and the following are your alternatives:

A. You can remind the department manager that you were on the search committee that recommended him and then ask him to return the favor, since he "owes you one."
B. You can tell the department manager that you will form a new search committee to replace him if he doesn't change his position.
C. You can take a tranquilizer and then ask your people to try to perform the additional work within the original time and cost constraints.
D. You can go to the vice president and general manager and request that the former requirements be adhered to, at least temporarily.
E. You can send a memo to the department manager explaining your problem and asking him to help you find a solution.
F. You can tell the department manager that your people cannot handle the request and his people will have to find alternate ways of solving their problems.
G. You can send a memo to the department manager requesting an appointment, at his earliest convenience, to help you resolve your problem.
H. You can go to the department manager's office later that afternoon and continue the discussion further.
I. You can send the department manager a memo telling him that you have decided to use the old requirements but will honor his request at a later time.

Line	Part	Personal		Group	
		Choice	Score	Choice	Score
1	1. Facing the Conflict				
2	2. Understanding Emotions				
3	3. Establishing Communications				
4	4. Conflict Resolution				
5	5. Understanding Your Choices				
6	6. Interpersonal Influences				
	TOTAL				

Although other alternatives exist, assume that these are the only ones open to you at the moment. Without discussing the answer with your group, record the letter representing your choice in the appropriate space on line 1 of the worksheet under "Personal."

As soon as all of your group have finished, discuss the problem as a group and determine that alternative that the group considers to be best. Record this answer on line 1 of the worksheet under "Group." Allow ten minutes for this part.

Part 2: Understanding Emotions

Never having worked with this department manager before, you try to predict what his reactions will be when confronted with the problem. Obviously, he can react in a variety of ways:

A. He can *accept* your solution in its entirety without asking any questions.
B. He can discuss some sort of justification in order to *defend* his position.
C. He can become extremely annoyed with having to discuss the problem again and demonstrate *hostility.*
D. He can demonstrate a willingness to *cooperate* with you in resolving the problem.
E. He can avoid making any decision at this time by *withdrawing* from the discussion.

	Your Choice					**Group Choice**				
	Acc.	**Def.**	**Host.**	**Coop.**	**With.**	**Acc.**	**Def.**	**Host.**	**Coop.**	**With.**
A. I've given my answer. See the general manager if you're not happy.										
B. I understand your problem. Let's do it your way.										
C. I understand your problem, but I'm doing what is best for my department.										
D. Let's discuss the problem. Perhaps there are alternatives.										
E. Let me explain to you why we need the new requirements.										
F. See my section supervisors. It was their recommendation.										
G. New managers are supposed to come up with new and better ways, aren't they?										

In the table above are several possible statements that could be made by the department manager when confronted with the problem. Without discussion with your group, place a check mark beside the appropriate emotion that could describe this statement. When each member of

the group has completed his choice, determine the group choice. Numerical values will be assigned to your choices in the discussion that follows. Do not mark the worksheet at this time. Allow ten minutes for this part.

Part 3: Establishing Communications

Unhappy over the department manager's memo and the resulting follow-up phone conversation, you decide to walk in on the department manager. You tell him that you will have a problem trying to honor his request. He tells you that he is too busy with his own problems of restructuring his department and that your schedule and cost problems are of no concern to him at this time. You storm out of his office, leaving him with the impression that his actions and remarks are not in the best interest of either the project or the company.

The department manager's actions do not, of course, appear to be those of a dedicated manager. He should be more concerned about what's in the best interest of the company. As you contemplate the situation, you wonder if you could have received a better response from him had you approached him differently. In other words, what is your best approach to opening up communications between you and the department manager? From the list of alternatives shown below, and working alone, select the alternative that best represents how you would handle this situation. When all members of the group have selected their personal choices, repeat the process and make a group choice. Record your personal and group choices on line 3 of the worksheet. Allow ten minutes for this part.

A. Comply with the request and document all results so that you will be able to defend yourself at a later date in order to show that the department manager should be held accountable.
B. Immediately send him a memo reiterating your position and tell him that at a later time you will reconsider his new requirements. Tell him that time is of utmost importance, and you need an immediate response if he is displeased.
C. Send him a memo stating that you are holding him accountable for all cost overruns and schedule delays.
D. Send him a memo stating you are considering his request and that you plan to see him again at a later date to discuss changing the requirements.
E. See him as soon as possible. Tell him that he need not apologize for his remarks and actions, and that you have reconsidered your position and wish to discuss it with him.
F. Delay talking to him for a few days in hopes that he will cool off sufficiently and then see him in hopes that you can reopen the discussions.
G. Wait a day or so for everyone to cool off and then try to see him through an appointment; apologize for losing your temper, and ask him if he would like to help you resolve the problem.

Part 4: Conflict Resolution Modes

Having never worked with this manager before, you are unsure about which conflict resolution mode would work best. You decide to wait a few days and then set up an appointment with the department manager without stating what subject matter will be discussed. You then try to determine what conflict resolution mode appears to be dominant based on the opening remarks of the department manager. Neglecting the fact that your conversation with the department manager might already be considered as confrontation, for each statement shown below, select the conflict resolution mode

that the *department manager* appears to prefer. After each member of the group has recorded his personal choices in the table below, determine the group choices. Numerical values will be attached to your answers at a later time. Allow ten minutes for this part.

A. *Withdrawal* is retreating from a potential conflict.
B. *Smoothing* is emphasizing areas of agreement and de-emphasizing areas of disagreement.
C. *Compromising* is the willingness to give and take.
D. *Forcing* is directing the resolution in one direction or another, a win-or-lose position.
E. *Confrontation* is a face-to-face meeting to resolve the conflict.

	Personal Choice					**Group Choice**				
	With.	**Smooth.**	**Comp.**	**Forc.**	**Conf.**	**With.**	**Smooth.**	**Comp.**	**Forc.**	**Conf.**
A. The requirements are my decision, and we're doing it my way.										
B. I've thought about it and you're right. We'll do it your way.										
C. Let's discuss the problem. Perhaps there are alternatives.										
D. Let me again explain why we need the new requirements.										
E. See my section supervisors; they're handling it now.										
F. I've looked over the problem and I might be able to ease up on some of the requirements.										

Part 5: Understanding Your Choices

Assume that the department manager has refused to see you again to discuss the new requirements. Time is running out, and you would like to make a decision before the costs and schedules get out of hand. From the list below, select your personal choice and then, after each group member is finished, find a group choice.

A. Disregard the new requirements, since they weren't part of the original project plan.
B. Adhere to the new requirements, and absorb the increased costs and delays.
C. Ask the vice president and general manager to step in and make the final decision.
D. Ask the other department managers who may realize a schedule delay to try to convince this department manager to ease his request or even delay it.

Record your answer on line 5 of the worksheet. Allow five minutes for this part.

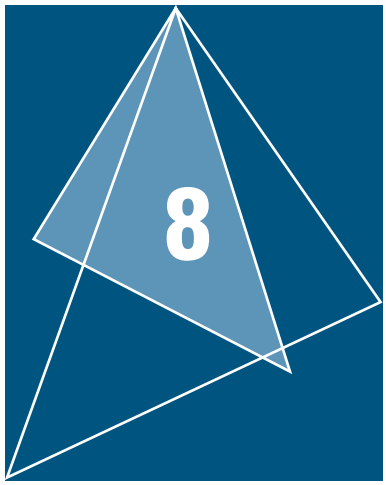
Part 6: Interpersonal Influences

Assume that upper-level management resolves the conflict in your favor. In order to complete the original work requirements you will need support from this department manager's organization. Unfortunately, you are not sure as to which type of interpersonal influence to use. Although you are considered as an expert in your field, you fear that this manager's functional employees may have a strong allegiance to the department manager and may not want to adhere to your requests. Which of the following interpersonal influence styles would be best under the given set of conditions?

A. You threaten the employees with penalty power by telling them that you will turn in a bad performance report to their department manager.
B. You can use reward power and promise the employees a good evaluation, possible promotion, and increased responsibilities on your next project.
C. You can continue your technique of trying to convince the functional personnel to do your bidding because you are the expert in the field.
D. You can try to motivate the employees to do a good job by convincing them that the work is challenging.
E. You can make sure that they understand that your authority has been delegated to you by the vice president and general manager and that they must do what you say.
F. You can try to build up friendships and off-work relationships with these people and rely on referent power.

Record your personal and group choices on line 6 of the worksheet. Allow ten minutes for completion of this part.

The solution to this exercise appears in Appendix A.



Special Topics

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8.0 INTRODUCTION

There are several situations or special topics that deserve attention. These include:

- Performance measurement
- Compensation and rewards
- Managing small projects

- Managing mega projects
- Morality, ethics and the corporate culture
- Internal partnerships
- External partnerships
- Training and education
- Integrated project teams
- Virtual teams

8.1 PERFORMANCE MEASUREMENT

PMBOK® Guide, 4th Edition
9.3.2.6 Recognition and Rewards
9.4.2 Manage Project Team

A good project manager will make it immediately clear to all new functional employees that if they perform well in the project, then he (the proj-ect manager) will inform the functional manager of their progress and achievements. This assumes that the functional manager is not providing close supervision over the functional employees and is, instead, passing on some of the responsibility to the project manager—a common situation in project management organization structures.

Many good projects as well as project management structures have failed because of the inability of the system to evaluate properly the functional employee's performance. In a project management structure, there are basically six ways that a functional employee can be evaluated on a project:

- *The project manager prepares a written, confidential evaluation and gives it to the functional manager.* The functional manager will evaluate the validity of the project manager's comments and prepare his own evaluation. Only the line manager's evaluation is shown to the employee. The use of confidential forms is not preferred because it may be contrary to government regulations and it does not provide the necessary feedback for an employee to improve.
- *The project manager prepares a nonconfidential evaluation and gives it to the functional manager.* The functional manager prepares his own evaluation form and shows both evaluations to the functional employee. This is the technique preferred by most project and functional managers. However, there are several major difficulties with this technique. If the functional employee is an average or below-average worker, and if this employee is still to be assigned to this project after his evaluation, then the project manager might rate the employee as above average simply to prevent any sabotage or bad feelings downstream. In this situation, the functional manager might want a confidential evaluation instead, knowing that the functional employee will see both evaluation forms. Functional employees tend to blame the project manager if they receive a below-average merit pay increase, but give credit to the functional manager if the increase is above average. The best bet here is for the project manager periodically to tell the functional employees how well they are doing, and to give them an honest appraisal. Several companies that use this technique allow the project manager to show the form to the line manager first (to avoid conflict later) and then show it to the employee.
- *The project manager provides the functional manager with an oral evaluation of the employee's performance.* Although this technique is commonly used, most

functional managers prefer documentation on employee progress. Again, lack of feedback may prevent the employee from improving.

- *The functional manager makes the entire evaluation without any input from the project manager.* In order for this technique to be effective, the functional manager must have sufficient time to supervise each subordinate's performance on a continual basis. Unfortunately, most functional managers do not have this luxury because of their broad span of control and must therefore rely heavily on the project manager's input.
- *The project manager makes the entire evaluation for the functional manager.* This technique can work if the functional employee spends 100 percent of his time on one project, or if he is physically located at a remote site where he cannot be observed by his functional manager.
- *All project and functional managers jointly evaluate all project functional employees at the same time.* This technique should be limited to small companies with fewer than fifty or so employees; otherwise the evaluation process might be time-consuming for key personnel. A bad evaluation will be known by everyone.

Evaluation forms can be filled out either when the employee is up for evaluation or after the project is completed. If it is to be filled out when the employee is eligible for promotion or a merit increase, then the project manager should be willing to give an *honest*

PERFORMANCE FACTORS	EXCELLENT (1 OUT OF 15)	VERY GOOD (3 OUT OF 15)	GOOD (8 OUT OF 15)	FAIR (2 OUT OF 15)	UNSATISFACTORY (1 OUT OF 15)
QUALITY	LEAPS TALL BUILDINGS WITH A SINGLE BOUND	MUST TAKE RUNNING START TO LEAP OVER TALL BUILDING	CAN ONLY LEAP OVER A SHORT BUILDING OR MEDIUM ONE WITHOUT SPIRES	CRASHES INTO BUILDING	CANNOT RECOGNIZE BUILDINGS
TIMELINESS	IS FASTER THAN A SPEEDING BULLET	IS AS FAST AS A SPEEDING BULLET	NOT QUITE AS FAST AS A SPEEDING BULLET	WOULD YOU BELIEVE A SLOW BULLET?	WOUNDS HIMSELF WITH THE BULLET
INITIATIVE	IS STRONGER THAN A LOCOMOTIVE	IS STRONGER THAN A BULL ELEPHANT	IS STRONGER THAN A BULL	SHOOTS THE BULL	SMELLS LIKE A BULL
ADAPTABILITY	WALKS ON WATER CONSISTENTLY	WALKS ON WATER IN EMERGENCIES	WASHES WITH WATER	DRINKS WATER	PASSES WATER IN EMERGENCIES
COMMUNICATIONS	TALKS WITH GOD	TALKS WITH ANGELS	TALKS TO HIMSELF	ARGUES WITH HIMSELF	LOSES THE ARGUMENT WITH HIMSELF

FIGURE 8–1. Guide to performance appraisal.

appraisal of the employee's performance. Of course, the project manager should not fill out the evaluation form if he has not had sufficient time to observe the employee at work.

The evaluation form can be filled out at the termination of the project. This, however, may produce a problem in that the project may end the month after the employee is considered for promotion. The advantage of this technique is that the project manager may have been able to find sufficient time both to observe the employee in action and to see the output.

Figure 8–1 (see page 321) represents, in a humorous way, how project personnel perceive the evaluation form. Unfortunately, the evaluation process is very serious and can easily have a severe impact on an individual's career path with the company even though the final evaluation rests with the functional manager.

Figure 8–2 shows a simple type of evaluation form on which the project manager identifies the best description of the employee's performance. This type of form is generally used whenever the employee is up for evaluation.

Figure 8–3 shows another typical form that can be used to evaluate an employee. In each category, the employee is rated on a subjective scale. In order to minimize time and

EMPLOYEE'S NAME	DATE
PROJECT TITLE	JOB NUMBER
EMPLOYEE ASSIGNMENT	
EMPLOYEE'S TOTAL TIME TO DATE ON PROJECT	EMPLOYEE'S REMAINING TIME ON PROJECT

TECHNICAL JUDGMENT:				
☐ Quickly reaches sound conclusions	☐ Usually makes sound conclusions	☐ Marginal decision-making ability	☐ Needs technical assistance	☐ Makes faulty conclusions
WORK PLANNING:				
☐ Good planner	☐ Plans well with help	☐ Occasionally plans well	☐ Needs detailed instructions	☐ Cannot plan at all
COMMUNICATIONS:				
☐ Always understands instructions	☐ Sometimes needs clarification	☐ Always needs clarifications	☐ Needs follow-up	☐ Needs constant instruction
ATTITUDE:				
☐ Always job interested	☐ Shows interest most of the time	☐ Shows no job interest	☐ More interested in other activities	☐ Does not care about job
COOPERATION:				
☐ Always enthusiastic	☐ Works well until job is completed	☐ Usually works well with others	☐ Works poorly with others	☐ Wants it done his/her way
WORK HABITS:				
☐ Always project oriented	☐ Most often project oriented	☐ Usually consistent with requests	☐ Works poorly with others	☐ Always works alone

ADDITIONAL COMMENTS: _____

FIGURE 8–2. Project work assignment appraisal.

EMPLOYEE'S NAME DATE

PROJECT TITLE JOB NUMBER

EMPLOYEE ASSIGNMENT

EMPLOYEE'S TOTAL TIME TO DATE ON PROJECT EMPLOYEE'S REMAINING TIME ON PROJECT

	EXCELLENT	ABOVE AVERAGE	AVERAGE	BELOW AVERAGE	INADEQUATE
TECHNICAL JUDGMENT					
WORK PLANNING					
COMMUNICATIONS					
ATTITUDE					
COOPERATION					
WORK HABITS					
PROFIT CONTRIBUTION					

ADDITIONAL COMMENTS: _____

FIGURE 8–3. Project work assignment appraisal.

paperwork, it is also possible to have a single evaluation form at project termination for evaluation of all employees. This is shown in Figure 8–4. All employees are rated in each category on a scale of 1 to 5. Totals are obtained to provide a relative comparison of employees.

Obviously, evaluation forms such as that shown in Figure 8–4 have severe limitations, as a one-to-one comparison of all project functional personnel is of little value if the employees are from different departments. How can a project engineer be compared to a cost accountant?

Several companies are using this form by assigning coefficients of importance to each topic. For example, under a topic of technical judgment, the project engineer might have a coefficient of importance of 0.90, whereas the cost accountant's coefficient might be 0.25. These coefficients could be reversed for a topic on cost consciousness. Unfortunately, such comparisons have questionable validity, and this type of evaluation form is usually of a confidential nature.

Even though the project manager fills out an evaluation form, there is no guarantee that the functional manager will believe the project manager's evaluation. There are always situations in which the project and functional managers disagree as to either quality or direction of work.

Another problem may exist in the situation where the project manager is a "generalist," say at a grade-7 level, and requests that the functional manager assign his best

PROJECT TITLE	JOB NUMBER
EMPLOYEE ASSIGNMENT	DATE

CODE:

EXCELLENT = 5
ABOVE AVERAGE = 4
AVERAGE = 3
BELOW AVERAGE = 2
INADEQUATE = 1

NAMES	TECHNICAL JUDGMENT	WORK PLANNING	COMMUNICATIONS	ATTITUDE	COOPERATION	WORK HABITS	PROFIT CONTRIBUTION	SELF MOTIVATION	TOTAL POINTS

FIGURE 8–4. Project work assignment appraisal.

employee to the project. The functional manager agrees to the request and assigns his best employee, a grade-10 specialist. One solution to this problem is to have the project manager evaluate the expert only in certain categories such as communications, work habits, and problem-solving, but not in the area of his technical expertise.

As a final note, it is sometimes argued that functional employees should have some sort of indirect input into a project manager's evaluation. This raises rather interesting questions as to how far we can go with the indirect evaluation procedure.

From a top-management perspective, the indirect evaluation process brings with it several headaches. Wage and salary administrators readily accept the necessity for using different evaluation forms for white-collar and blue-collar workers. But now, we have a situation in which there can be more than one type of evaluation system for white-collar workers alone. Those employees who work in project-driven functional departments will be evaluated directly and indirectly, but based on formal procedures. Employees who charge their time to overhead accounts and non–project-driven departments might simply be evaluated by a single, direct evaluation procedure.

Many wage and salary administrators contend that they cannot live with a white-collar evaluation system and therefore have tried to combine the direct and indirect evaluation forms into one, as shown in Figure 8–5. Some administrators have even gone so far

I. EMPLOYEE INFORMATION:

1. NAME _____ 2. DATE OF EVALUATION _____
3. JOB ASSIGNMENT _____ 4. DATE OF LAST EVALUATION _____
5. PAY GRADE _____
6. EMPLOYEE'S IMMEDIATE SUPERVISOR _____
7. SUPERVISOR'S LEVEL: ☐ SECTION ☐ DEPT. ☐ DIVISION ☐ EXECUTIVE

II. EVALUATOR'S INFORMATION:

1. EVALUATOR'S NAME _____
2. EVALUATOR'S LEVEL: ☐ SECTION ☐ DEPT. ☐ DIVISION ☐ EXECUTIVE
3. RATE THE EMPLOYEE ON THE FOLLOWING:

	EXCELLENT	VERY GOOD	GOOD	FAIR	POOR
ABILITY TO ASSUME RESPONSIBILITY					
WORKS WELL WITH OTHERS					
LOYAL ATTITUDE TOWARD COMPANY					
DOCUMENTS WORK WELL AND IS BOTH COST AND PROFIT CONSCIOUS					
RELIABILITY TO SEE JOB THROUGH					
ABILITY TO ACCEPT CRITCISM					
WILLINGNESS TO WORK OVERTIME					
PLANS JOB EXECUTION CAREFULLY					
TECHNICAL KNOWLEDGE					
COMMUNICATIVE SKILLS					
OVERALL RATING					

4. RATE THE EMPLOYEE IN COMPARISON TO HIS CONTEMPORARIES:

LOWER 10%	LOWER 25%	LOWER 40%	MIDWAY	UPPER 40%	UPPER 25%	UPPER 10%

5. RATE THE EMPLOYEE IN COMPARISON TO HIS CONTEMPORARIES:

SHOULD BE PROMOTED AT ONCE	PROMOTABLE NEXT YEAR	PROMOTABLE ALONG WITH CONTEMPORARIES	NEEDS TO MATURE IN GRADE	DEFINITELY NOT PROMOTABLE

6. EVALUATOR'S COMMENTS: _____

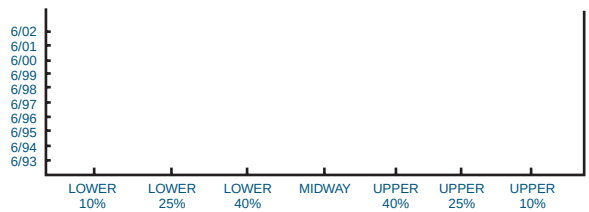
SIGNATURE _____

III. CONCURRENCE SECTION:

1. NAME _____
2. POSITION: ☐ DEPARTMENT ☐ DIVISION ☐ EXECUTIVE
3. CONCURRENCE ☐ AGREE ☐ DISAGREE
4. COMMENTS: _____

SIGNATURE _____

IV. PERSONNEL SECTION: (to be completed by the Personnel Department only)



V. EMPLOYEE'S SIGNATURE: _____ DATE: _____

FIGURE 8–5. Job evaluation.

as to adopt a single form company-wide, regardless of whether an individual is a white- or blue-collar worker.

The design of the employee's evaluation form depends on what evaluation method or procedure is being used. Generally speaking, there are nine methods available for evaluating personnel:

- Essay appraisal
- Graphic rating scale
- Field review
- Forced-choice review
- Critical incident appraisal
- Management by objectives
- Work standards approach
- Ranking methods
- Assessment center

Descriptions of these methods can be found in almost any text on wage and salary administration. Which method is best suited for a project-driven organizational structure? To answer this question, we must analyze the characteristics of the organizational form as well as those of the personnel who must perform there. An an example, project management can be described as an arena of conflict. Which of the above evaluation procedures can best be used to evaluate an employee's ability to work and progress in an atmosphere of conflict? Figure 8–6 compares the above nine evaluation procedures against the six most common project conflicts. This type of analysis must be carried out for all variables and

	Essay Appraisal	Graphic Rating Scale	Field Review	Forced-Choice Review	Critical Incident Appraisal	Management By Objectives	Work Standards Approach	Ranking Methods	Assessment Center
Conflict over schedules	●	●		●	●		●	●	
Conflict over priorities	●	●		●	●		●	●	
Conflict over technical issues	●			●			●		
Conflict over administration	●	●	●	●			●	●	●
Personality conflict	●	●		●			●		
Conflict over cost	●		●	●	●		●	●	●

Circles define areas where evaluation technique may be difficult to implement.

FIGURE 8–6. Rating evaluation techniques against types of conflict.

characteristics that describe the project management environment. Most compensation managers would agree that the management by objectives (MBO) technique offers the greatest promise for a fair and equitable evaluation of all employees. Although MBO implies that functional employees will have a say in establishing their own goals and objectives, this may not be the case. In project management, maybe the project manager or functional manager will set the objectives, and the functional employee will be told that he has to live with that. Obviously, there will be advantages and disadvantages to whatever evaluation procedures are finally selected.

8.2 FINANCIAL COMPENSATION AND REWARDS

PMBOK® Guide, 4th Edition
9.3.2.6 Recognition and Rewards

Proper financial compensation and rewards are important to the morale and motivation of people in any organization. However, there are several issues that often make it necessary to treat compensation practices of project personnel separately from the rest of the organization:

- *Job classification and job descriptions* for project personnel are usually not compatible with those existing for other professional jobs. It is often difficult to pick an existing classification and adapt it to project personnel. Without proper adjustment, the small amount of formal authority of the project and the small number of direct reports may distort the position level of project personnel in spite of their broad range of business responsibilities.
- *Dual accountability* and dual reporting relationships of project personnel raise the question of who should assess performance and control the rewards.
- *Bases for financial rewards* are often difficult to establish, quantify, and administer. The criteria for "doing a good job" are difficult to quantify.
- *Special compensations* for overtime, extensive travel, or living away from home should be considered in addition to bonus pay for preestablished results. Bonus pay is a particularly difficult and delicate issue because often many people contribute to the results of such incentives. Discretionary bonus practices can be demoralizing to the project team.

Some specific guidelines are provided here to help managers establish compensation systems for their project organizations. The foundations of these compensation practices are based on four systems: (1) job classification, (2) base pay, (3) performance appraisals, and (4) merit increases.

Job Classifications and Job Descriptions

Every effort should be made to fit the new classifications for project personnel into the existing standard classification that has already been established for the organization.

The first step is to define job titles for various project personnel and their corresponding responsibilities. Titles are noteworthy because they imply certain responsibilities,

position power, organizational status, and pay level. Furthermore, titles may indicate certain functional responsibilities, as does, for example, the title of task manager.[1] Therefore, titles should be carefully selected and each of them supported by a formal job description.

The job description provides the basic charter for the job and the individual in charge of it. A good job description is brief and concise, not exceeding one page. Typically, it is broken down into three sections: (1) overall responsibilities, (2) specific duties, and (3) qualifications. A sample job description is given in Table 8–1.

Base-Pay Classifications and Incentives

After the job descriptions have been developed, one can delineate pay classes consistent with the responsibilities and accountabilities for business results. If left to the personnel specialist, these pay scales may slip toward the lower end of an equitable compensation. This is understandable because, on the surface, project positions look less senior than their functional counterparts, as formal authority over resources and direct reports are often less necessary for project positions than for traditional functional positions. The impact of such a skewed compensation system is that the project organization will attract less qualified personnel and may be seen as an inferior career path.

Many companies that have struggled with this problem have solved it by (1) working out compensation schemes as a team of senior managers and personnel specialists, and (2) applying criteria of responsibility and business/profit accountability to setting pay scales for project personnel in accord with other jobs in their organization. Managers who are hiring can choose a salary from the established range based on their judgment of actual position responsibilities, the candidate's qualifications, the available budget, and other considerations.

Performance Appraisals

Traditionally, the purpose of the performance appraisal is to:

- Assess the employee's work performance, preferably against preestablished objectives
- Provide a justification for salary actions
- Establish new goals and objectives for the next review period
- Identify and deal with work-related problems
- Serve as a basis for career discussions

In reality, however, the first two objectives are in conflict. As a result, traditional performance appraisals essentially become a salary discussion with the objective to justify subsequent

1. In most organizations the title of task manager indicates being responsible for managing the technical content of a project subsystem within a functional unit, having dual accountabilities to the functional superior and the project office.

TABLE 8–1. SAMPLE JOB DESCRIPTION

Job Description: Lead Project
Engineer of Processor Development

Overall Responsibility
Responsible for directing the technical development of the new Central Processor including managing the technical personnel assigned to this development. The Lead Project Engineer has dual responsibility, (1) to his/her functional superior for the technical implementation and engineering quality and (2) to the project manager for managing the development within the established budget and schedule.

Specific Duties and Responsibilities
1. Provide necessary program direction for planning, organizing, developing and integrating the engineering effort, including establishing the specific objectives, schedules, and budgets for the processor subsystem.
2. Provide technical leadership for analyzing and establishing requirements, preliminary designing, designing, prototyping, and testing of the processor subsystem.
3. Divide the work into discrete and clearly definable tasks. Assign tasks to technical personnel within the Lead Engineer's area of responsibility and other organizational units.
4. Define, negotiate, and allocate budgets and schedules according to the specific tasks and overall program requirements.
5. Measure and control cost, schedule, and technical performance against program plan.
6. Report deviations from program plan to program office.
7. Replan trade-off and redirect the development effort in case of contingencies such as to best utilize the available resources toward the overall program objectives.
8. Plan, maintain, and utilize engineering facilities to meet the long-range program requirements.

Qualifications
1. Strong technical background in state-of-the-art central processor development.
2. Prior task management experience with proven record for effective cost and schedule control of multi-disciplinary technology-based task in excess of SIM.
3. Personal skills to lead, direct, and motivate senior engineering personnel.
4. Excellent communication skills, both orally and in writing.

managerial actions.[2] In addition, discussions dominated by salary actions are usually not conducive for future goal setting, problem-solving, or career planning.

In order to get around this dilemma, many companies have separated the salary discussion from the other parts of the performance appraisal. Moreover, successful managers have carefully considered the complex issues involved and have built a performance appraisal system solidly based on content, measurability, and source of information.

The first challenge is in content, that is, to decide "what to review" and "how to measure performance." Modern management practices try to individualize accountability as much as possible. Furthermore, subsequent incentive or merit increases are tied to profit performance. Although most companies apply these principles to their project organizations, they do it with a great deal of skepticism. Practices are often modified to assure balance and equity for jointly performed responsibilities. A similar dilemma exists in the area

2. For detailed discussions, see The Conference Board, *Matrix Organizations of Complex Businesses*, 1979; plus some basic research by H. H. Meyer, E. Kay, and J. R. P. French, "Split Roles in Performance Appraisal," *Harvard Business Review*, January–February 1965.

of profit accountability. The comment of a project manager at the General Electric Company is typical of the situation faced by business managers: "Although I am responsible for business results of a large program, I really can't control more than 20 percent of its cost." Acknowledging the realities, organizations are measuring performance of their *project managers,* in at least two areas:

- *Business results* as measured by profits, contribution margin, return on investment, new business, and income; also, on-time delivery, meeting contractual requirements, and within-budget performance.
- *Managerial performance* as measured by overall project management effectiveness, organization, direction and leadership, and team performance.

The first area applies only if the project manager is indeed responsible for business results such as contractual performance or new business acquisitions. Many project managers work with company-internal sponsors, such as a company-internal new product development or a feasibility study. In these cases, producing the results within agreed-on schedule and budget constraints becomes the primary measure of performance. The second area is clearly more difficult to assess. Moreover, if handled improperly, it will lead to manipulation and game playing. Table 8–2 provides some specific measures of project management performance. Whether the sponsor is company-internal or external, project managers are usually being assessed on how long it took to organize the team, whether the project is moving along according to agreed-on schedules and budgets, and how closely they meet the global goals and objectives set by their superiors.

PMBOK® Guide, 4th Edition
9.4.2 Manage Project Team
9.4.2.2 Project Performance Appraisals

TABLE 8–2. PERFORMANCE MEASURES FOR PROJECT MANAGERS

Who Performs Appraisal
Functional superior of project manager

Source of Performance Data
Functional superior, resource managers, general managers

Primary Measures
1. Project manager's success in leading the project toward preestablished global objectives
   - Target costs
   - Key milestones
   - Profit, net income, return on investment, contribution margin
   - Quality
   - Technical accomplishments
   - Market measures, new business, follow-on contract
2. Project manager's effectiveness in overall project direction and leadership during all phases, including establishing:
   - Objectives and customer requirements
   - Budgets and schedules
   - Policies
   - Performance measures and controls
   - Reporting and review system

(*continues*)

TABLE 8–2. PERFORMANCE MEASURES FOR PROJECT MANAGERS (*Continued*)

Secondary Measures

1. Ability to utilize organizational resources
   - Overhead cost reduction
   - Working with existing personnel
   - Cost-effective make-buy decisions
2. Ability to build effective project team
   - Project staffing
   - Interfunctional communications
   - Low team conflict complaints and hassles
   - Professionally satisfied team members
   - Work with support groups
3. Effective project planning and plan implementation
   - Plan detail and measurability
   - Commitment by key personnel and management
   - Management involvement
   - Contingency provisions
   - Reports and reviews
4. Customer/client satisfaction
   - Perception of overall project performance by sponsor
   - Communications, liaison
   - Responsiveness to changes
5. Participation in business management
   - Keeping mangement informed of new project/product/business opportunities
   - Bid proposal work
   - Business planning, policy development

Additional Considerations

1. Difficulty of tasks involved
   - Technical tasks
   - Administrative and orgnizational complexity
   - Multidisciplinary nature
   - Staffing and start-up
2. Scope of the project
   - Total project budget
   - Number of personnel involved
   - Number of organizations and subcontractors involved
3. Changing work environment
   - Nature and degree of customer changes and redirections
   - Contingencies

On the other side of the project organization, resource managers or project personnel are being assessed primarily on their ability to direct the implementation of a specific project subsystem:

- *Technical implementation* as measured against requirements, quality, schedules, and cost targets
- *Team performance* as measured by ability to staff, build an effective task group, interface with other groups, and integrate among various functions

Specific performance measures are shown in Table 8–3. In addition, the actual project performance of both project managers and their resource personnel should be assessed on the conditions under which it was achieved: the degree of task difficulty, complexity, size, changes, and general business conditions.

TABLE 8–3. PERFORMANCE MEASURES FOR PROJECT PERSONNEL

Who Performs Appraisal
Functional superior of project person

Source of Performance Data
Project manager and resource managers

Primary Measures
1. Success in directing the agreed-on task toward completion
   - Technical implementation according to requirements
   - Quality
   - Key milestones/schedules
   - Target costs, design-to-cost
   - Innovation
   - Trade-offs
2. Effectiveness as a team member or team leader
   - Building effective task team
   - Working together with others, participation, involvement
   - Interfacing with support organizations and subcontractors
   - Interfunctional coordination
   - Getting along with others
   - Change orientation
   - Making commitments

Secondary Measures
1. Success and effectiveness in performing functional tasks in addition to project work in accordance with functional charter
   - Special assignments
   - Advancing technology
   - Developing organization
   - Resource planning
   - Functional direction and leadership
2. Administrative support services
   - Reports and reviews
   - Special task forces and committees
   - Project planning
   - Procedure development
3. New business development
   - Bid proposal support
   - Customer presentations
4. Professional development
   - Keeping abreast in professional field
   - Publications
   - Liaison with society, vendors, customers, and educational institutions

Additional Considerations
1. Difficulty of tasks involved
   - Technical challenges
   - State-of-the-art considerations
   - Changes and contingencies
2. Managerial responsibilities
   - Task leader for number of project personnel
   - Multifunctional integration
   - Budget responsibility
   - Staffing responsibility
   - Specific accountabilities
3. Multiproject involvement
   - Number of different projects
   - Number and magnitude of functional task and duties
   - Overall workload

Finally, one needs to decide who is to perform the performance appraisal and to make the salary adjustment. Where dual accountabilities are involved, good practices call for inputs from both bosses. Such a situation could exist for project managers who report functionally to one superior but are also accountable for specific business results to another person. While dual accountability of project managers is an exception for most organizations, it is common for project resource personnel who are responsible to their functional superior for the quality of the work and to their project manager for meeting the requirements within budget and schedule. Moreover, resource personnel may be shared among many projects. Only the functional or resource manager can judge overall performance of resource personnel.

Merit Increases and Bonuses

Professionals have come to expect merit increases as a reward for a job well done. However, under inflationary conditions, pay adjustments seldom keep up with cost-of-living increases. To deal with this salary compression and to give incentive for management performance, companies have introduced bonuses. The problem is that these standard plans for merit increases and bonuses are based on individual accountability while project personnel work in teams with shared accountabilities, responsibilities, and controls. It is usually very difficult to credit project success or failure to a single individual or a small group.

Most managers with these dilemmas have turned to the traditional remedy of the performance appraisal. If done well, the appraisal should provide particular measures of job performance that assess the level and magnitude at which the individual has contributed to the success of the project, including the managerial performance and team performance components. Therefore, a properly designed and executed performance appraisal that includes input from all accountable management elements, and the basic agreement of the employee with the conclusions, is a sound basis for future salary reviews.

8.3 CRITICAL ISSUES WITH REWARDING PROJECT TEAMS

PMBOK® Guide, 4th Edition
9.3.2.6 Recognition and Rewards

Today, most companies are using project teams. However, there still exist challenges in how to reward project teams for successful performance. The importance of how teams are rewarded is identified by Parker, McAdams, and Zielinski[3]:

> Some organizations are fond of saying, "We're all part of the team", but too often it is merely management-speak. This is especially common in conventional hierarchical organizations; they say the words but don't follow up with significant action. Their employees may read the articles and attend the conferences and come to believe that many companies have turned collaborative. Actually, though, few organizations today are genuinely team-based.

3. G. Parker, J. McAdams, and D. Zielinski, *Rewarding Teams* (San Francisco: Jossey-Bass, an imprint of John Wiley & Sons, 2000), p. 17; reproduced by permission of John Wiley & Sons.

> Others who want to quibble point to how they reward or recognize teams with splashy bonuses or profit-sharing plans. But these do not by themselves represent a commitment to teams; they're more like a gift from a rich uncle. If top management believes that only money and a few recognition programs ("team of year" and that sort of thing) reinforce teamwork, they are wrong. These alone do not cause fundamental change in the way people and teams are managed.
>
> But in a few organizations, teaming is a key component of the corporate strategy, involvement with teams is second nature, and collaboration happens without great thought or fanfare. There are natural work groups (teams of people who do the same or similar work in the same location), permanent cross-functional teams, ad hoc project teams, process improvement teams, and real management teams. Involvement just happens.

Why is it so difficult to reward project teams? To answer this question, we must understand what a team is and is not. According to Parker et al.[4]:

> Consider this statement: an organizational unit can act like a team, but a team is not necessarily an organizational unit, at least for describing reward plans. An organizational unit is just that, a group of employees organized into an identifiable business unit that appears on the organizational chart. They may behave in a spirit of teamwork, but for the purposes of developing reward plans they are not a "team." The organizational unit may be a whole company, a strategic business unit, a division, a department, or a work group.
>
> A "team" is a small group of people allied by a common project and sharing performance objectives. They generally have complementary skills or knowledge and an interdependence that requires that they work together to accomplish their project's objective. Team members hold themselves mutually accountable for their results. These teams are not found on an organization chart.

Incentives are difficult to apply because project teams may not appear on an organizational chart. Figure 8-7 shows the reinforcement model for employees.[5] For project teams, the emphasis is the three arrows on the right-hand side of Figure 8-7.

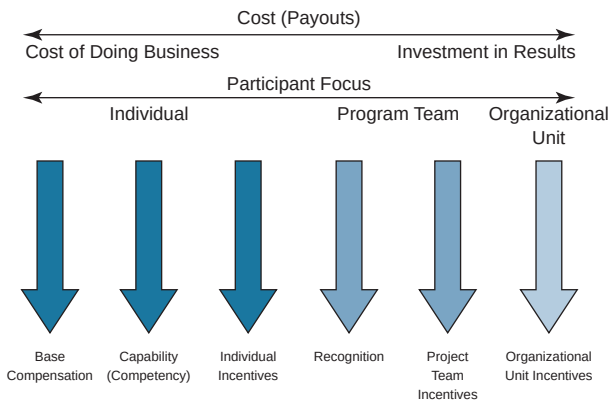


Figure 8–7. The reinforcement model.

4. See note 3, Parker et al., p. 17.
5. See note 3, Parker et al., p. 29.

Project team incentives are important because team members expect appropriate rewards and recognition for work well done. According to Parker et al.[6]:

> Project teams are usually, but not always, formed by management to tackle specific projects or challenges with a defined time frame—reviewing processes for efficiency or cost-savings recommendations, launching a new software product, or implementing enterprise resource planning systems are just a few examples. In other cases, teams self-form around specific issues or as part of continuous improvement initiatives such as team-based suggestion systems.
>
> Project teams can have cross-functional membership or simply be a subset of an existing organizational unit. The person who sponsors the team—its "champion" typically—creates an incentive plan with specific objective measures and an award schedule tied to achieving those measures. To qualify as an incentive, the plan must include pre-announced goals, with a "do this, get that" guarantee for teams. The incentive usually varies with the value added by the project.

Project team incentive plans usually have some combination of these basic measures:

- **Project Milestones:** Hit a milestone, on budget and on time, and all team members earn a defined amount. Although sound in theory, there are inherent problems in tying financial incentives to hitting milestones. Milestones often change for good reason (technological advances, market shifts, other developments) and you don't want the team and management to get into a negotiation on slipping dates to trigger the incentive. Unless milestones are set in stone and reaching them is simply a function of the team doing its normal, everyday job, it's generally best to use recognition-after-the-fact celebration of reaching milestones—rather than tying financial incentives to it.
- Rewards need not always be time-based, such that when the team hits a milestone by a certain date it earns a reward. If, for example, a product development team debugs a new piece of software on time, that's not necessarily a reason to reward it. But if it discovers and solves an unsuspected problem or writes better code before a delivery date, rewards are due.
- **Project Completion:** All team members earn a defined amount when they complete the project on budget and on time (or to the team champion's quality standards).
- **Value Added:** This award is a function of the value added by a project, and depends largely on the ability of the organization to create and track objective measures. Examples include reduced turnaround time on customer requests, improved cycle times for product development, cost savings due to new process efficiencies, or incremental profit or market share created by the product or service developed or implemented by the project team.

One warning about project incentive plans: They can be very effective in helping teams stay focused, accomplish goals, and feel like they are rewarded for their hard work, but they tend to be exclusionary. Not everyone can be on a project team. Some employees

6. See note 3, Parker et al., pp. 38–39.

(team members) will have an opportunity to earn an incentive that others (nonteam members) do not. There is a lack of internal equity. One way to address this is to reward core team members with incentives for reaching team goals and to recognize peripheral players who supported the team, either by offering advice, resources, or a pair of hands, or by covering for project team members back at their regular job.

Some projects are of such strategic importance that you can live with these internal equity problems and non-team members' grousing about exclusionary incentives. Bottom line, though, is this tool should be used cautiously.

Some organizations focus only on cash awards. However, Parker et al. have concluded from their research that noncash awards can work equally well, if not better, than cash awards.[7]

Many of our case organizations use noncash awards because of their staying power. Everyone loves money, but cash payments can lose their motivational impact over time. However, noncash awards carry trophy value that has great staying power because each time you took at that television set or plaque you are reminded of what you or your team did to earn it. Each of the plans encourages awards that are coveted by the recipients and, therefore, will be memorable.

If you ask employees what they want, they will invariably say cash. But providing it can be difficult if the budget is small or the targeted earnings in an incentive plan are modest. If you pay out more often than annually and take taxes out, the net amount may look pretty small, even cheap. Noncash awards tend to be more dependent on their symbolic value than their financial value.

Noncash awards come in all forms: a simple thank you, a letter of congratulations, time off with pay, a trophy, company merchandise, a plaque, gift certificates, special services, a dinner for two, a free lunch, a credit to a card issued by the company for purchases at local stores, specific items or merchandise, merchandise from an extensive catalog, travel for business or a vacation with the family, and stock options. Only the creativity and imagination of the plan creators limit the choices.

8.4 EFFECTIVE PROJECT MANAGEMENT IN THE SMALL BUSINESS ORGANIZATION

The definition of a small project could be:

- Total duration is usually three to twelve months.
- Total dollar value is $50,000 to $1.5 million (upper limit is usually capital equipment projects).
- There is continuous communication between team members, and no more than three or four cost centers are involved.
- Manual rather than computerized cost control may be acceptable.
- Project managers work closely with functional personnel and managers on a daily basis, so time-consuming detail reporting is not necessary.
- The work breakdown structure does not go beyond level three.

7. See note 3, Parker et al., pp. 190–191.

Here, we are discussing project management in both small companies and small organizations within a larger corporation. In small organizations, major differences from large companies must be accounted for:

- *In small companies, the project manager has to wear multiple hats and may have to act as a project manager and line manager at the same time.* Large companies may have the luxury of a single full-time project manager for the duration of a project. Smaller companies may not be able to afford a full-time project manager and therefore may require that functional managers wear two hats. This poses a problem in that the functional managers may be more dedicated to their own functional unit than to the project, and the project may suffer. There is also the risk that when the line manager also acts as project manager, the line manager may keep the best resources for his own project. The line manager's project may be a success at the expense of all the other projects that he must supply resources for.

  In the ideal situation, the project manager works horizontally and has project dedication, whereas the line manager works vertically and has functional (or company) dedication. If the working relationship between the project and functional managers is a good one, then decisions will be made in a manner that is in the best interest of both the project and the company. Unfortunately, this may be difficult to accomplish in small companies when an individual wears multiple hats.

- *In a small company, the project manager handles multiple projects, perhaps each with a different priority.* In large companies, project managers normally handle only one project at a time. Handling multiple projects becomes a serious problem if the priorities are not close together. For this reason, many small companies avoid the establishment of priorities for fear that the lower-priority activities will never be accomplished.

- *In a small company, the project manager has limited resources.* In a large company, if the project manager is unhappy with resources that are provided, he may have the luxury of returning to the functional manager to either demand or negotiate for other resources. In a small organization, the resources assigned may be simply the only resources available.

- *In a small company, project managers must generally have a better understanding of interpersonal skills than in a larger company.* This is a necessity because a project manager in the small company has limited resources and must provide the best motivation that he can.

- *In the smaller company, the project manager generally has shorter lines of communications.* In small organizations project managers almost always report to a top-level executive, whereas in larger organizations the project managers can report to any level of management. Small companies tend to have fewer levels of management.

- *Small companies do not have a project office.* Large companies, especially in aerospace or construction, can easily support a project office of twenty to thirty people, whereas in the smaller company the project manager may have to be the entire project office. This implies that the project manager in a small company may be required to have more general and specific information about all company activities, policies, and procedures than his counterparts in the larger companies.

- *In a small company, there may be a much greater risk to the total company with the failure of as little as one project.* Large companies may be able to afford the loss of a multimillion-dollar program, whereas the smaller company may be in serious financial

trouble. Thus many smaller companies avoid bidding on projects that would necessitate hiring additional resources or giving up some of its smaller accounts.

- *In a small company, there might be tighter monetary controls but with less sophisticated control techniques.* Because the smaller company incurs greater risk with the failure (or cost overrun) of as little as one project, costs are generally controlled much more tightly and more frequently than in larger companies. However, smaller companies generally rely on manual or partially computerized systems, whereas larger organizations rely heavily on sophisticated software packages.
- *In a small company, there is usually more upper-level management interference.* This is expected because in the small company there is a much greater risk with the failure of a single project. In addition, executives in smaller companies "meddle" more than executives in larger companies, and quite often delegate as little as possible to project managers.
- *Evaluation procedures for individuals are usually easier in a smaller company.* This holds true because the project manager gets to know the people better, and, as stated above, there exists a greater need for interpersonal skills on the horizontal line in a smaller company.
- *In a smaller company, project estimating is usually more precise and based on either history or standards.* This type of planning process is usually manual as opposed to computerized. In addition, functional managers in a small company usually feel obligated to live up to their commitments, whereas in larger companies, much more lip service is given.

8.5 MEGA PROJECTS

Mega projects may have a different set of rules and guidelines from those of smaller projects. For example, in large projects:

- Vast numbers of people may be required, often for short or intense periods of time.
- Continuous organizational restructuring may be necessary as each project goes through a different life-cycle phase.
- The matrix and project organizational form may be used interchangeably.
- The following elements are critical for success.
  - Training in project management
  - Rules and procedures clearly defined
  - Communications at all levels
  - Quality front-end planning

Many companies dream of winning mega project contracts only to find disaster rather than a pot of gold. The difficulty in managing mega projects stems mainly from resource restraints:

- Lack of available on-site workers (or local labor forces)
- Lack of skilled workers

- Lack of properly trained on-site supervision
- Lack of raw materials

As a result of such problems, the company immediately assigns its best employees to the mega project, thus creating severe risks for the smaller projects, many of which could lead to substantial follow-on business. Overtime is usually required, on a prolonged basis, and this results in lower efficiency and unhappy employees.

As the project schedule slips, management hires additional home-office personnel to support the project. By the time that the project is finished, the total organization is overstaffed, many smaller customers have taken their business elsewhere, and the company finds itself in the position of needing another mega project in order to survive and support the existing staff.

Mega projects are not always as glorious as people think they are. Organizational stability, accompanied by a moderate growth rate, may be more important than quantum steps to mega projects. The lesson here is that mega projects should be left to those companies that have the facilities, expertise, resources, and management know-how to handle the situation.

8.6 MORALITY, ETHICS, AND THE CORPORATE CULTURE

PMBOK® Guide, 4th Edition
1.1 Domain of Professional Responsibility and the PMP® Code of Conduct

Companies that promote morality and ethics in business usually have an easier time developing a cooperative culture than those that encourage unethical or immoral behavior. The adversity generated by unethical acts can be either internally or externally driven. Internally driven adversity occurs when employees or managers in your own company ask you to take action that may be in the best interest of your company but violates your own moral and ethical beliefs. Typical examples might include:

- You are asked to lie to the customer in a proposal in order to win the contract.
- You are asked to withhold bad news from your own management.
- You are asked to withhold bad news from the customer.
- You are instructed to ship a potentially defective unit to the customer in order to maintain production quotas.
- You are ordered to violate ethical accounting practices to make your numbers "look good" for senior management.
- You are asked to cover up acts of embezzlement or use the wrong charge numbers.
- You are asked to violate the confidence of a private personal decision by a team member.

External adversity occurs when your customers ask you to take action that may be in the customer's best interest (and possibly your company's best interest), but once again violates your personal moral and ethical beliefs. Typical examples might include:

- You are asked to hide or destroy information that could be damaging to the customer during legal action against your customer.
- You are asked to lie to consumers to help maintain your customer's public image.

- You are asked to release unreliable information that would be damaging to one of your customer's competitors.
- The customer's project manager asks you to lie in your proposal so that he/she will have an easier time in approving contract award.

Project managers are often placed in positions where an action must be taken for the best interest of the company and its customers, and yet the same action could be upsetting to the workers. Consider the following example as a positive way to handle this:

- A project had a delivery date where a specific number of completed units had to be on the firm's biggest customer's receiving dock by January 5. This customer represented 30% of the firm's sales and 33% of its profits. Because of product development problems and slippages, the project could not be completed early. The employees, many of whom were exempt, were informed that they would be expected to work 12-hour days, including Christmas and New Year's, to maintain the schedule. The project manager worked the same hours as his manufacturing team and was visible to all. The company allowed family members to visit the workers during the lunch and dinner hours during this period. After delivery was accomplished, the project manager arranged for all of the team members to receive two weeks of paid time off. At completion of the project, the team members were volunteering to work again for this project manager.

The project manager realized that asking his team to work these days might be viewed as immoral. Yet, because he also worked, his behavior reinforced the importance of meeting the schedule. The project manager's actions actually strengthened the cooperative nature of the culture within the firm.

Not all changes are in the best interest of both the company and the workers. Sometimes change is needed simply to survive, and this could force employees to depart from their comfort zones. The employees might even view the change as immoral. Consider the following example:

- Because of a recession, a machine tool company switched from a non–project-driven to a project-driven company. Management recognized the change and tried to convince employees that customers now wanted specialty products rather than standard products, and that the survival of the firm may be at stake. The company hired a project management consulting company to help bring in project management since the business was now project-driven. The employees vigorously resisted both the change and the training with the mistaken belief that, once the recession ended, the customers would once again want the standard, off-the-shelf products and that project management was a waste of time. The company is no longer in business and, as the employees walked out of the plant for the last time, they blamed project management for the loss of employment.

Some companies develop "Standard Practice Manuals" that describe in detail what is meant by ethical conduct in dealing with customers and suppliers. Yet, even with the

existence of these manuals, well-meaning individuals may create unintended consequences that wreak havoc.

Consider the following example:

- The executive project sponsor on a government-funded R&D project decided to "massage" the raw data to make the numbers look better before presenting the data to a customer. When the customer realized what had happened, their relationship, which had been based upon trust and open communications, was now based upon mistrust and formal documentation. The entire project team suffered because of the self-serving conduct of one executive.

Sometimes, project managers find themselves in situations where the outcome most likely will be a win-lose position rather than a win-win situation. Consider the following three situations:

- An assistant project manager, Mary, had the opportunity to be promoted and manage a new large project that was about to begin. She needed her manager's permission to accept the new assignment, but if she left, her manager would have to perform her work in addition to his own for at least three months. The project manager refused to release her, and the project manager developed a reputation of preventing people from being promoted while working on his project.
- In the first month of a twelve-month project, the project manager realized that the end date was optimistic, but he purposely withheld information from the customer in hopes that a miracle would occur. Ten months later, the project manager was still withholding information waiting for the miracle. In the eleventh month, the customer was told the truth. People then labeled the project manager as an individual who would rather lie than tell the truth because it was easier.
- To maintain the customer's schedule, the project manager demanded that employees work excessive overtime, knowing that this often led to more mistakes. The company fired a tired worker who inadvertently withdrew the wrong raw materials from inventory, resulting in a $55,000 manufacturing mistake.

In all three situations, the project manager believed that his decision was in the best interest of the company at that time. Yet the final result in each case was that the project manager was labeled as unethical or immoral.

It is often said that "money is the root of all evil." Sometimes companies believe that recognizing the achievements of an individual through a financial reward system is appropriate without considering the impact on the culture. Consider the following example:

- At the end of a highly successful project, the project manager was promoted, given a $5,000 bonus and a paid vacation. The team members who were key to the project's success and who earned minimum wage, went to a fast food restaurant to celebrate their contribution to the firm and their support of each other. The project manager celebrated alone.

The company failed to recognize that project management was a team effort. The workers viewed management's reward policy as immoral and unethical because the project manager was successful due to the efforts of the entire team.

Moral and ethical conduct by project managers, project sponsors, and line managers can improve the corporate culture. Likewise, poor decisions can destroy a culture, often in much less time than it took for the culture to be developed.

8.7 PROFESSIONAL RESPONSIBILITIES

PMBOK® Guide, 4th Edition
1.1 Domain of Professional Responsibility and the PMP® Code of Conduct

Professional responsibilities for project managers have become increasingly important in the last few years because of the unfavorable publicity on the dealings of corporate America. These professional responsibilities have been with us for some time, especially in dealing with government agencies. Professional responsibilities for a project manager are both broad-based and encompassing. PMI® released a Project Management Professional (PMP®) Role Delineation Study in 2000 that emphasizes the professional responsibilities of the project manager. The Professional Responsibilities Domain Area in the PMBOK®Guide is based upon the Role Delineation Study and The PMI® Code of Conduct. There are five tasks emphasized under Professional Responsibilities Domain Area of the PMBOK® Guide:

- **Ensure Individual Integrity and Professionalism:** The project manager is expected to act in a professional manner at all times. This includes adhering to all legal requirements, maintaining moral and ethical standards, and protecting the community and all stakeholders even though there may be some conflicting interests among the shareholders. The project manager must be knowledgeable about legal requirements (including professional standards legal requirements), as well as multinational, ethnic, ethical, and cultural standards at both the project's location and within the team. Understanding the values set forth by the stakeholders is also necessary.
- **Contribute to the Project Management Knowledge Base:** Project managers are expected to contribute to the project management knowledge base by sharing project management knowledge on such topics as current research, best practices, lessons learned, and continuous improvement efforts. The intent of this contribution is to advance the profession, improve the quality of project management, and improve the capabilities of one's colleagues. Contributions can take the form of articles, presentations, books, and various other media.
- **Enhance Individual Competence:** Project managers are expected to enhance their own individual competencies in the same manner as they contribute to the profession. Usually, project managers that contribute to the profession enhance their own competencies at the same time.
- **Balance Stakeholder Interests:** All stakeholders may have different values and interests. These competing interests mandate that project managers not only

understand stakeholder needs and objectives but also possess strong conflict resolution skills, negotiation skills, and communication skills.

- **Interact with the Team and Stakeholders in a Professional and Cooperative Manner:** Project managers are expected to understand the ethnic and cultural norms of both the team members and the stakeholders. This leads to the category of cultural diversity and socioeconomic influences such as political differences, national holidays, communication preferences, religious practices, ethical and moral beliefs, and other demographic considerations. Project managers must be willing to embrace diversity, be open-minded, exercise self-control, exhibit empathy, and exercise tolerance with a willingness to compromise.

In addition to the five tasks described under professional responsibility, PMI® has developed a Code of Professional Conduct that reinforces these five tasks. The code applies to everyone working in a project environment, not merely the project manager. As such, the code emphasizes that PMP®s must function as "role models" and exhibit characteristics such as honesty, morality, and ethical behavior.

The code has two major sections:

- Responsibilities to the Profession
- Responsibilities to the Customers and the Public

There are numerous situations that can create problems for project managers in dealing with professional responsibilities expectations. These situations include:

- Maintaining professional integrity
- Adhering to ethical standards
- Recognizing diversity
- Avoiding/reporting conflicts of interest
- Not making project decisions for personal gains
- Receiving gifts from customers and vendors
- Providing gifts to customers and vendors
- Truthfully reporting information
- Willing to identify violations
- Balancing stakeholder needs
- Succumbing to stakeholder pressure
- Managing your firm's intellectual property
- Managing your customer's intellectual property
- Adhering to security and confidentiality requirements
- Abiding by the Code of Professional Conduct

Several of these topics are explained below.

Conflict of Interest

A conflict of interest is a situation where the individual is placed in a compromising position where the individual can gain personally based upon the decisions made. This is also referred to as personal enrichment. There are

numerous situations where a project manager is placed in such a position. Examples might be:

- Insider knowledge that the stock will be going up or down
- Being asked to improperly allow employees to use charge numbers on your project even though they are not working on your project
- Receiving or giving inappropriate (by dollar value) gifts
- Receiving unjustified compensation or kickbacks
- Providing the customer with false information just to keep the project alive

Project managers are expected to abide by the PMI® Code of Professional Conduct, which makes it clear that project managers should conduct themselves in an ethical manner. Unjust compensation or gains not only are frowned upon but are unacceptable. Unless these conflict-of-interest situations are understood, the legitimate interests of both the customer and the company may not be forthcoming.

Inappropriate Connections

Not all stakeholders are equal in their ability to influence the decisions made by the project manager. Some stakeholders can provide inappropriate influence/compensation, such as:

- A loan with a very low interest rate
- Ability to purchase a product/service at a price that may appear equivalent to a gift
- Ability to receive free gifts such as airline tickets, tickets to athletic events, free meals and entertainment, or even cash

Another form of inappropriate connections would be with family or friends. These individuals may provide you with information or influence by which you could gain personally in a business situation. Examples of affiliation connections might be:

- Receiving insider information
- Receiving privileged information
- Opening doors that you could not open by yourself, at least without some difficulty

Acceptance of Gifts

Today, all companies have rules concerning the acceptance of gifts and their disclosure. While it may be customary in some countries to give or accept gifts, the standard rule is usually to avoid all gifts. Some companies may stipulate limits on when gifts are permitted and the appropriateness of the gift. The gifts might be cash, free meals, or other such items.

Responsibility to Your Company (and Stakeholders)

Companies today, more than ever before, are under pressure to maintain ethical practices with customers and suppliers. This could be interpreted as a company code of ethics that stipulates the professional

behavior expected from the project manager and the team members. This applies specifically to the actions of both the project manager as well as the team members. Some companies even go so far as to develop "standard practice manuals" on how to act in a professional manner. Typical sections of such manuals might be:

- Truthful representation of all information
- Full disclosure of all information
- Protection of company-proprietary information
- Responsibility to report violations
- Full compliance with groups auditing violations
- Full disclosure, and in a timely manner, of all conflicts of interest
- Ensure that all of the team members abide by the above items

8.8 INTERNAL PARTNERSHIPS

A partnership is a group of two or more individuals working together to achieve a common objective. In project management, maintaining excellent, working relations with internal partners is essential. Internally, the critical relationship is between the project and line manager.

In the early days of project management, the selection of the individual to serve as the project manager was most often dependent upon who possessed the greatest command of technology. The result, as shown in Figure 8–8, was a very poor working relationship between the project and line manager. Line managers viewed project managers as a threat, and their relationship developed into a competitive, superior-subordinate relationship. The most common form of organizational structure was a very strong matrix where the project

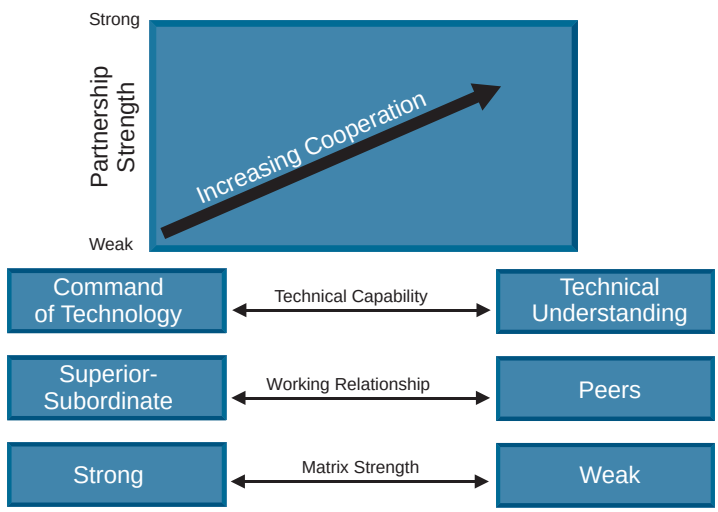


FIGURE 8–8. Partnership strength.

manager, perceived as having a command of technology, had a greater influence over the assigned employees than did their line manager.

As the magnitude and technical complexity of the projects grew, it became obvious that the project managers could not maintain a command of technology in all aspects of the project. Project managers were viewed as possessing an understanding of rather than command of technology. They became more dependent upon line managers for technical support. The project manager then found himself in the midst of a weak matrix where the employees were receiving the majority of their technical direction from the line managers.

As the partnership between the project and line managers developed, management recognized that partnerships worked best on a peer-to-peer basis. Project and line managers began to view each other as equals and share in the authority, responsibility, and accountability needed to assure project success. Good project management methodologies emphasize the cooperative working relationship that must exist between the project and line managers.

8.9 EXTERNAL PARTNERSHIPS

PMBOK® Guide, 4th Edition
2.3 Vendor Business Partners

Project management methodologies also emphasize the working relationships with external organizations such as suppliers. Outsourcing has become a major trend because it allows companies to bring their products and services to the market faster and often at a more competitive price. Therefore, external partnerships can become beneficial for both the suppliers and the customers.

There are three categories of suppliers:

- **An External Supplier:** These are suppliers that you may or may not have worked with previously. There has been no investment into a relationship with these suppliers. If they win a contract, and even if they perform well, there is no guarantee that they will receive another contract. Usually an external supplier must go through all of the requirements of the competitive bidding process for each project.
- **An Approved Supplier:** This is usually considered the lowest level of external partnering. Approved suppliers are part of an approved supplier-bidding list and are invited to bid on selected projects. If the approved supplier wins a contract, there is no guarantee that any additional contracts will be forthcoming. Some minimal relationship between the customer and supplier may exist, but the supplier may still be required to go through all of the standard protocols of competitive bidding.
- **A Preferred Supplier:** These suppliers usually get the first chance at receiving a contract but may still have to go through the entire competitive bidding process, but with a minimum amount of paperwork. Proposal information on previous history, past experience with the customer or the type of project, and other such information may not be required as part of the contractual bidding process in order to reduce time and cost. A relationship between the customer and the supplier exists. Information on lessons learned, best practices, and technological changes are often exchanged freely.

- **A Strategic Partnership Supplier:** A strong relationship exists between the customer and supplier, and they freely exchange information, especially strategic information. Each views the relationship as a long-term partnership with long-term benefits. Strategic suppliers often receive sole-source contracts without having to prepare a formal proposal, thus generating cost savings for both companies. Strategic suppliers may not be the lowest cost suppliers, but the customer's cost savings of not having to perform competitive bidding is well worth the effort.

External partnerships, if properly managed, can provide significant long-term benefits to both the customer and supplier.

The Department of Defense has been conducting research into what constitutes an effective supplier relationship.[8] Each Chrysler supplier had a Chrysler person knowledgeable about the supplier's business to contact for all supplier dealings for that commodity. These companies also interacted with key suppliers in close teaming arrangements that facilitated sharing information. Commonly called integrated product teams (IPTs), members worked together so that design, manufacturing, and cost issues were considered together. Team members were encouraged to participate as partners in meeting project goals and to interact frequently. In addition, some companies collocated suppliers with their own people or set up central working facilities with suppliers for working out issues such as how a product might be improved or be made less expensive. Motorola and Xerox saw such teams as a key vehicle for facilitating early supplier involvement in their products—one of their primary strategies. Motorola said key suppliers had building access and came in many times during a week to work with Motorola engineers.

These companies also asked suppliers to meet high standards, then differentiated the types of relationships within their pool of suppliers. Many treated key suppliers—those contributing the most to their product, such as critical parts or unique processes—differently than suppliers for noncritical or standard parts. For example, one Corning division categorized suppliers and developed relationships with them based on the extent of their impact on the customer and performance. Level 1 suppliers have a direct impact on customer satisfaction, level 2 suppliers are important to day-to-day operations, and level 3 suppliers provided commonly available products. DuPont differentiated between alliance partners—suppliers with similar goals and objectives that wish to work with DuPont for mutual benefit—and all other suppliers.

Perhaps more significantly, Chrysler's relationships with its suppliers had evolved to the point that it no longer needed to make large investments in some key technology areas. Instead, the suppliers made the technology investment themselves and had enough confidence in their relationship with Chrysler that they did not fear the long-term commitment that this entailed. For its part, Chrysler trusted the suppliers to make investments that would help keep their vehicles competitive. In this case, both supplier and product developer saw their success as that of the final product and a continuing mutually beneficial relationship.

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8. *DoD Can Help Suppliers Contribute More to Weapon System Programs*, Best Practices Series, GAO/NSIAD-98-87, Government Accounting Office, March 1998, pp. 38, 48, 51.

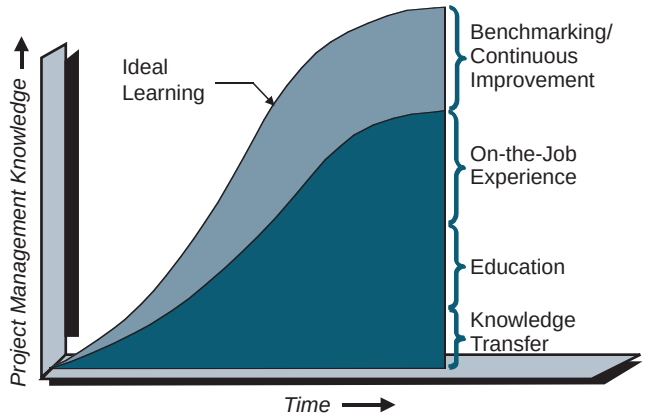


FIGURE 8–9. Project management learning curve.

8.10 TRAINING AND EDUCATION

PMBOK® Guide, 4th Edition
Task 3 of Professional Responsibility—Enhance Individual Competence

Given that most companies use the same basic tools as part of their methodology, what makes one company better than another? The answer lies in the execution of the methodology. Training and education can accelerate not only the project management maturity process but also the ability to execute the methodology.

Actual learning takes place in three areas, as shown in Figure 8–9: on-the-job experience, education, and knowledge transfer. Ideal project management knowledge would be obtained by allowing each employee to be educated on the results of the company's lessons learned studies including risk management, benchmarking, and continuous improvement efforts. Unfortunately, this is rarely done and ideal learning is hardly ever reached. To make matters worse, actual learning is less than most people believe because of lost knowledge. This lost knowledge is shown in Figure 8–10 and will occur even in companies that maintain low employee turnover ratios. These two figures also illustrate the importance of maintaining the same personnel on the project for the duration of the effort.

Companies often find themselves in a position of having to provide a key initiative for a multitude of people, or simply specialized training to a program team about to embark upon a new long-term effort. In such cases, specialized training is required, with targeted goals and results that are specifically planned for. The elements common to training on a key initiative or practice include[9]:

- A front-end analysis of the program team's needs and training requirements
- Involvement of the program teams in key decisions

9. Adapted from *DoD Training Can Do More to Help Weapon System Programs Implement Best Practices,* Best Practices Series, GAO/NSIAD-99-206, Government Accounting Office, August 1999, pp. 40–41, 51.

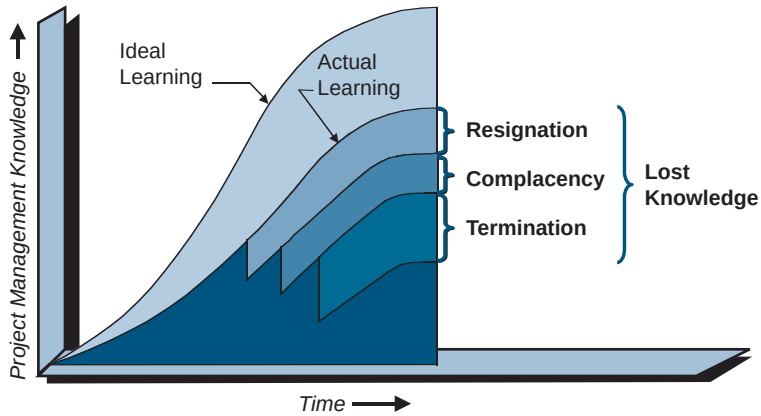


FIGURE 8–10. Project management learning curve.

- Customized training to meet program team's specific needs
- Targeted training for the implementation of specific practices
- Improved training outcomes, including better course depth, timeliness, and reach

The front-end analysis is used to determine the needs and requirements of the program office implementing the practice. The analysis is also used to identify and address barriers each program office faces when implementing new practices. According to the director of the benchmarking forum for the American Society of Training and Development, this type of analysis is crucial for an organization to be able to institute performance-improving measures. Using information from the front-end analysis, the training organizations customize the training to ensure that it directly assists program teams in implementing new practices. To ensure that the training will address the needs of the program teams, the training organizations involve the staff in making important training decisions. Program staff help decide the amount of training to be provided for certain job descriptions, course objectives, and depth of course coverage. Companies doing this believe their training approach, which includes program staff, has resulted in the right amount of course depth, timeliness, and coverage of personnel.

Officials at Boeing's Employee Training and Development organization state that their primary goal is to support their customers, the employees assigned to the Commercial Airplane Group. The training representatives develop a partnership with the staff from the beginning of the program to design and manufacture a new airplane. The training representatives form "drop teams" to collate with the program to conduct a front-end analysis and learn as much as possible about the business process and the staff's concerns. The analysis allows the drop team to determine what training is needed to support the staff implementing the new practice.

Boeing training officials said they worked side by side with the program staff to create a training program that provided team building and conflict resolution techniques and technical skills training that specifically focused on improving work competencies that

would change as a result of the 777's new digital environment. To ensure all 777 staff was equally trained, employees were required to complete training before they reported to the program. For example, the professional employees—engineers and drafters—were required to complete 120 hours of start-up training on several key 777 practices, including design build teams and computer-aided three-dimensional interactive applications software.[10] Teams were often trained together at the work location. Boeing officials stated that training was instrumental to the implementation of key practices on the 777 program, such as design build teams—essentially integrated program teams (IPTs). The officials stated that design build teams were at odds with the company's culture because employees were not accustomed to working in a team environment and sharing information across functional areas.

Boeing's director of learning program development summarized the corporate training strategy for implementing new practices as one that includes a clearly stated vision or mission statement, well-defined goals, and enablers, such as training and good processes, to support the implementers. This philosophy enabled Boeing to take a year to develop the training program tailored to the 777 program—which was intended to change the corporate culture and encourage employees to rethink how they did their jobs. Both Boeing training and program officials believe that the training investment resulted in the successful implementation of the key 777 practices.

While the company officials acknowledged that training was instrumental in the implementation of the key practices, everyone also stated that training was just one of the necessary components. Creating the right environment is also key to the successful implementation of new practices, and the quality of the training was dependent on the environment. Boeing officials stressed that strong leadership is often another key force. At the inception of key programs at IBM, top leaders provide sufficient funding for training, well-defined expectations, clear direction, oversight, continued interest, and incentives to ensure that the new practices are possible to implement. The manager for the 777 program stated that Boeing's management works in teams—a key practice. He believed that it was management's ability to lead by example that helped prevent a return to the former functional way of operating. These companies believe that other factors, such as an accommodating organizational structure, good internal communication, consistent application, and supportive technology, are needed to foster the implementation of key new practices.

8.11 INTEGRATED PRODUCT/PROJECT TEAMS

PMBOK® Guide, 4th Edition
Chapter 4 Integration Management
Chapter 9 Human Resources Management

In recent years, there has been an effort to substantially improve the formation and makeup of teams required to develop a new product or implement a new practice. These teams have membership from across the entire organization and are called integrated product/project teams (IPTs).

10. This application is a computer-based design tool that allows designers the opportunity to view design drawings and the interface of millions of airplane parts as three-dimensional.

The IPT consists of a sponsor, program manager, and the core team. For the most part, members of the core team are assigned full-time to the team but may not be on the team for the duration of the entire project.

The skills needed to be a member of the core team include:

- Self-starter ability
- Work without supervision
- Good communication skills
- Cooperative
- Technical understanding
- Willing to learn backup skills
- Able to perform feasibility studies and cost/benefit analyses
- Able to perform or assist in market research studies
- Able to evaluate asset utilization
- Decision-maker
- Knowledgeable in risk management
- Understand the need for continuous validation

Each IPT is given a project charter that identifies the project's mission and identifies the assigned project manager. However, unlike traditional charters, the IPT charter can also identify the key members of the IPT by name or job responsibility.

Unlike traditional project teams, the IPT thrives on sharing information across the team and collective decision-making. IPTs eventually develop their own culture and, as such, can function in either a formal or informal capacity.

Since the concept of an IPT is well suited to large, long-term projects, it is no wonder that the Department of Defense has been researching best practices for an IPT.[11] The government looked at four projects, in both the public and private sectors, which were highly successful using the IPT approach and four government projects that had less than acceptable results. The successful IPT projects are shown in Table 8–4. The unsuccessful IPT

TABLE 8–4. EFFECTIVE IPTS

Program	Cost Status	Schedule Status	Performance Status
Daimler-Chrysler	Product cost was lowered	Decreased development cycle months by 50 percent	Improved vehicle designs
Hewlett-Packard	Lowered cost by over 60 percent	Shortened development schedule by over 60 percent	Improved system integration and product design
3M	Outperformed cost goals	Product deliveries shortened by 12 to 18 months	Improved performance by 80 percent
Advanced Amphibious Assault Vehicle	Product unit cost lower than original estimate	Ahead of original development schedule	Demonstrated fivefold increase in speed

11. *DoD Teaming Practices Not Achieving Potential Results*, Best Practices Series, GOA-01-501, Government Accounting Office, April 2001.

TABLE 8–5. INEFFECTIVE IPTS

Program	Cost Status	Schedule Status	Performance Status
CH-60S Helicopter	Increased cost but due to additional purchases	Schedule delayed	Software and structural difficulties
Extended Range Guided Munitions	Increases in development costs	Schedule slipped three years	Redesigning due to technical difficulties
Global Broadcast Service	Experiencing cost growth	Schedule slipped 1.5 years	Software and hardware design shortfalls
Land Warrior	Cost increase of about 50 percent	Schedule delayed four years	Overweight equipment, inadequate battery power and design

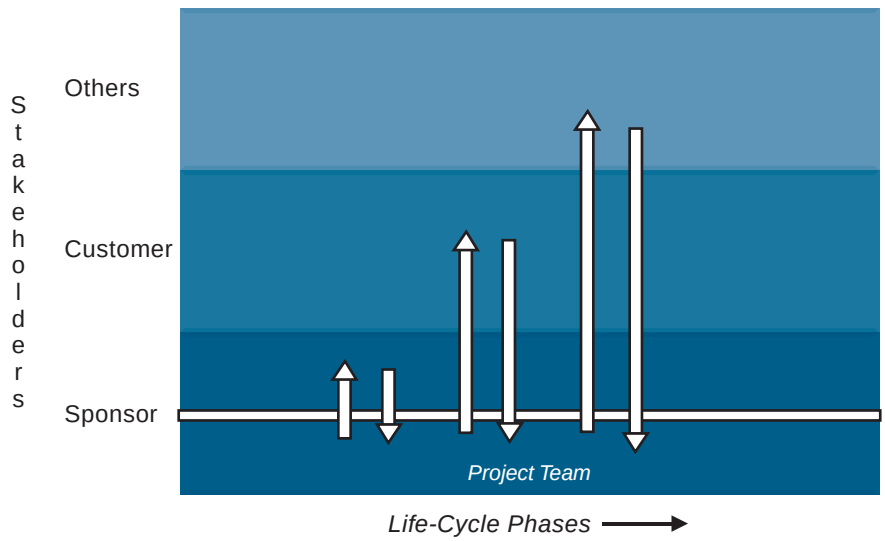


FIGURE 8–11. Knowledge and authority.

projects are shown in Table 8–5. In analyzing the data, the government came up with the results shown in Figure 8–11. Each vertical line in Figure 8–11 is a situation where the IPT must go outside of its own domain to seek information and approvals. Each time this happens, it is referred to as a "hit." The government research indicated that the greater the number of hits, the more likely it is that the time, cost, and performance constraints will not be achieved. The research confirmed that if the IPT has the knowledge necessary to make decisions, and also has the authority to make the decisions, then the desired performance would be achieved. Hits will delay decisions and cause schedule slippages.

8.12 VIRTUAL PROJECT TEAMS

Historically, project management was a face-to-face environment where team meetings involved all players convening together in one room. The team itself may even be

co-located. Today, because of the size and complexity of projects, it is impossible to find all team members located under one roof. Other possible characteristics of a virtual team are shown in Table 8–6.

Duarte and Snyder define seven types of virtual teams.[12] These are shown in Table 8–7. Culture and technology can have a major impact on the performance of virtual teams. Duarte and Snyder have identified some of these relationships in Table 8–8.

TABLE 8–6. CHARACTERISTICS OF VIRTUAL TEAMS

Characteristic	Traditional Teams	Virtual Teams
Membership	Team members are all from the same company.	Team members may be multinational and all from different companies and countries.
Proximity	Team members work in close proximity with each other.	Team members may never meet face-to-face.
Methodology usage	One approach exists, perhaps an enterprise project management methodology.	Each unit can have their own methodology
Methodology structure	One approach, which is based upon either policies and procedures, or forms guidelines, templates, and checklists.	Each unit's methodology can have its own structure.
Trust	Very little trust may exist.	Trust is essential.
Authority	Leadership may focus on authority.	Leadership may focus on influence power.

TABLE 8–7. TYPES OF VIRTUAL TEAMS

Type of Team	Description
Network	Team membership is diffuse and fluid; members come and go as needed. Team lacks clear boundaries within the organization.
Parallel	Team has clear boundaries and distinct membership. Team works in the short term to develop recommendation for an improvement in a process or system.
Project or product development	Team has fluid membership, clear boundaries, and a defined customer base, technical requirement, and output. Longer-term team task is nonroutine, and the team has decision-making authority.
Work or production	Team as distinct membership and clear boundaries. Members perform regular and outgoing work, usually in one functional area.
Service	Team has distinct membership and supports ongoing customer network activity.
Management	Team has distinct membership and works on a regular basis to lead corporate activities.
Action	Team deals with immediate action, usually in an emergency situation. Membership may be fluid or distinct.

12. D. L. Duarte and N. T. Snyder, *Mastering Virtual Teams* (San Francisco: Jossey-Bass, an imprint of John Wiley & Sons, 2001), p. 10; reproduced by permission of John Wiley & Sons.

TABLE 8–8. TECHNOLOGY AND CULTURE

Cultural Factor	Technological Considerations
Power distance	Members from high-power-distance cultures may participate more freely with technologies that are asynchronous and allow anonymous input. These cultures sometimes use technology to indicate status differences between team members.
Uncertainty avoidance	People from cultures with high uncertainty avoidance may be slower adopters of technology. They may also prefer technology that is able to produce more permanent records of discussions and decisions.
Individualism–collectivism	Members from highly collectivistic cultures may prefer face-to-face interactions.
Masculinity–femininity	People from cultures with more "feminine" orientations are more prone to use technology in a nurturing way, especially during team startups.
Context	People from high-content cultures may prefer more information-rich technologies, as well as those that offer opportunities for the feeling of social presence. They may resist using technologies with low social presence to communicate with people they have never met. People from low-context cultures may prefer more asynchronous communications.

Source: D.L. Duarte and N. Tennant Snyder, *Mastering Virtual Teams.* San Francisco: Jossey-Bass, 2001, p. 60.

The importance of culture cannot be understated. Duarte and Snyder identify four important points to remember concerning the impact of culture on virtual teams. The four points are[13]:

1. There are national cultures, organizational cultures, functional cultures, and team cultures. They can be sources of competitive advantages for virtual teams that know how to use cultural differences to create synergy. Team leaders and members who understand and are sensitive to cultural differences can create more robust outcomes than can members of homogeneous teams with members who think and act alike. Cultural differences can create distinctive advantages for teams if they are understood and used in positive ways.
2. The most important aspect of understanding and working with cultural differences is to create a team culture in which problems can be surfaced and differences can he discussed in a productive, respectful manner.
3. It is essential to distinguish between problems that result from cultural differences and problems that are performance based.
4. Business practices and business ethics vary in different parts of the world. Virtual teams need to clearly articulate approaches to these that every member understands and abides by.

8.13 BREAKTHROUGH PROJECTS

Once the decision to implement project management is made, support is needed from the rest of the organization. This is best accomplished by a breakthrough project that managers

13. See note 12, Duarte and Snyder, p. 70.

and employees can follow to see project management in action. The breakthrough project should have a high probability of success, otherwise employees may erroneously blame project management for the failure when, in fact, the failure may be due to other causes.

Some people believe that the breakthrough project should be a small effort such that the employees can easily see the benefits of project management. Others contend that a large project be used as the breakthrough project because success on a small project is no guarantee that the same success can be achieved on a large project.

There are strategies and tactics that should be carefully considered during the implementation of a breakthrough project:

- **The Push for Change:** Project management implementation often requires a push for change. The push for excessive changes, such as the implementation of new and cumbersome policies and procedures, may generate more enemies than allies. Also, the recommended changes should be applicable to a broad range of projects, be easy to accept, and deemed necessary for the completion of the objectives.
- **Retention of Authority and Power:** People are more likely to accept project management if they do not feel threatened by a shift in the balance of power and authority.
- **Focus on the Deliverables:** All too often, people erroneously focus on the tools and software of project management rather than on the end result. This is a mistake. Initially, the focus should be on the deliverables and the fact that a structured project management process can improve the chances of success on each project.
- **Information Flow:** People need to see the flow of project management information in order to make an evaluation. The project information should flow according to the traditional channels.

8.14 STUDYING TIPS FOR THE PMI® PROJECT MANAGEMENT CERTIFICATION EXAM

This section is applicable as a review of the principles to support the knowledge areas and domain groups in the PMBOK® Guide. This chapter addresses:

- Human Resources Management
- Professional Responsibility
- Planning
- Execution

Understanding the following principles is beneficial if the reader is using this text to study for the PMP® Certification Exam:

- Principles and tasks included under professional responsibility
- Factors that affect professional responsibility such as conflicts of interest and gifts
- PMI® Code of Professional Conduct (this can be downloaded from the PMI® web site, pmi.org)

- That personnel performance reviews, whether formal or informal, are part of a project manager's responsibility
- Differences between project management in a large company and project management in a small company

The following multiple-choice questions will be helpful in reviewing the principles of this chapter:

1. You have been sent on a business trip to visit one of the companies bidding on a contract to be awarded by your company. You are there to determine the validity of the information in its proposal. They take you to dinner one evening at a very expensive restaurant. When the bill comes, you should:
   A. Thank them for their generosity and let them pay the bill
   B. Thank them for their generosity and tell them that you prefer to pay for your own meal
   C. Offer to pay for the meal for everyone and put it on your company's credit card
   D. Offer to pay the bill, put it on your company's credit card, and make the appropriate adjustment in the company's bid price to cover the cost of the meals
2. You are preparing a proposal in response to a Request for Proposal (RFP) from a potentially important client. The salesperson in your company working on the proposal tells you to "lie" in the proposal to improve the company's chance of winning the contract. You should:
   A. Do as you are told
   B. Refuse to work on the proposal
   C. Report the matter to your superior, the project sponsor, or the corporate legal group
   D. Resign from the company
3. You are preparing for a customer interface meeting and your project sponsor asks you to lie to the customer about certain test results. You should:
   A. Do as you are told
   B. Refuse to work on the project from this point forth
   C. Report the matter to either your superior or the corporate legal group for advice
   D. Resign from the company
4. One of the project managers in your company approaches you with a request to use some of the charge numbers from your project (which is currently running under budget) for work on their project (which is currently running over budget). Your contract is a cost-reimbursable contract for a client external to your company. You should:
   A. Do as you are requested
   B. Refuse to do this unless the project manager allows you to use his charge numbers later on
   C. Report the matter to your superior, the project sponsor, or the corporate legal group
   D. Ask the project manager to resign from the company
5. You have submitted a proposal to a client as part of a competitive bidding effort. One of the people evaluating your bid informs you that it is customary to send them some gifts in order to have a better chance of winning the contract. You should:
   A. Send them some gifts
   B. Do not send any gifts and see what happens
   C. Report the matter to your superior, the project sponsor, or the corporate legal group for advice
   D. Withdraw the proposal

6. You just discovered that the company in which your brother-in-law is employed has submitted a proposal to your company. Your brother-in-law has asked you to do everything possible to make sure that his company will win the contract because his job may be in jeopardy. You should:
A. Do what your brother-in-law requests
B. Refuse to look into the matter and pretend it never happened
C. Report the conflict of interest to your superior, the project sponsor, or the corporate legal group
D. Hire an attorney for advice

7. As part of a proposal evaluation team, you have discovered that the contract will be awarded to Alpha Company and that a formal announcement will be made in two days. The price of Alpha Company's stock may just skyrocket because of this contract award. You should:
A. Purchase as much Alpha Company stock as you can within the next two days
B. Tell family members to purchase the stock
C. Tell employees in the company to purchase the stock
D. Do nothing about stock purchases until after the formal announcement has been made

8. Your company has decided to cancel a contract with Beta Company. Only a handful of employees know about this upcoming cancellation. The announcement of the cancellation will be made in about two days. You own several shares of Beta Company stock and know full well that the stock will plunge on the bad news. You should:
A. Sell your stock as quickly as possible
B. Sell your stock and tell others whom you know own the stock to do the same thing
C. Tell the executives to sell their shares if they are stockowners
D. Do nothing until after the formal announcement is made

9. You are performing a two-day quality audit of one of your suppliers. The supplier asks you to remain a few more days so that they can take you out deep-sea fishing and gambling at the local casino. You should:
A. Accept as long as you complete the audit within two days
B. Accept but take vacation time for fishing and gambling
C. Accept their invitation but at a later time so that it does not interfere with the audit
D. Gracefully decline their invitation

10. You have been assigned as the project manager for a large project in the Pacific Rim. This is a very important project for both your company and the client. In your first meeting with the client, you are presented with a very expensive gift for yourself and another expensive gift for your husband. You were told by your company that this is considered an acceptable custom when doing work in this country. You should:
A. Gracefully accept both gifts
B. Gracefully accept both gifts but report only your gift to your company
C. Gracefully accept both gifts and report both gifts to your company
D. Gracefully refuse both gifts.

11. Your company is looking at the purchase of some property for a new plant. You are part of the committee making the final decision. You discover that the owner of a local auto dealership from whom you purchase family cars owns one of the properties. The owner of the dealership tells you in confidence that he will give you a new model car to use for free for up to three years if your company purchases his property for the new plant. You should:
A. Say thank you and accept the offer
B. Remove yourself from the committee for conflict of interest

C. Report the matter to your superior, the project sponsor, or the corporate legal group for advice
D. Accept the offer as long as the car is in your spouse's name

12. Your company has embarked upon a large project (with you as project manager) and as an output from the project there will be some toxic waste as residue from the manufacturing operations. A subsidiary plan has been developed for the containment and removal of the toxic waste and no environmental danger exists. This information on toxic waste has not been made available to the general public as yet, and the general public does not appear to know about this waste problem. During an interview with local newspaper personnel you are discussing the new project and the question of environmental concerns comes up. You should:
A. Say there are no problems with environmental concerns
B. Say that you have not looked at the environmental issues problems as yet
C. Say nothing and ask for the next question
D. Be truthful and reply as delicately as possible

13. As a project manager, you establish a project policy that you, in advance of the meeting, review all handouts presented to your external customer during project status review meetings. While reviewing the handouts, you notice that one slide contains company confidential information. Presenting this information to the customer would certainly enhance good will. You should:
A. Present the information to the customer
B. Remove the confidential information immediately
C. Discuss the possible violation with senior management and the legal department before taking any action
D. First discuss the situation with the team member that created the slide and then discuss the possible violation with senior management and the legal department before taking any action

14. You are managing a project for an external client. Your company developed a new testing procedure to validate certain properties of a product and the new testing procedure was developed entirely with internal funds. Your company owns all of the intellectual property rights associated with the new test. The workers that developed the new test used one of the components developed for your current customer as part of the experimental process. The results using the new test showed that the component would actually exceed the customer's expectations. You should:
A. Show the results to the customer but do not discuss the fact that it came from the new test procedure
B. Do not show the results of the new test procedure since the customer's specifications call for use of the old test procedures
C. First change the customer's specifications and then show the customer the results
D. Discuss the release of this information with your legal department and senior management before taking any action

15. Using the same scenario as in the previous question, assume that the new test procedure that is expected to be more accurate than the old test procedure indicates that performance will not meet customer specifications whereas the old test indicates that customer specifications will be barely met. You should:
A. Present the old test results to the customer showing that specification requirements will be met
B. Show both sets of test results and explain that the new procedure is unproven technology
C. First change the customer's specifications and then show the customer the results

D. Discuss the release of this information with your legal department and senior management before taking any action

16. Your customer has demanded to see the "raw data" test results from last week's testing. Usually the test results are not released to customers until after the company reaches a conclusion on the meaning of the test results. Your customer has heard through the grapevine that the testing showed poor results. Management has left the entire decision up to you. You should:
A. Show the results and explain that it is simply raw data and that your company's interpretation of the results will be forthcoming
B. Withhold the information until after the results are verified
C. Stall for time even if it means lying to the customer
D. Explain to the customer your company's policy of not releasing raw data

17. One of your team members plays golf with your external customer's project manager. You discover that the employee has been feeding the customer company-sensitive information. You should:
A. Inform the customer that project information from anyone other than the project manager is not official until released by the project manager
B. Change the contractual terms and conditions and release the information
C. Remove the employee from your project team
D. Explain to the employee the ramifications of his actions and that he still represents the company when not at work; then report this as a violation

18. Your company has a policy that all company-sensitive material must be stored in locked filing cabinets at the end of each day. One of your employees has received several notices from the security office for violating this policy. You should:
A. Reprimand the employee
B. Remove the employee from your project
C. Ask the Human Resources Group to have the employee terminated
D. Counsel the employee as well as other team members on the importance of confidentiality and the possible consequences for violations

19. You have just received last month's earned-value information that must be shown to the customer in the monthly status review meeting. Last month's data showed unfavorable variances that exceeded the permissible threshold limits on time and cost variances. This was the result of a prolonged power outage in the manufacturing area. Your manufacturing engineer tells you that this is not a problem and next month you will be right on target on time and cost as you have been in the last five months. You should:
A. Provide the data to the customer and be truthful in the explanation of the variances
B. Adjust the variances so that they fall within the threshold limits since this problem will correct itself next month
C. Do not report any variances this month
D. Expand the threshold limits on the acceptable variances but do not tell the customer

20. You are working in a foreign country where it is customary for a customer to present gifts to the contractor's project manager throughout the project as a way of showing appreciation. Declining the gifts would be perceived by the customer as an insult. Your company has a policy on how to report gifts received. The *best* way to handle this situation would be to:
A. Refuse all gifts
B. Send the customer a copy of our company's policy on accepting gifts
C. Accept the gifts and report the gifts according to policy
D. Report all gifts even though the policy says that some gifts need not be reported

21. You are interviewing a candidate to fill a project management position in your company. On her resume, she states that she is a PMP®. One of your workers who knows the candidate informs you that she is not a PMP® yet but is planning to take the test next month and certainly expects to pass. You should:
A. Wait until she passes the exam before interviewing her
B. Interview her and ask her why she lied
C. Inform PMI® of the violation
D. Forget about it and hire her if she looks like the right person for the job

22. You are managing a multinational project from your office in Chicago. Half of your proj-ect team are from a foreign country but are living in Chicago while working on your proj-ect. These people inform you that two days during next week are national religious holidays in their country and they will be observing the holiday by not coming into work. You should:
A. Respect their beliefs and say nothing
B. Force them to work because they are in the United States where their holiday is not celebrated
C. Tell them that they must work noncompensated overtime when they return to work in order to make up the lost time
D. Remove them from the project team if possible

23. PMI® informs you that one of your team members who took the PMP® exam last week and passed may have had the answers to the questions in advance provided to him by some of your other team members who are also PMP®s and were tutoring him. PMI® is asking for your support in the investigation. You should:
A. Assist PMI® in the investigation of the violation
B. Call in the employee for interrogation and counseling
C. Call in the other team members for interrogation and counseling
D. Tell PMI® that it is their problem, not your problem

24. One of your team members has been with you for the past year since her graduation from college. The team member informs you that she is now a PMP® and shows you her certificate from PMI® acknowledging this. You wonder how she was qualified to take the exam since she had no prior work experience prior to joining your company one year ago. You should:
A. Report this to PMI® as a possible violation
B. Call in the employee for counseling
C. Ask the employee to surrender her PMP® credentials
D. Do nothing

25. Four companies have responded to your RFP. Each proposal has a different technical solution to your problem and each proposal states that the information in the proposal is company-proprietary knowledge and not to be shared with anyone. After evaluation of the proposals, you discover that the best technical approach is from the highest bidder. You are unhappy about this. You decide to show the proposal from the highest bidder to the lowest bidder to see if the lowest bidder can provide the same technical solution but at a lower cost. This situation is:
A. Acceptable since once the proposals are submitted to your company, you have unlimited access to the intellectual property in the proposals
B. Acceptable since all companies do this
C. Acceptable as long as you inform the high bidder that you are showing their proposal to the lowest bidder
D. Unacceptable and is a violation of the Code of Professional Conduct

ANSWERS

1. B
2. C
3. C
4. C
5. C
6. C
7. D
8. D
9. D
10. C
11. C
12. D
13. D
14. D
15. D
16. A
17. D
18. D
19. A
20. D
21. C
22. A
23. A
24. A
25. D

PROBLEMS

8–1 Beta Company has decided to modify its wage and salary administration program whereby line managers are evaluated for promotion and merit increases based on how well they have lived up to the commitments that they made to the project managers. What are the advantages and disadvantages of this approach?

8–2 How should a project manager handle a situation in which the functional employee (or functional manager) appears to have more loyalty to his profession, discipline, or expertise than to the project? Can a project manager also have this loyalty, say, on an R&D project?

8–3 Most wage and salary administrators contend that project management organizational structures must be "married" to the personnel evaluation process because personnel are always concerned with how they will be evaluated. Furthermore, converting from a traditional structure

to a project management structure cannot be accomplished without first considering performance evaluation. What are your feelings on this?

8–4 As part of the evaluation process for functional employees, each project manager submits a written, confidential evaluation report to the employee's department manager who, in turn, makes the final judgment. The employee is permitted to see only the evaluation from his department manager. Assume that the average department merit increase is 7 percent, and that the employee could receive the merit increases shown in the following table. How would he respond in each case?

Project Manager's Evaluation	Merit Increase, %	Credit or Blame to		Reason
		P.M.	Fct. Mgr.	
Excellent	5			
Excellent	7			
Excellent	9			
Average	5			
Average	7			
Average	9			
Poor	5			
Poor	7			
Poor	9			

8–5 Should the evaluation form in Figure 8–4 be shown to the employees?

8–6 Does a functional employee have the right to challenge any items in the project manager's nonconfidential evaluation form?

8–7 Some people contend that functional employees should be able to evaluate the effectiveness of the project manager after project termination. Design an evaluation form for this purpose.

8–8 Some executives feel that evaluation forms should not include cooperation and attitude. The executives feel that a functional employee will always follow the instructions of the functional manager, and therefore attitude and cooperation are unnecessary topics. Does this kind of thinking also apply to the indirect evaluation forms that are filled out by the project managers?

8–9 Consider a situation in which the project manager (a generalist) is asked to provide an evaluation of a functional employee (a specialist). Can the project manager effectively evaluate the functional employee on technical performance? If not, then on what information can the project manager base his evaluation? Can a grade-7 generalist evaluate a grade-12 specialist?

8–10 Gary has been assigned as a part-time, assistant project manager. Gary's duties are split between assistant project management and being a functional employee. In addition, Gary reports both vertically to his functional manager and horizontally to a project manager. As part of his project responsibilities, Gary must integrate activities between his department and two

other departments within his divison. His responsibilities also include writing a nonconfidential performance evaluation for all functional employees from all three departments that are assigned to his project. Can Gary effectively and honestly evaluate functional employees in his own department—people with whom he will be working side by side when the project is over? Should the project manager come to his rescue? Suppose Gary is a part-time project manager instead of a part-time assistant project manager. Can anyone come to his rescue now?

8–11 The following question was asked of executives: How do you know when to cut off research? The answers given: That's a good question, a very good question, and some people don't know when to cut it off. You have to have a feel; in some cases it depends on how much resource you have and whether you have enough resources to take a chance on sustaining research that may appear to be heading for a dead end. You don't know sometimes whether you're heading down the wrong path or not; sometimes it's pretty obvious you ought to shift directions—you've gone about as far as you can or you've taken it far enough that you can demonstrate to your own satisfaction that you just can't get there from here, or it's going to be very costly. You may discover that there are more productive ways to get around the barrier; you're always looking for faster ways. And it depends entirely on how creative the person is, whether he has tunnel vision, a very narrow vision, or whether he is fairly flexible in his conceptual thinking so that he can conceive of better ways to solve the problem. Discuss the validity of these remarks.

8–12 In a small company, can a functional manager act as director of engineering and director of project management at the same time?

8–13 In 2002, an electrical equipment manufacturer decentralized the organization, allowing each division manager to set priorities for the work in his division. The division manager of the R&D division selected as his number one priority project the development of low-cost methods for manufacturing. This project required support from the manufacturing division. The division manager for manufacturing did not assign proper resources, claiming that the results of such a project would not be realized for at least five years, and that he (the manufacturing manager) was worried only about the immediate profits. Can this problem be resolved and divisional decentralization still be maintained?

8–14 The executives of a company that produces electro-optical equipment for military use found it necessary to implement project management using a matrix. The project managers reported to corporate sales, and the engineers with the most expertise were promoted to project engineering. After the first year of operation, it became obvious to the executives that the engineering functional managers were not committed to the projects. The executives then made a critical decision. The functional employees selected by the line managers to serve on projects would report as a solid line to the project engineer and dotted to the line manager. The project engineers, who were selected for their technical expertise, were allowed to give technical direction and monetary rewards to the employees. Can this situation work? What happens if an employee has a technical question? Can he go to his line manager? Should the employees return to their former line managers at project completion? What are the authority/responsibility problems with this structure? What are the long-term implications?

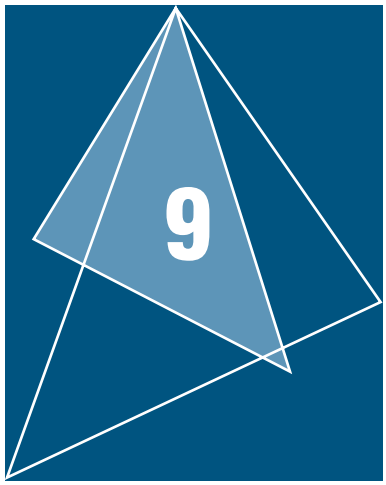
8–15 Consider the four items listed on page 123 that describe what happens when a matrix goes out of control. Which of these end up creating the greatest difficulty for the company? for the project managers? for the line managers? for executives?

8–16 As a functional employee, the project manager tells you, "Sign these prints or I'll fire you from this project." How should this situation be handled?

8–17 How efficient can project management be in a unionized, immobile manpower environment?

8–18 Corporate salary structures and limited annual raise allocations often prevent proper project management performance rewards. Explain how each of the following could serve as a motivational factor:

a. Job satisfaction
b. Personal recognition
c. Intellectual growth



The Variables for Success

Related Case Studies (from Kerzner/*Project Management Case Studies,* 3rd Edition)	Related Workbook Exercises (from Kerzner/*Project Management Workbook and PMP®/CAPM® Exam Study Guide,* 10th Edition)	PMBOK® Guide, 4th Edition, Reference Section for the PMP® Certification Exam
• Como Tool and Die (A) • Como Tool and Die (B)	• Multiple Choice Exam	• All PMBOK® Processes

9.0 INTRODUCTION

Project management cannot succeed unless the project manager is willing to employ the systems approach to project management by analyzing those variables that lead to success and failure. This chapter briefly discusses the dos and don'ts of project management and provides a "skeleton" checklist of the key success variables. The following four topics are included:

- Predicting project success
- Project management effectiveness
- Expectations

9.1 PREDICTING PROJECT SUCCESS

PMBOK® Guide, 4th Edition
3.2 Planning Process Group
Chapter 4 Project Integration
5.2 Define Scope

One of the most difficult tasks is predicting whether the project will be successful. Most goal-oriented managers look only at the time, cost, and performance parameters. If an out-of-tolerance condition exists, then additional analysis is required to identify the cause of the problem. Looking only at time, cost, and performance might identify immediate contributions to profits, but will not identify whether the project itself was managed correctly. This takes on paramount importance if the survival of the organization is based on a steady stream of successfully managed projects. Once or twice a program manager might be able to force a project to success by continually swinging a large baseball bat. After a while, however, either the effect of the big bat will become tolerable, or people will avoid working on his projects.

Project success is often measured by the "actions" of three groups: the project manager and team, the parent organization, and the customer's organization. There are certain actions that the project manager and team can take in order to stimulate project success. These actions include:

- Insist on the right to select key project team members.
- Select key team members with proven track records in their fields.
- Develop commitment and a sense of mission from the outset.
- Seek sufficient authority and a projectized organizational form.
- Coordinate and maintain a good relationship with the client, parent, and team.
- Seek to enhance the public's image of the project.
- Have key team members assist in decision-making and problem-solving.
- Develop realistic cost, schedule, and performance estimates and goals.
- Have backup strategies in anticipation of potential problems.
- Provide a team structure that is appropriate, yet flexible and flat.
- Go beyond formal authority to maximize influence over people and key decisions.
- Employ a workable set of project planning and control tools.
- Avoid overreliance on one type of control tool.
- Stress the importance of meeting cost, schedule, and performance goals.
- Give priority to achieving the mission or function of the end-item.
- Keep changes under control.
- Seek to find ways of assuring job security for effective project team members.

In Chapter 4 we stated that a project cannot be successful unless it is recognized asa project and has the support of top-level management. Top-level management must be willing to commit company resources and provide the necessary administrative support so that the project easily adapts to the company's day-to-day routine of doing business. Furthermore, the parent organization must develop an atmosphere conducive to good working relationships between the project manager, parent organization, and client organization.

With regard to the parent organization, there exist a number of variables that can be used to evaluate parent organization support. These variables include:

- A willingness to coordinate efforts
- A willingness to maintain structural flexibility
- A willingness to adapt to change
- Effective strategic planning
- Rapport maintenance
- Proper emphasis on past experience
- External buffering
- Prompt and accurate communications
- Enthusiastic support
- Identification to all concerned parties that the project does, in fact, contribute to parent capabilities

The mere identification and existence of these variables do not guarantee project success in dealing with the parent organization. Instead, they imply that there exists a good foundation with which to work so that if the project manager and team, and the parent organization, take the appropriate actions, project success is likely. The following actions must be taken:

- Select at an early point, a project manager with a proven track record of technical skills, human skills, and administrative skills (not necessarily in that order) to lead the project team.
- Develop clear and workable guidelines for the project manager.
- Delegate sufficient authority to the project manager, and let him make important decisions in conjunction with key team members.
- Demonstrate enthusiasm for and commitment to the project and team.
- Develop and maintain short and informal lines of communication.
- Avoid excessive pressure on the project manager to win contracts.
- Avoid arbitrarily slashing or ballooning the project team's cost estimate.
- Avoid "buy-ins."
- Develop close, not meddling, working relationships with the principal client contact and project manager.

Both the parent organization and the project team must employ proper managerial techniques to ensure that judicious and adequate, but not excessive, use of planning, controlling, and communications systems can be made. These proper management techniques must also include preconditioning, such as:

- Clearly established specifications and designs
- Realistic schedules
- Realistic cost estimates
- Avoidance of "buy-ins"
- Avoidance of overoptimism

The client organization can have a great deal of influence on project success by minimizing team meetings, making rapid responses to requests for information, and simply

letting the contractor "do his thing" without any interference. The variables that exist for the client organization include:

- A willingness to coordinate efforts
- Rapport maintenance
- Establishment of reasonable and specific goals and criteria
- Well-established procedures for changes
- Prompt and accurate communications
- Commitment of client resources
- Minimization of red tape
- Providing sufficient authority to the client contact (especially for decision-making)

With these variables as the basic foundation, it should be possible to:

- Encourage openness and honesty from the start from all participants
- Create an atmosphere that encourages healthy competition, but not cutthroat situations or "liars'" contests
- Plan for adequate funding to complete the entire project
- Develop clear understandings of the relative importance of cost, schedule, and technical performance goals
- Develop short and informal lines of communication and a flat organizational structure
- Delegate sufficient authority to the principal client contact, and allow prompt approval or rejection of important project decisions
- Reject "buy-ins"
- Make prompt decisions regarding contract award or go-ahead
- Develop close, not meddling, working relationships with project participants
- Avoid arms-length relationships
- Avoid excessive reporting schemes
- Make prompt decisions regarding changes

By combining the relevant actions of the project team, parent organization, and client organization, we can identify the fundamental lessons for management. These include:

- When starting off in project management, plan to go all the way.
  - Recognize authority conflicts—resolve.
  - Recognize change impact—be a change agent.
- Match the right people with the right jobs.
  - No system is better than the people who implement it.
- Allow adequate time and effort for laying out the project groundwork and defining work:
  - Work breakdown structure
  - Network planning
- Ensure that work packages are the proper size:
  - Manageable, with organizational accountability
  - Realistic in terms of effort and time

- Establish and use planning and control systems as the focal point of project implementation:
  - Know where you're going.
  - Know when you've gotten there.
- Be sure information flow is realistic:
  - Information is the basis for problem-solving and decision-making.
  - Communication "pitfalls" are the greatest contributor to project difficulties.
- Be willing to replan—do so:
  - The best-laid plans can often go astray.
  - Change is inevitable.
- Tie together responsibility, performance, and rewards:
  - Management by objectives
  - Key to motivation and productivity
- Long before the project ends, plan for its end:
  - Disposition of personnel
  - Disposal of material and other resources
  - Transfer of knowledge
  - Closing out work orders
  - Customer/contractor financial payments and reporting

The last lesson, project termination, has been the downfall for many good project managers. As projects near completion, there is a natural tendency to minimize costs by transferring people as soon as possible and by closing out work orders. This often leaves the project manager with the responsibility for writing the final report and transferring raw materials to other programs. Many projects require one or two months after work completion simply for administrative reporting and final cost summary.

Having defined project success, we can now identify some of the major causes for the failure of project management:

- *Selection of a concept that is not applicable.* Since each application is unique, selecting a project that does not have a sound basis, or forcing a change when the time is not appropriate, can lead to immediate failure.
- *Selection of the wrong person as project manager.* The individual selected must be more of a manager than a doer. He must place emphasis on all aspects of the work, not merely the technical.
- *Upper management that is not supportive.* Upper management must concur in the concept and must behave accordingly.
- *Inadequately defined tasks.* There must exist an adequate system for planning and control such that a proper balance between cost, schedule, and technical performance can be maintained.
- *Misused management techniques.* There exists the inevitable tendency in technical communities to attempt to do more than is initially required by contract. Technology must be watched, and individuals must buy only what is needed.
- *Project termination that is not planned.* By definition, each project must stop. Termination must be planned so that the impact can be identified.

9.2 PROJECT MANAGEMENT EFFECTIVENESS[1]

PMBOK® Guide, 4th Edition
Chapter 4 Integration Management
Chapter 9 Human Resources Management
Chapter 10 Communications Management

Project managers interact continually with upper-level management, perhaps more so than with functional managers. Not only the success of the project, but even the career path of the project manager can depend on the working relationships and expectations established with upper-level management. There are four key variables in measuring the effectiveness of dealing with upper-level management. These variables are credibility, priority, accessibility, and visibility:

- Credibility
  - Credibility comes from being a sound decision maker.
  - It is normally based on experience in a variety of assignments.
  - It is refueled by the manager and the status of his project.
  - Making success visible to others increases credibility.
  - To be believable, emphasize facts rather than opinions.
  - Give credit to others; they may return this favor.
- Priority
  - Sell the specific importance of the project to the objectives of the total organization.
  - Stress the competitive aspect, if relevant.
  - Stress changes for success.
  - Secure testimonial support from others—functional departments, other managers, customers, independent sources.
  - Emphasize "spin-offs" that may result from projects.
  - Anticipate "priority problems."
  - Sell priority on a one-to-one basis.
- Accessibility
  - Accessibility involves the ability to communicate directly with top management.
  - Show that your proposals are good for the total organization, not just the project.
  - Weigh the facts carefully; explain the pros and cons.
  - Be logical and polished in your presentations.
  - Become personally known by members of top management.
  - Create a desire in the "customer" for your abilities and your project.
  - Make curiosity work for you.
- Visibility
  - Be aware of the amount of visibility you really need.
  - Make a good impact when presenting the project to top management.
  - Adopt a contrasting style of management when feasible and possible.

1. This section and Section 9.3 are adapted from *Seminar in Project Management Workbook*, copyright 1977 by Hans J. Thamhain. Reproduced by permission of Dr. Hans J. Thamhain.

- Use team members to help regulate the visibility you need.
- Conduct timely "informational" meetings with those who count.
- Use available publicity media.

9.3 EXPECTATIONS

PMBOK® Guide, 4th Edition
Chapter 9 Human Resources Management
Chapter 10 Communications Management

In the project management environment, the project managers, team members, and upper-level managers each have expectations of what their relationships should be with the other parties. To illustrate this, top management expects project managers to:

- Assume total accountability for the success or failure to provide results
- Provide effective reports and information
- Provide minimum organizational disruption during the execution of a project
- Present recommendations, not just alternatives
- Have the capacity to handle most interpersonal problems
- Demonstrate a self-starting capacity
- Demonstrate growth with each assignment

At first glance, it may appear that these qualities are expected of all managers, not necessarily project managers. But this is not true. The first four items are different. The line managers are not accountable for total project success, just for that portion performed by their line organization. Line managers can be promoted on their technical ability, not necessarily on their ability to write effective reports. Line managers cannot disrupt an entire organization, but the project manager can. Line managers do not necessarily have to make decisions, just provide alternatives and recommendations.

Just as top management has expectations of project managers, project managers have certain expectations of top management. Project management expects top management to:

- Provide clearly defined decision channels
- Take actions on requests
- Facilitate interfacing with support departments
- Assist in conflict resolution
- Provide sufficient resources/charter
- Provide sufficient strategic/long-range information
- Provide feedback
- Give advice and stage-setting support
- Define expectations clearly
- Provide protection from political infighting
- Provide the opportunity for personal and professional growth

The project team also has expectations of their leader, the project manager. The project team expects the project manager to:

- Assist in the problem-solving process by coming up with ideas
- Provide proper direction and leadership
- Provide a relaxed environment
- Interact informally with team members
- Stimulate the group process
- Facilitate adoption of new members
- Reduce conflicts
- Defend the team against outside pressure
- Resist changes
- Act as the group spokesperson
- Provide representation with higher management

In order to provide high task efficiency and productivity, a project team should have certain traits and characteristics. A project manager expects the project team to:

- Demonstrate membership self-development
- Demonstrate the potential for innovative and creative behavior
- Communicate effectively
- Be committed to the project
- Demonstrate the capacity for conflict resolution
- Be results oriented
- Be change oriented
- Interface effectively and with high morale

Team members want, in general, to fill certain primary needs. The project manager should understand these needs before demanding that the team live up to his expectations. Members of the project team need:

- A sense of belonging
- Interest in the work itself
- Respect for the work being done
- Protection from political infighting
- Job security and job continuity
- Potential for career growth

Project managers must remember that team members may not always be able to verbalize these needs, but they exist nevertheless.

9.4 LESSONS LEARNED

PMBOK® Guide, 4th Edition
Professional Responsibility
Task #2—Contribute to the PM Knowledge Base

Lessons can be learned from each and every project, even if the project is a failure. But many companies do not document lessons learned because employees are reluctant to sign their names to documents that indicate they made mistakes. Thus employees end up repeating the mistakes that others have made.

Today, there is increasing emphasis on documenting lessons learned. Boeing maintains diaries of lessons learned on each airplane project. Another company conducts a post-implementation meeting where the team is required to prepare a three- to five-page case study documenting the successes and failures on the project. The case studies are then used by the training department in preparing individuals to become future project managers. Some companies even mandate that project managers keep project notebooks documenting all decisions as well as a project file with all project correspondence. On large projects, this may be impractical.

Most companies seem to prefer postimplementation meetings and case study documentation. The problem is when to hold the postimplementation meeting. One company uses project management for new product development and production. When the first production run is complete, the company holds a postimplementation meeting to discuss what was learned. Approximately six months later, the company conducts a second postimplementation meeting to discuss customer reaction to the product. There have been situations where the reaction of the customer indicated that what the company thought they did right turned out to be a wrong decision. A follow-up case study is now prepared during the second meeting.

9.5 UNDERSTANDING BEST PRACTICES

PMBOK® Guide, 4th Edition
Chapter 9 Human Resources Management
9.4 Manage Project Team

One of the benefits of understanding the variable of success is that it provides you with a means for capturing and retaining best practices. Unfortunately this is easier said than done. There are multiple definitions of a best practice, such as:

PMBOK® Guide, 4th Edition
Professional Responsibility
Task #2—Contribute to the PM Knowledge Base

- Something that works
- Something that works well
- Something that works well on a repetitive basis
- Something that leads to a competitive advantage
- Something that can be identified in a proposal to generate business

In the author's opinion, *best practices are those actions or activities undertaken by the company or individuals that lead to a sustained competitive advantage in project management.*

It has only been in recent years that the importance of best practices has been recognized. In the early years of project management, there were misconceptions concerning project management. Some of the misconceptions included:

- Project management is a scheduling tool such as PERT/CPM scheduling.
- Project management applies to large projects only.
- Project management is designed for government projects only.
- Project managers must be engineers and preferably with advanced degrees.
- Project managers need a "command of technology" to be successful.
- Project success is measured in technical terms only.

As project management evolved, best practices became important. Best practices can be learned from both successes and failures. In the early years of project management, private industry focused on learning best practices from successes. The government, however, focused on learning about best practices from failures. When the government finally focused on learning from successes, the knowledge on best practices came from their relationships with both their prime contractors and the subcontractors. Some of the best practices that came out of the government included:

- Use of life-cycle phases
- Standardization and consistency
- Use of templates for planning, scheduling, control, and risk
- Providing military personnel in project management positions with extended tours of duty at the same location
- Use of integrated project teams (IPTs)
- Control of contractor-generated scope changes
- Use of earned-value measurement (discussed in Chapter 15)

What to Do with a Best Practice?

With the definition that a best practice leads to a sustained competitive advantage, it is no wonder that some companies were reluctant to make their best practices known to the general public. Therefore, what should a company do with its best practices if not publicize them? The most common options available include:

- **Sharing Knowledge Internally Only:** This is accomplished using the company intranet to share information with employees. There may be a separate group within the company responsible for control of the information, perhaps even the project management officer (PMO).
- **Hidden from All But a Selected Few:** Some companies spend vast amounts of money on the preparation of forms, guidelines, templates, and checklists for project management. These documents are viewed as both company-proprietary information and best practices and are provided to only a select few on a need-to-know basis. An example of a "restricted" best practice might be specialized forms and templates for project approval wherein information contained within may be company-sensitive financial data or the company's position on profitability and market share.
- **Advertise to Your Customers:** In this approach, companies may develop a best practices brochure to market their achievements and may also maintain an extensive best practices library that is shared with their customers after contract award.

Even though companies collect best practices, not all best practices are shared outside of the company, even during benchmarking studies where all parties are expected to share information. Students often ask why textbooks do not include more information on detailed best practices such as forms and templates. One company commented to the author:

> We must have spent at least $1 million over the last several years developing an extensive template on how to evaluate the risks associated with transitioning a project from engineering to

manufacturing. Our company would not be happy giving this template to everyone who wants to purchase a book for $80. Some best practices templates are common knowledge and we would certainly share this information. But we view the transitioning template as proprietary knowledge not to be shared.

Critical Questions

There are several questions that must be addressed before an activity is recognized as a best practice. Three frequently asked questions are:

- Who determines that an activity is a best practice?
- How do you properly evaluate what you think is best practice to validate that in fact it is a true best practice?
- How do you get executives to recognize that best practices are true value-added activities and should be championed by executive management?

Some organizations have committees that have as their primary function the evaluation of potential best practices. Other organizations use the PMO to perform this work. These committees most often report to senior levels of management.

There is a difference between lessons learned and best practices. Lessons learned can be favorable or unfavorable, whereas best practices are usually favorable outcomes.

Evaluating whether or not something is a best practice is not time-consuming, but it is complex. Simply believing that an action is a best practice does not mean that it is a best practice. PMOs are currently developing templates and criteria for determining whether an activity may qualify as a best practice. Some items that may be included in the template are:

- Is it a measurable metric?
- Does it identify measurable efficiency?
- Does it identify measurable effectiveness?
- Does it add value to the company?
- Does it add value to the customers?
- Is it transferable to other projects?
- Does it have the potential for longevity?
- Is it applicable to multiple users?
- Does it differentiate us from our competitors?
- Will the best practice require governance?
- Will the best practice require employee training?
- Is the best practice company proprietary knowledge?

One company had two unique characteristics in its best practices template:

- Helps to avoid failure
- In a crisis, helps to resolve a critical situation

Executives must realize that these best practices are, in fact, intellectual property to benefit the entire organization. If the best practice can be quantified, then it is usually easier to convince senior management.

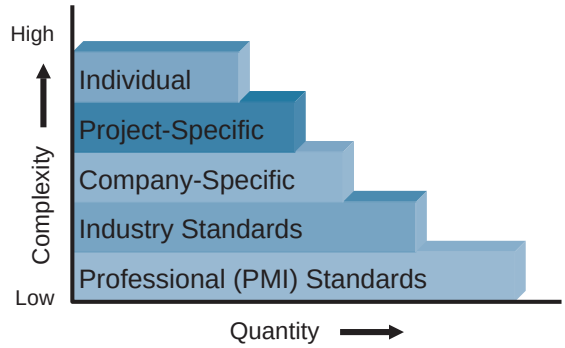


FIGURE 9–1. Levels of best practices.

Levels of Best Practices

Best practices can be discovered anywhere within or outside an organization. Figure 9–1 shows various levels of best practices. The bottom level is the professional standards level, which would include professional standards as defined by PMI®. The professional standards level contains the greatest number of best practices, but they are general rather than specific and have a low level of complexity.

The industry standards level identifies best practices related to performance within the industry. For example, the automotive industry has established standards and best practices specific to the auto industry.

As we progress to the individual best practices in Figure 9–1, the complexity of the best practices goes from general to very specific applications and, as expected, the quantity of best practices is less. An example of a best practice at each level might be (from general to specific):

- **Professional Standards:** Preparation and use of a risk management plan, including templates, guidelines, forms, and checklists for risk management.
- **Industry-Specific:** The risk management plan includes industry best practices such as the best way to transition from engineering to manufacturing.
- **Company-Specific:** The risk management plan identifies the roles and interactions of engineering, manufacturing, and quality assurance groups during transition.
- **Project-Specific:** The risk management plan identifies the roles and interactions of affected groups as they relate to a specific product/service for a customer.
- **Individual:** The risk management plan identifies the roles and interactions of affected groups based upon their personal tolerance for risk, possibly through the use of a responsibility assignment matrix prepared by the project manager.

Best practices can be extremely useful during strategic planning activities. As shown in Figure 9–2, the bottom two levels may be more useful for project strategy formulation whereas the top three levels are more appropriate for the execution of a strategy.

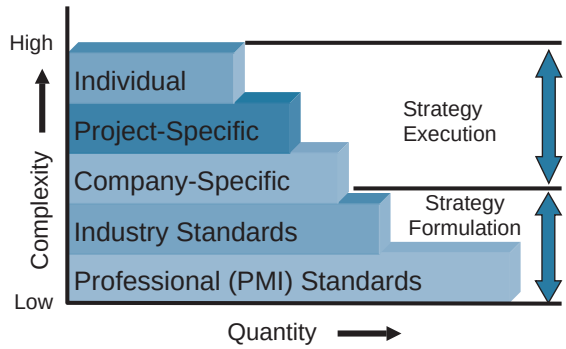


FIGURE 9–2. Usefulness of best practices.

Common Beliefs

There are several common beliefs concerning best practices. A partial list includes:

- Because best practices can be interrelated, the identification of one best practice can lead to the discovery of another best practice, especially in the same category or level of best practices.
- Because of the dependencies that can exist between best practices, it is often easier to identify categories of best practices rather than individual best practices.
- Best practices may not be transferable. What works well for one company may not work for another company.
- Even though some best practices seem simplistic and common sense in most companies, the constant reminder and use of these best practices lead to excellence and customer satisfaction.
- Best practices are not limited exclusively to companies in good financial health

Care must be taken that the implementation of a best practice does not lead to detrimental results. One company decided that the organization must recognize project management as a profession in order to maximize performance and retain qualified people. A project management career path was created and integrated into the corporate reward system.

Unfortunately the company made a severe mistake. Project managers were given significantly larger salary increases than line managers and workers. People became jealous of the project managers and applied for transfer into project management thinking that the "grass was greener." The company's technical prowess diminished and some people resigned when not given the opportunity to become project managers.

Companies can have the greatest intentions when implementing best practices and yet detrimental results can occur. Table 9–1 identifies some possible expectations and the detrimental results that can occur. The poor results could have been the result of poor expectations or not fully understanding the possible ramifications after implementation.

There are other reasons why best practices can fail or provide unsatisfactory results. These include:

- Lack of stability, clarity, or understanding of the best practice
- Failure to use best practices correctly
- Identifying a best practice that lacks rigor
- Identifying a best practice based upon erroneous judgment

Best Practices Library

With the premise that project management knowledge and best practices are intellectual property, how does a company retain this information? The solution is usually the creation of a best practices library. Figure 9–3 shows the three levels of best practices that seem most appropriate for storage in a best practices library.

Figure 9–4 shows the process of creating a best practices library. The bottom level is the discovery and understanding of what is or is not a "potential" best practice. The sources for potential best practices can originate anywhere within the organization.

The next level is the evaluation level to confirm that it is a best practice. The evaluation process can be done by the PMO or a committee but should have involvement by the senior levels of management. The evaluation process is very difficult because a one-time positive occurrence may not reflect a best practice. There must exist established criteria for the evaluation of a best practice.

Once it is agreed upon that a best practice exists, it must be classified and stored in some retrieval system such as a company intranet best practices library.

Figure 9–1 shows the levels of best practices, but the classification system for storage purposes can be significantly different. Figure 9–5 shows a typical classification system for a best practices library.

TABLE 9–1. RESULTS OF IMPLEMENTING BEST PRACTICES

Type of Best Practice	Expected Advantage	Potential Disadvantage
Use of traffic light reporting	Speed and simplicity	Poor accuracy of information
Use of a risk management template/form	Forward looking and accurate	Inability to see some potential critical risks
Highly detailed WBS	Control, accuracy, and completeness	Excessive control and cost of reporting
Using EPM on all projects	Standardization and consistency	Too expensive on certain projects
Using specialized software	Better decision-making	Too much reliance on tools

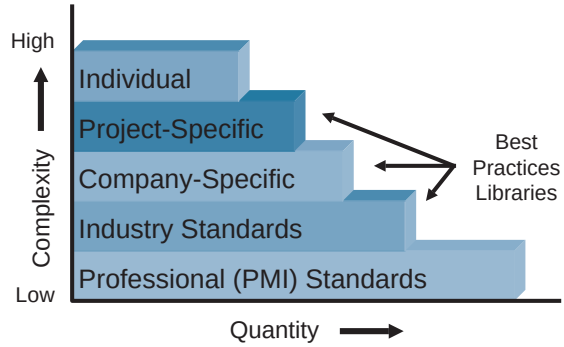


FIGURE 9–3. Levels of best practices.

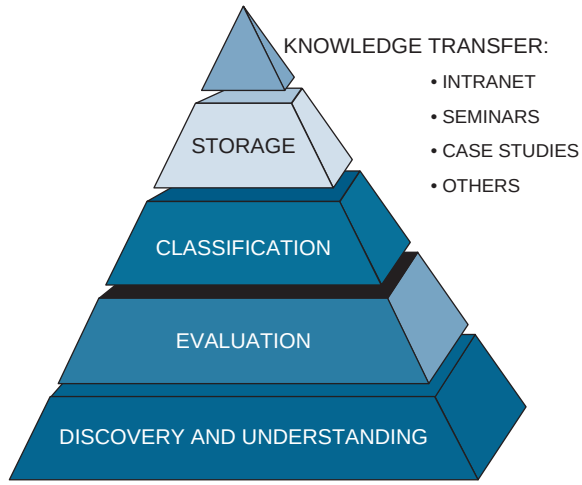


FIGURE 9–4. Creating a best practices library.

The purpose for creating a best practices library is to transfer knowledge to employees. The knowledge can be transferred through the company intranet, seminars on best practices, and case studies. Some companies require that the project team prepare case studies on lessons learned and best practices before the team is disbanded. These companies then use the case studies in company-sponsored seminars. Best practices and lessons learned must be communicated to the entire organization. The problem is determining how to do it effectively.

Another critical problem is best practices overload. One company started up a best practices library and, after a few years, had amassed hundreds of what were considered to be best practices. Nobody bothered to reevaluate whether or not all of these were still best practices. After reevaluation had taken place, it was determined that less than one-third of these were still regarded as best practices. Some were no longer best practices, others needed to be updated, and others had to be replaced with newer best practices.

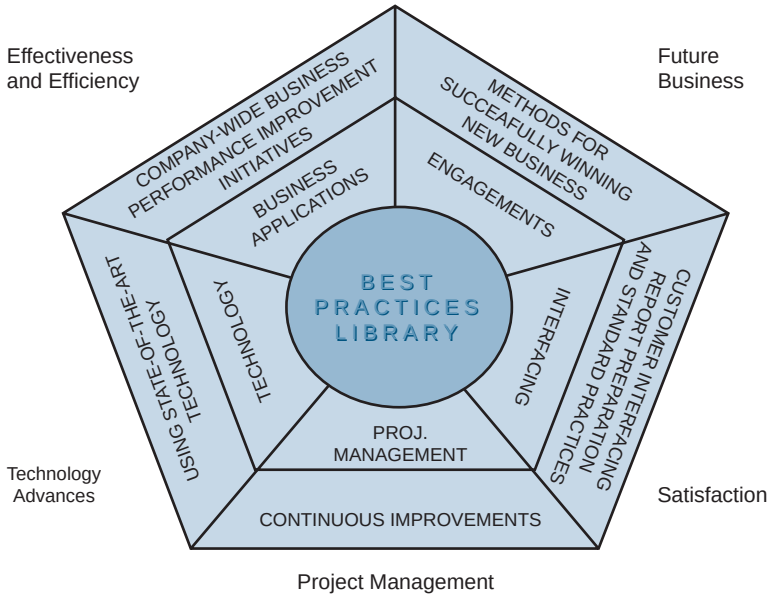


FIGURE 9–5. Best practices library.

9.6 STUDYING TIPS FOR THE PMI® PROJECT MANAGEMENT CERTIFICATION EXAM

This section is applicable as a review of the principles to support the knowledge areas and domain groups in the PMBOK® Guide. This chapter addresses:

- Communications Management
- Initiation
- Planning
- Execution
- Monitoring
- Closure

Understanding the following principles is beneficial if the reader is using this text to study for the PMP® Certification Exam:

- Importance of capturing and reporting best practices as part of all project management processes
- Variables for success

The following multiple-choice questions will be helpful in reviewing the principles of this chapter:

1. Lessons learned and best practices are captured:
A. Only at the end of the project
B. Only after execution is completed
C. Only when directed to do so by the project sponsor
D. At all times but primarily at the closure of each life-cycle phase

2. The person responsible for the identification of a best practice is the:
A. Project manager
B. Project sponsor
C. Team member
D. All of the above

3. The primary benefit of capturing lessons learned is to:
A. Appease the customer
B. Appease the sponsor
C. Benefit the entire company on a continuous basis
D. Follow the PMBOK® requirements for reporting

ANSWERS

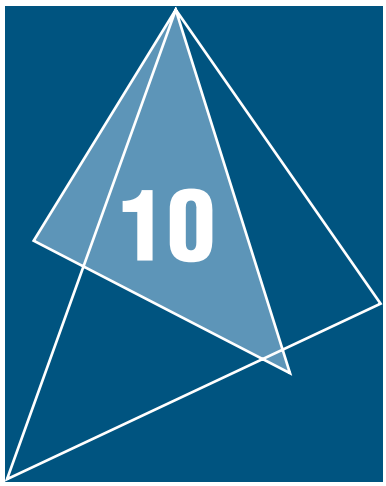
1. D
2. D
3. C

PROBLEMS

9–1 What is an effective working relationship between project managers themselves?

9–2 Must everyone in the organization understand the "rules of the game" for project management to be effective?

9–3 Defend the statement that the first step in making project management work must be a complete definition of the boundaries across which the project manager must interact.



Working with Executives

Related Case Studies (from Kerzner/*Project Management Case Studies*, 3rd Edition)	Related Workbook Exercises (from Kerzner/*Project Management Workbook and PMP®/CAPM® Exam Study Guide*, 10th Edition)	PMBOK® Guide, 4th Edition, Reference Section for the PMP® Certification Exam
• Greyson Corporation • The Blue Spider Project • Corwin Corporation*	• Multiple Choice Exam	• Integration Management • Scope Management • Human Resource Management

10.0 INTRODUCTION

PMBOK® Guide, 4th Edition
Chapter 4 Integration Management
Chapter 9 Human Resources Management Chapter

In any project management environment, project managers must continually interface with executives during both the planning and execution stages. Unless the project manager understands the executive's role and thought process, a poor working relationship will develop. In order to understand the executive–project interface, two topics are discussed:

- The project sponsor
- The in-house representatives

*Case Study also appears at end of chapter.

10.1 THE PROJECT SPONSOR

PMBOK® Guide, 4th Edition
2.3 Key Stakeholders
5.1.2 Stakeholder Analysis

For more than two decades, the traditional role of senior management, as far as projects were concerned, has been to function as project sponsors. The project sponsor usually comes from the executive levels and has the primary responsibility of maintaining executive–client contact. The sponsor ensures that the correct information from the contractor's organization is reaching executives in the customer's organization, that there is no filtering of information from the contractor to the customer, and that someone at the executive levels is making sure that the customer's money is being spent wisely. The project sponsor will normally transmit cost and deliverables information to the customer, whereas schedule and performance status data come from the project manager.

In addition to executive–client contact, the sponsor also provides guidance on:

- Objective setting
- Priority setting
- Project organizational structure
- Project policies and procedures
- Project master planning
- Up-front planning
- Key staffing
- Monitoring execution
- Conflict resolution

The role of the project sponsor takes on different dimensions based on the life-cycle phase the project is in. During the planning/initiation phase of a project, the sponsor normally functions in an active role, which includes such activities as:

- Assisting the project manager in establishing the correct objectives for the project
- Providing the project manager with information on the environmental/political factors that could influence the project's execution
- Establishing the priority for the project (either individually or through consultation with other executives) and informing the project manager of the established priority and the *reason* for the priority
- Providing guidance for the establishment of policies and procedures by which to govern the project
- Functioning as the executive–client contact point

During the initiation or kickoff phase of a project, the project sponsor must be actively involved in setting objectives and priorities. It is absolutely mandatory that the executives establish the priorities in both business and technical terms.

During the execution phase of the project, the role of the executive sponsor is more passive than active. The sponsor will provide assistance to the project manager on an as-needed basis except for routine status briefings.

During the execution stage of a project, the sponsor must be *selective* in the problems that he or she wishes to help resolve. Trying to get involved in every problem will not only result in severe micromanagement, but will undermine the project manager's ability to get the job done.

The role of the sponsor is similar to that of a referee. Table 10–1 shows the working relationship between the project manager and the line managers in both mature and immature organizations. When conflicts or problems exist in the project–line interface and cannot be resolved at that level, the sponsor might find it necessary to step in and provide assistance. Table 10–2 shows the mature and immature ways that a sponsor interfaces with the project.

PMBOK® Guide, 4th Edition
1.6 Interpersonal Skills

TABLE 10–1. THE PROJECT–LINE INTERFACE

Immature Organization	Mature Organization
• Project manager is vested with power/ authority over the line managers. • Project manager negotiates for best people. • Project manager works directly with functional employees. • Project manager has no input into employee performance evaluations. • Leadership is project manager-centered.	• Project and line managers share authority and power. • Project manager negotiates for line manager's commitment. • Project manager works through line managers. • Project manager makes recommendations to the line managers. • Leadership is team-centered.

TABLE 10–2. THE EXECUTIVE INTERFACE

Immature Organization	Mature Organization
• Executive is actively involved in projects. • Executive acts as the project champion. • Executive questions the project manager's decisions. • Priority shifting occurs frequently. • Executive views project management as a necessary evil. • There is very little project management support. • Executive discourages bringing problems upstairs. • Executive is not committed to project sponsorship. • Executive support exists only during project start-up. • Executive encourages project decisions to be made. • No procedures exist for assigning project sponsors. • Executives seek perfection. • Executive discourages use of a project charter. • Executive is not involved in charter preparation. • Executive does not understand what goes into a charter. • Executives do not believe that the project team is performing.	• Executive involvement is passive. • Executive acts as the project sponsor. • Executive trusts the project manager's decisions. • Priority shifting is avoided. • Executive views project management as beneficial. • There is visible, ongoing support. • Executive encourages bringing problems upstairs. • Executive is committed to sponsorship (and ownership). • Executive support exists on a continuous basis. • Executive encourages business decisions to be made. • Sponsorship assignment procedures are visible. • Executives seek what is possible. • Executive recognizes the importance of a charter. • Executive takes responsibility for charter preparation. • Executive understands the content of a charter. • Executives trust that performance is taking place.

It should be understood that the sponsor exists for everyone on the project, including the line managers and their employees. Project sponsors must maintain open-door policies, even though maintaining an open-door policy can have detrimental effects. First, employees may flood the sponsor with trivial items. Second, employees may feel that they can by-pass levels of management and converse directly with the sponsor. The moral here is that employees, including the project manager, must be encouraged to be careful about how many times and under what circumstances they "go to the well."

In addition to his/her normal functional job, the sponsor must be available to provide as-needed assistance to the projects. Sponsorship can become a time-consuming effort, especially if problems occur. Therefore, executives are limited as to how many projects they can sponsor effectively at the same time.

If an executive has to function as a sponsor on several problems at once, problems can occur such as:

- Slow decision-marking resulting in problem-solving delays
- Policy issues that remain unresolved and impact decisions
- Inability to prioritize projects when necessary

As an organization matures in project management, executives begin to trust middle- and lower-level management to function as sponsors. There are several reasons for supporting this:

- Executives do not have time to function as sponsors on each and every project.
- Not all projects require sponsorship from the executive levels.
- Middle management is closer to where the work is being performed.
- Middle management is in a better position to provide advice on certain risks.
- Project personnel have easier access to middle management.

Sometimes executives in large diversified corporations are extremely busy with strategic planning activities and simply do not have the time to properly function as a sponsor. In such cases, sponsorship falls one level below senior management.

Figure 10–1 shows the major functions of a project sponsor. At the onset of a project, a senior committee meets to decide whether a given project should be deemed as priority or nonpriority. If the project is critical or strategic, then the committee may assign a senior manager as the sponsor, perhaps even a member of the committee. It is common practice for steering committee executives to function as sponsors for the projects that the steering committee oversees.

For projects that are routine, maintenance, or noncritical, a sponsor could be assigned from the middle-management levels. One organization that strongly prefers to have middle management assigned as sponsors cites the benefit of generating an atmosphere of management buy-in at the critical middle levels.

Not all projects need a project sponsor. Sponsorship is generally needed on those projects that require a multitude of resources or a large amount of integration between functional lines or that have the potential for disruptive conflicts or the need for strong customer communications. This last item requires further comment. Quite often customers wish to make sure that the contractor's project manager is spending funds prudently.

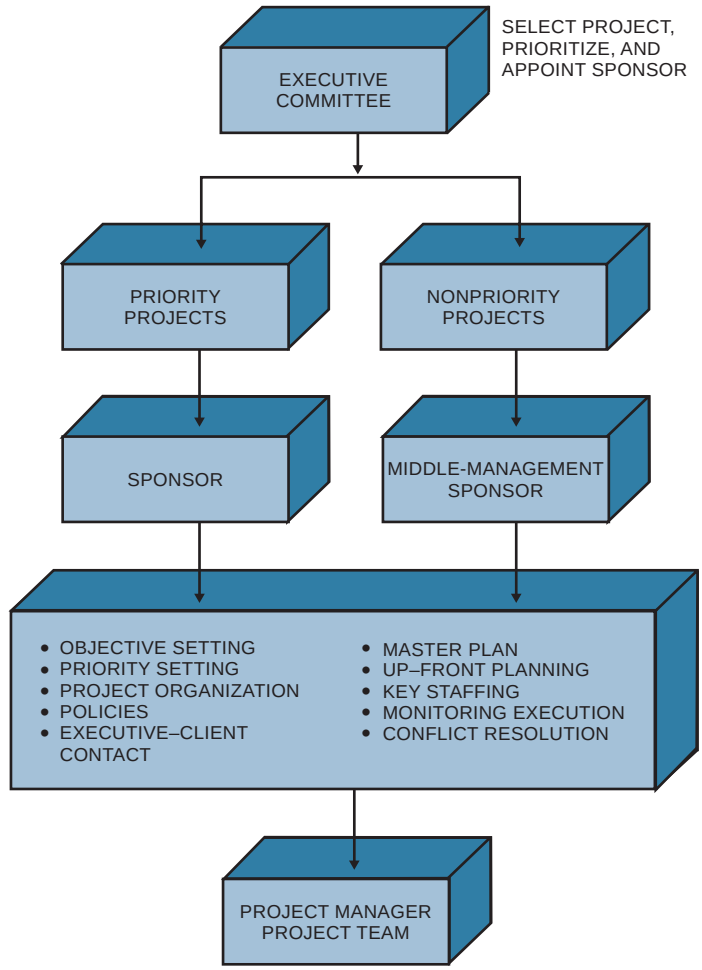


FIGURE 10–1. Project sponsorship.

Customers therefore like it when an executive sponsor supervises the project manager's funding allocation.

It is common practice for companies that are heavily involved in competitive bidding to identify in their proposal not only the resumé of the project manager, but the resumé of the executive project sponsor as well. This may give the bidder a competitive advantage, all other things being equal, because customers believe they have a direct path of communications to executive management. One such contractor identified the functions of the executive project sponsor as follows:

- Major participation in sales effort and contract negotiations
- Establishes and maintains top-level client relationships

- Assists project manager in getting the project underway (planning, procedures, staffing, etc.)
- Maintains current knowledge of major project activities (receives copies of major correspondence and reports, attends major client and project review meetings, visits project regularly, etc.)
- Handles major contractual matters
- Interprets company policy for the project manager
- Assists project manager in identifying and solving major problems
- Keeps general management and company management advised of major problems

Consider a project that is broken down into two life-cycle phases: planning and execution. For short-duration projects, say two years or less, it is advisable for the project sponsor to be the same individual for the entire project. For long-term projects of five years or so, it is possible to have a different project sponsor for each life-cycle phase, but preferably from the same level of management. The sponsor does not have to come from the same line organization as the one where the majority of the work will be taking place. Some companies even go so far as demanding that the sponsor come from a line organization that has no vested interest in the project.

The project sponsor is actually a "big brother" or advisor for the project manager. Under *no* circumstances should the project sponsor try to function as the project manager. The project sponsor should assist the project manager in solving those problems that the project manager cannot resolve by himself.

In one government organization, the project manager wanted to open up a new position on his project, and already had a woman identified to fill the position. Unfortunately, the size of the government project office was constrained by a unit-manning document that dictated the number of available positions.

The project manager obtained the assistance of an executive sponsor who, working with human resources, created a new position within thirty days. Without executive sponsorship, the bureaucratic system creating a new position would have taken months. By that time, the project would have been over.

In a second case study, the president of a medium-sized manufacturing company, a subsidiary of a larger corporation, wanted to act as sponsor on a special project. The project manager decided to make full use of this high-ranking sponsor by assigning him certain critical functions. As part of the project's schedule, four months were allocated to obtain corporate approval for tooling dollars. The project manager "assigned" this task to the project sponsor, who reluctantly agreed to fly to corporate headquarters. He returned two days later with authorization for tooling. The company actually reduced project completion time by four months, thanks to the project sponsor.

Figure 10–2 represents a situation where there were two project sponsors for one project. Alpha Company received a $25 million prime contractor project from the Air Force and subcontracted out $2 million to Beta Company. The project manager in Alpha Company earned $175,000 per year and refused to communicate directly with the project manager of Beta Company because his salary was only $90,000 per year. After all, as one executive said, "Elephants don't communicate with mice." The Alpha Company project manager instead sought out someone at Beta in his own salary range to act as the project sponsor, and the burden fell on the director of engineering.

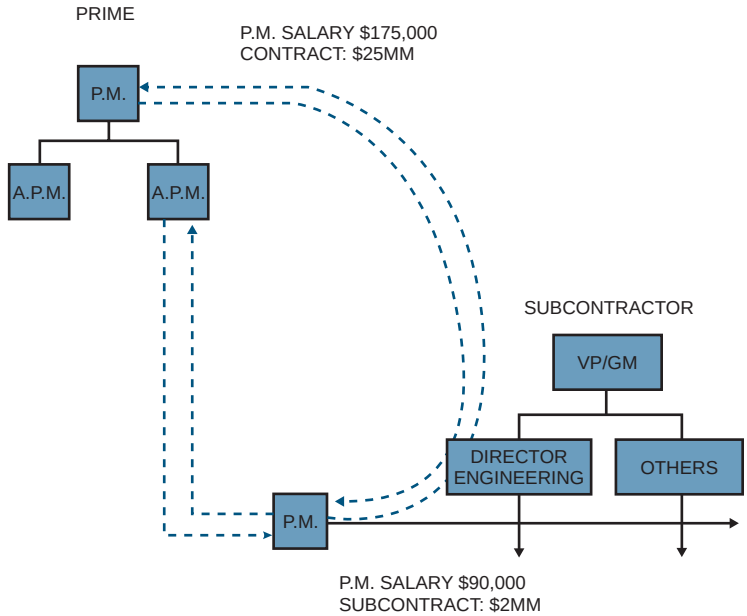


FIGURE 10–2. Multiple project sponsors.

The Alpha Company project manager reported to an Air Force colonel. The Air Force colonel considered his counterpart in Beta Company to be the vice president and general manager. Here, power and title were more important than the $100,000 differential in their salaries. Thus, there was one project sponsor for the prime contractor and a second project sponsor for the customer.

In some industries, such as construction, the project sponsor is identified in the proposal, and thus everyone knows who it is. Unfortunately, there are situations where the project sponsor is "hidden," and the project manager may not realize who it is, or know if the customer realizes who it is. This concept of invisible sponsorship occurs most frequently at the executive level and is referred to as absentee sponsorship.

There are several ways that invisible sponsorship can occur. The first is when the manager who is appointed as a sponsor refuses to act as a sponsor for fear that poor decisions or an unsuccessful project could have a negative impact on his or her career. The second type results when an executive really does not understand either sponsorship or project management and simply provides lip service to the sponsorship function. The third way involves an executive who is already overburdened and simply does not have the time to perform meaningfully as a sponsor. The fourth way occurs when the project manager refuses to keep the sponsor informed and involved. The sponsor may believe that everything is flowing smoothly and that he is not needed.

Some people contend that the best way for the project manager to work with an invisible sponsor is for the project manager to make a decision and then send a memo to the sponsor

stating "This is the decision that I have made and, unless I hear from you in the next 48 hours, I will assume that you agree with my decision."

The opposite extreme is the sponsor who micromanages. One way for the project manager to handle this situation is to bury the sponsor with work in hopes that he will let go. Unfortunately this could end up reinforcing the sponsor's belief that what he is doing is correct.

The better alternative for handling a micromanaging sponsor is to ask for role clarification. The project manager should try working with the sponsor to define the roles of project manager and project sponsor more clearly.

The invisible sponsor and the overbearing sponsor are not as detrimental as the "can't-say-no" sponsor. In one company, the executive sponsor conducted executive–client communications on the golf course by playing golf with the customer's sponsor. After every golf game, the executive sponsor would return with customer requests, which were actually scope changes that were considered as no-cost changes by the customer. When a sponsor continuously says "yes" to the customer, everyone in the contractor's organization eventually suffers.

Sometimes the existence of a sponsor can do more harm than good, especially if the sponsor focuses on the wrong objectives around which to make decisions. The following two remarks were made by two project managers at an appliance manufacturer:

- Projects here emphasize time measures: deadlines! We should emphasize milestones reached and quality. We say, "We'll get you a system by a deadline." We should be saying, "We'll get you a good system."
- Upper management may not allow true project management to occur. Too many executives are "date-driven" rather than "requirements-driven." Original target dates should be for broad planning only. Specific target dates should be set utilizing the full concept of project management (i.e., available resources, separation of basic requirements from enhancements, technical and hardware constraints, unplanned activities, contingencies, etc.)

These comments illustrate the necessity of having a sponsor who understands project management rather than one who simply assists in decision-making. The goals and objectives of the sponsor must be aligned with the goals and objectives of the project, and they must be realistic. If sponsorship is to exist at the executive levels, the sponsor must be visible and constantly informed concerning the project status.

Committee Sponsorship

For years companies have assigned a single individual as the sponsor for a project. The risk was that the sponsor would show favoritism to his line group and suboptimal decision-making would occur. Recently, companies have begun looking at sponsorship by committee to correct this.

Committee sponsorship is common in those organizations committed to concurrent engineering and shortening product development time. Committees are comprised of middle managers from marketing, R&D, and operations. The idea is that the committee will be able to make decisions in the best interest of the company more easily than a single individual could.

Committee sponsorship also has its limitations. At the executive levels, it is almost impossible to find time when senior managers can convene. For a company with a large number of projects, committee sponsorship may not be a viable approach.

In time of crisis, project managers may need immediate access to their sponsors. If the sponsor is a committee, then how does the project manager get the committee to convene quickly? Also, individual project sponsors may be more dedicated than committees. Committee sponsorship has been shown to work well if one, and only one, member of the committee acts as the prime sponsor for a given project.

When to Seek Help

During status reporting, a project manager can wave either a red, yellow, or green flag. This is known as the "traffic light" reporting system, thanks in part to color printers. For each element in the status report, the project manager will illuminate one of three lights according to the following criteria:

- *Green light:* Work is progressing as planned. Sponsor involvement is not necessary.
- *Yellow light:* A potential problem may exist. The sponsor is informed but no action by the sponsor is necessary at this time.
- *Red light:* A problem exists that may affect time, cost, scope, or quality. Sponsor involvement is necessary.

Yellow flags are warnings that should be resolved at the middle levels of management or lower.

If the project manager waves a red flag, then the sponsor will probably wish to be actively involved. Red flag problems can affect the time, cost, or performance constraints of the project and an immediate decision must be made. The main function of the sponsor is to assist in making the best possible decision in a timely fashion.

Both project sponsors and project managers should not encourage employees to come to them with problems unless the employees also bring alternatives and recommendations. Usually, employees will solve most of their own problems once they prepare alternatives and recommendations.

Good corporate cultures encourage people to bring problems to the surface quickly for resolution. The quicker the potential problem is identified, the more opportunities are available for resolution.

A current problem plaguing executives is who determines the color of the light. Consider the following problem: A department manager had planned to perform 1000 hours of work in a given time frame but has completed only 500 hours at the end of the period. According to the project manager's calculation, the project is behind schedule, and he would prefer to have the traffic light colored yellow or red. The line manager, however, feels that he still has enough "wiggle room" in his schedule and that his effort will still be completed within time and cost, so he wants the traffic light colored green. Most executives seem to favor the line manager who has the responsibility for the deliverable. Although the project manager has the final say on the color of traffic light, it is most often based upon the previous working relationship between the two and the level of trust.

Some companies use more than three colors to indicate project status. One company also has an orange light for activities that are still being performed after the target milestone date.

The New Role of the Executive

As project management matures, executives decentralize project sponsorship to middle- and lower-level management. Senior management then takes on new roles such as:

- Establishing a Center for Excellence in project management
- Establishing a project office or centralized project management function
- Creating a project management career path
- Creating a mentorship program for newly appointed project managers
- Creating an organization committed to benchmarking best practices in project management in other organizations
- Providing strategic information for risk management

This last bullet requires further comment. Because of the pressure placed upon the project manager for schedule compression, risk management could very well become the single most critical skill for project managers. Executives will find it necessary to provide project management with strategic business intelligence, assist in risk identification, and evaluate or prioritize risk-handling options.

Active versus Passive Involvement

One of the questions facing senior management in the assigning of a project sponsor is whether or not the sponsor should have a vested interest in the project or be an impartial outsider. Table 10–3 shows the pros and cons of this. Sponsors that that do not have a vested interest in the project seem to function more as exit champions rather than project sponsors.

Managing Scope Creep

Technically oriented team members are motivated not only by meeting specifications, but also by exceeding them. Unfortunately, exceeding specifications can be quite costly. Project managers must monitor scope creep and develop plans for controlling scope changes.

PMBOK® Guide, 4th Edition
5.5 Scope Control
5.5.3.3 Change Control System

But what if it is the project manager who initiates scope creep? The project sponsor must meet periodically with the project manager to review the scope baseline changes or unauthorized changes may occur and significant cost increases will result, as shown in Situation 10–1 below:

TABLE 10–3. VESTED INTEREST OR NOT?

Vested Interest	Impartial
• Finance the fund-starved project	• Provide no funding and limited support
• Keep project alive	• Let project die
• Maximum protection from obstacles	• Limited protection from obstacles
• Fend off internal enemies	• Avoid politics and enemies
• Actively involved	• Go through motions
• Involved in personnel assignments	• Partial involvement in assignment

SITUATION 10–1: PINE LAKE AMUSEMENT PARK

After six years of debate, the board of directors of Pine Lake Amusement Park finally came to an agreement on the park's new aquarium. The aquarium would be built, at an estimated cost of $30 million and, between fundraising and bank loans, financing was possible.

After the drawings were completed and approved, the project was estimated as a two-year construction effort. Because of the project's complexity, a decision was made to have the project manager brought on board from the beginning of the design efforts, and to remain until six months after opening day. The project manager assigned was well known for his emphasis on details and his strong feelings for the aesthetic beauty of a ride or show.

The drawings were completed and a detailed construction cost estimate was undertaken. When the final cost estimate of $40 million was announced, the board of directors was faced with three alternatives: cancel the project, seek an additional $10 million in financing, or descope (i.e., reduce functionality of) the project. Additional funding was unacceptable and years of publicity on the future aquarium would be embarrassing for the board if the project were to be canceled. The only reasonable alternative was to reduce the project's scope.

After two months of intensive replanning, the project team proposed a $32 million aquarium. The board of directors agreed to the new design and the construction phase of the project began. The project manager was given specific instructions that cost overruns would not be tolerated.

At the end of the first year, more than $22 million had been spent. Not only had the project manager reinserted the scope that had been removed during the descoping efforts, but also additional scope creep had increased to the point where the final cost would now exceed $62 million. The new schedule now indicated a three-year effort. By the time that management held its review meetings with the project team, the changes had been made.

The Executive Champion

Executive champions are needed for those activities that require the implementation of change, such as a new corporate methodology for project management. Executive champions "drive" the implementation of project management down into the organization and accelerate its acceptance because their involvement implies executive-level support and interest.

10.2 HANDLING DISAGREEMENTS WITH THE SPONSOR

For years, we believed that the project sponsor had the final say on all decisions affecting the project. The sponsor usually had a vested interest in the project and was responsible for obtaining funding for the project. But what if the project manager believes that the sponsor has made the wrong decision? Should the project manager have a path for recourse action in such a situation?

There are several reasons why disagreements between the project manager and project sponsor will occur. First, the project sponsors may not have sufficient technical knowledge

or information to evaluate the risks of any potential decision. Second, sponsors may be heavily burdened with other activities and unable to devote sufficient time to sponsorship. Third, some companies prefer to assign sponsors who have no vested interest in the project in hopes of getting impartial decision-making. Finally, sponsorship may be pushed down to a middle-management level where the assigned sponsor may not have all of the business knowledge necessary to make the best decisions.

Project managers are expected to challenge the project's assumptions continuously. This could lead to trade-offs. It could also lead to disagreements and conflicts between the project manager and the project sponsor. In such cases, the conflict will be brought to the executive steering committee for resolution. Sponsors must understand that their decisions as a sponsor can and should be challenged by the project manager.

Recognizing that these conflicts can exist, companies are instituting executive steering committees or executive policy board committees to quickly resolve these disputes. Few conflicts ever make it to the executive steering committee, but those that do are usually severe and may expose the company to unwanted risks.

A common conflict that may end up at the executive steering committee level is when one party wants to cancel the project and the second party wants to continue. This situation occurred at a telecommunications company where the project manager felt that the project should be canceled but the sponsor wanted the project to continue because its termination would reflect poorly upon him. Unfortunately, the steering committee sided with the sponsor and let the project continue. The company squandered precious resources for several more months before finally terminating the project.

10.3 THE COLLECTIVE BELIEF

Some projects, especially very long-term projects, often mandate that a collective belief exist. The collective belief is a fervent, and perhaps blind, desire to achieve that can permeate the entire team, the project sponsor, and even the most senior levels of management. The collective belief can make a rational organization act in an irrational manner. This is particularly true if the project sponsor spearheads the collective belief.

When a collective belief exists, people are selected based upon their support for the collective belief. Nonbelievers are pressured into supporting the collective belief and team members are not allowed to challenge the results. As the collective belief grows, both advocates and nonbelievers are trampled. The pressure of the collective belief can outweigh the reality of the results.

There are several characteristics of the collective belief, which is why some large, high-technology projects are often difficult to kill:

- Inability or refusal to recognize failure
- Refusing to see the warning signs
- Seeing only what you want to see
- Fearful of exposing mistakes
- Viewing bad news as a personal failure

- Viewing failure as a sign of weakness
- Viewing failure as damage to one's career
- Viewing failure as damage to one's reputation

10.4 THE EXIT CHAMPION

Project sponsors and project champions do everything possible to make their project successful. But what if the project champions, as well as the project team, have blind faith in the success of the project? What happens if the strongly held convictions and the collective belief disregard the early warning signs of imminent danger? What happens if the collective belief drowns out dissent?

In such cases, an exit champion must be assigned. The exit champion sometimes needs to have some direct involvement in the project in order to have credibility, but direct involvement is not always a necessity. Exit champions must be willing to put their reputation on the line and possibly face the likelihood of being cast out from the project team. According to Isabelle Royer[1]:

> Sometimes it takes an individual, rather than growing evidence, to shake the collective belief of a project team. If the problem with unbridled enthusiasm starts as an unintended consequence of the legitimate work of a project champion, then what may be needed is a countervailing force—an exit champion. These people are more than devil's advocates. Instead of simply raising questions about a project, they seek objective evidence showing that problems in fact exist. This allows them to challenge—or, given the ambiguity of existing data, conceivably even to confirm—the viability of a project. They then take action based on the data.

The larger the project and the greater the financial risk to the firm, the higher up the exit champion should reside. If the project champion just happens to be the CEO, then someone on the board of directors or even the entire board of directors should assume the role of the exit champion. Unfortunately, there are situations where the collective belief permeates the entire board of directors. In this case, the collective belief can force the board of directors to shirk their responsibility for oversight.

Large projects incur large cost overruns and schedule slippages. Making the decision to cancel such a project, once it has started, is very difficult, according to David Davis[2]:

> The difficulty of abandoning a project after several million dollars have been committed to it tends to prevent objective review and recosting. For this reason, ideally an independent management team—one not involved in the projects development—should do the recosting

1. Isabelle Royer, "Why Bad Projects are So Hard to Kill," *Harvard Business Review*, February 2003, p.11; Copyright © 2003 by the Harvard Business School Publishing Corporation. All rights reserved.
2. David Davis, "New Projects: Beware of False Economics," *Harvard Business Review*, March–April 1985, pp.100–101; Copyright © 1985 by the President and Fellows of Harvard College. All rights reserved.

> and, if possible, the entire review. . . . If the numbers do not holdup in the review and recosting, the company should abandon the project. The number of bad projects that make it to the operational stage serves as proof that their supporters often balk at this decision.
>
> . . . Senior managers need to create an environment that rewards honesty and courage and provides for more decision making on the part of project managers. Companies must have an atmosphere that encourages projects to succeed, but executives must allow them to fail.

The longer the project, the greater the necessity for the exit champions and project sponsors to make sure that the business plan has "exit ramps" such that the project can be terminated before massive resources are committed and consumed. Unfortunately, when a collective belief exists, exit ramps are purposefully omitted from the project and business plans. Another reason for having exit champions is so that the project closure process can occur as quickly as possible. As projects approach their completion, team members often have apprehension about their next assignment and try to stretch out the existing project until they are ready to leave. In this case, the role of the exit champion is to accelerate the closure process without impacting the integrity of the project.

Some organizations use members of a portfolio review board to function as exit champions. Portfolio review boards have the final say in project selection. They also have the final say as to whether or not a project should be terminated. Usually, one member of the board functions as the exit champion and makes the final presentation to the remainder of the board.

10.5 THE IN-HOUSE REPRESENTATIVES

On high-risk, high-priority projects or during periods of mistrust, customers may wish to place in-house representatives in the contractor's plant. These representatives, if treated properly, are like additional project office personnel who are not supported by your budget. They are invaluable resources for reading rough drafts of reports and making recommendations as to how their company may wish to see the report organized.

In-house representatives are normally not situated in or near the contractor's project office because of the project manager's need for some degree of privacy. The exception would be in the design phase of a construction project, where it is imperative to design what the customer wants and to obtain quick decisions and approvals.

Most in-house representatives know where their authority begins and ends. Some companies demand that in-house representatives have a project office escort when touring the plant, talking to functional employees, or simply observing the testing and manufacturing of components.

It is possible to have a disruptive in-house representative removed from the company. This usually requires strong support from the project sponsor in the contractor's shop. The important point here is that executives and project sponsors must maintain proper contact with and control over the in-house representatives, perhaps more so than the project manager.

10.6 STUDYING TIPS FOR THE PMI® PROJECT MANAGEMENT CERTIFICATION EXAM

This section is applicable as a review of the principles to support the knowledge areas and domain groups in the PMBOK® Guide. This chapter addresses:

- Integration Management
- Scope Management
- Human Resources Management
- Initiation
- Planning
- Execution
- Monitoring
- Closure

Understanding the following principles is beneficial if the reader is using this text to study for the PMP® Certification Exam:

- Role of the executive sponsor or project sponsor
- That the project sponsor need not be at the executive levels
- That some projects have committee sponsorship
- When to bring a problem to the sponsor and what information to bring with you

In Appendix C, the following Dorale Products mini–case studies are applicable:

- Dorale Products (G) [Integration and Scope Management]

The following multiple-choice questions will be helpful in reviewing the principles of this chapter:

1. The role of the project sponsor during project initiation is to assist in:
   A. Defining the project's objectives in both business and technical terms
   B. Developing the project plan
   C. Performing the project feasibility study
   D. Performing the project cost-benefit analysis

2. The role of the project sponsor during project execution is to:
   A. Validate the project's objectives
   B. Validate the execution of the plan
   C. Make all project decisions
   D. Resolve problems/conflicts that cannot be resolved elsewhere in the organization

3. The role of the project sponsor during the closure of the project or a life-cycle phase of the project is to:
   A. Validate that the profit margins are correct
   B. Sign off on the acceptance of the deliverables
   C. Administer performance reviews of the project team members
   D. All of the above

ANSWERS

1. A
2. D
3. B

PROBLEMS

10–1 Should age have a bearing on how long it takes an executive to accept project management?

10–2 You have been called in by the executive management of a major utility company and asked to give a "selling" speech on why the company should go to project management. What are you going to say? What areas will you stress? What questions would you expect the executives to ask? What fears do you think the executives might have?

10–3 Some executives would prefer to have their project managers become tunnel-vision workaholics, with the project managers falling in love with their jobs and living to work instead of working to live. How do you feel about this?

10–4 Project management is designed to make effective and efficient use of resources. Most companies that adopt project management find it easier to underemploy and schedule overtime than to overemploy and either lay people off or drive up the overhead rate. A major electrical equipment manufacturer contends that with proper utilization of the project management concept, the majority of the employees who leave the company through either termination or retirement do not have to be replaced. Is this rationale reasonable?

10–5 The director of engineering services of R. P. Corporation believes that a project organizational structure of some sort would help resolve several of his problems. As part of the discussion, the director has made the following remarks: "All of our activities (or so-called projects if you wish) are loaded with up-front engineering. We have found in the past that time is the important parameter, not quality control or cost. Sometimes we rush into projects so fast that we have no choice but to cut corners, and, of course, quality must suffer."

What questions, if any, would you like to ask before recommending a project organizational form? Which form will you recommend?

10–6 How should a project manager react when he finds inefficiency in the functional lines? Should executive management become involved?

10–7 An electrical equipment manufacturing company has just hired you to conduct a three-day seminar on project management for sixty employees. The president of the company asks you to have lunch with him on the first day of the seminar. During lunch, the executive remarks, "I inherited the matrix structure when I took over. Actually I don't think it can work here, and I'm not sure how long I'll support it." How should you continue at this point?

10–8 Should project managers be permitted to establish prerequisites for top management regarding standard company procedures?

10–9 During the implementation of project management, you find that line managers are reluctant to release any information showing utilization of resources in their line function. How should this situation be handled, and by whom?

10–10 Corporate engineering of a large corporation usually assumes control of all plant expansion projects in each of its plants for all projects over $25 million. For each case below, discuss the ramifications of this, assuming that there are several other projects going on in each plant at the same time as the plant expansion project.

a. The project manager is supplied by corporate engineering and reports to corporate engineering, but all other resources are supplied by the plant manager.
b. The project manager is supplied by corporate but reports to the plant manager for the duration of the project.
c. The plant manager supplies the project manager, and the project manager reports "solid" to corporate and "dotted" to the plant manager for the duration of the project.

10–11 An aircraft company requires seven years from initial idea to full production of a military aircraft. Consider the following facts: engineering design requires a minimum of two years of R&D; manufacturing has a passive role during this time; and engineering builds its own prototype during the third year.

a. To whom in the organization should the program manager, project manager, and project engineering report? Does your answer depend on the life-cycle phase?
b. Can the project engineers be "solid" to the project manager and still be authorized by the engineering vice president to provide technical direction?
c. What should be the role of marketing?
d. Should there be a project sponsor?

10–12 Does a project sponsor have the right to have an in-house representative removed from his company?

10–13 An executive once commented that his company was having trouble managing projects, not because of a lack of tools and techniques, but because they (employees) did not know how to manage what they had. How does this relate to project management?

10–14 Ajax National is the world's largest machine tool equipment manufacturer. Its success is based on the experience of its personnel. The majority of its department managers are forty-five to fifty-five-year-old, nondegreed people who have come up from the ranks. Ajax has just hired several engineers with bachelors' and masters' degrees to control the project management and project engineering functions. Can this pose a problem? Are advanced-degreed people required because of the rapid rate of change of technology?

10–15 When does project management turn into overmanagement?

10–16 *Brainstorming at United Central Bank (Part I):* As part of the 1989 strategic policy plan for United Central Bank, the president, Joseph P. Keith, decided to embark on weekly "brainstorming meetings" in hopes of developing creative ideas that could lead to solutions to the bank's problems. The bank's executive vice president would serve as permanent chairman of the brainstorming committee. Personnel representation would be randomly selected under the constraint that 10 percent must be from division managers, 30 percent from department managers, 30 percent from section-level supervisors, and the remaining 30 percent from clerical and nonexempt personnel. President Keith further decreed that the brainstorming committee would criticize all ideas and submit only those that successfully passed the criticism test to upper-level management for review.

After six months, with only two ideas submitted to upper-level management (both ideas were made by division managers), Joseph Keith formed an inquiry committee to investigate the reasons

for the lack of interest by the brainstorming committee participants. Which of the following statements might be found in the inquiry committee report? (More than one answer is possible.)

a. Because of superior–subordinate relationships (i.e., pecking order), creativity is inhibited.
b. Criticism and ridicule have a tendency to inhibit spontaneity.
c. Good managers can become very conservative and unwilling to stick their necks out.
d. Pecking orders, unless adequately controlled, can inhibit teamwork and problem solving.
e. All seemingly crazy or unconventional ideas were ridiculed and eventually discarded.
f. Many lower-level people, who could have had good ideas to contribute, felt inferior.
g. Meetings were dominated by upper-level management personnel.
h. The meetings were held at inappropriate places and times.
i. Many people were not given adequate notification of meeting time and subject matter.

10–17 *Brainstorming at United Central Bank (Part II):* After reading the inquiry committee report, President Keith decided to reassess his thinking about brainstorming by listing the advantages and disadvantages. What are the arguments for and against brainstorming? If you were Joseph Keith, would you vote for or against the continuation of the brainstorming sessions?

10–18 *Brainstorming at United Central Bank (Part III):* President Keith evaluated all of the data and decided to give the brainstorming committee one more chance. What changes can Joseph Keith implement in order to prevent the previous problems from recurring?

10–19 Explain the meaning of the following proverb: "The first 10 percent of the work is accomplished with 90 percent of the budget. The second 90 percent of the work is accomplished with the remaining 10 percent of the budget."

10–20 You are a line manager, and two project managers (each reporting to a divisional vice president) enter your office soliciting resources. Each project manager claims that his project is top priority as assigned by his own vice president. How should you, as the line manager, handle this situation? What are the recommended solutions to keep this situation from recurring repeatedly?

10–21 Figure 10–3 shows the organizational structure for a new Environmental Protection Agency project. Alpha Company was one of three subcontractors chosen for the contract. Because this was a new effort, the project manager reported "dotted" to the board chairman, who was acting as the project sponsor. The vice president was the immediate superior to the project manager.

Because the project manager did not believe that Alpha Company maintained the expertise to do the job, he hired an outside consultant from one of the local colleges. Both the EPA and the prime contractor approved of the consultant, and the consultant's input was excellent.

The project manager's superior, the vice president, disapproved of the consultant, continually arguing that the company had the expertise internally. How should you, the project manager, handle this situation?

10–22 You are the customer for a twelve-month project. You have team meetings scheduled with your subcontractor on a monthly basis. The contract has a contractual requirement to prepare a twenty-five- to thirty-page handout for each team meeting. Are there any benefits for you, the customer, to see these handouts at least three to four days prior to the team meeting?

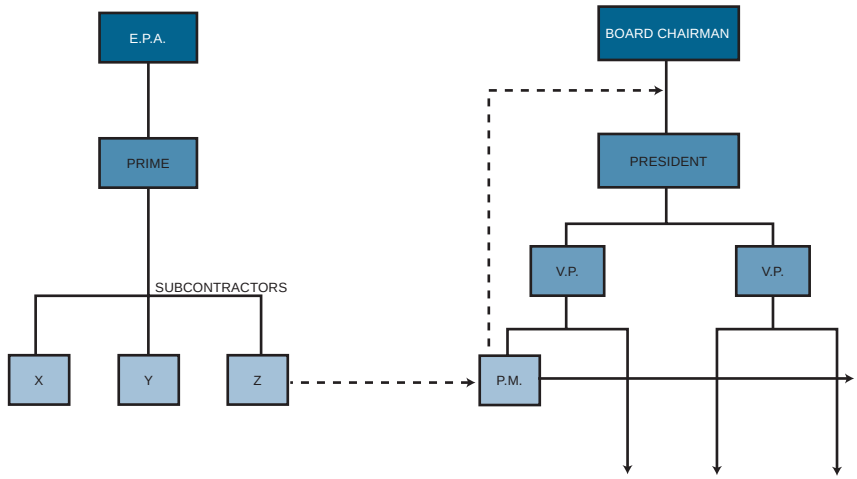


FIGURE 10–3. Organizational chart for EPA project.

10–23 You have a work breakdown structure (WBS) that is detailed to level 5. One level-5 work package requires that a technical subcontractor be selected to support one of the technical line organizations. Who should be responsible for customer–contractor communications: the project office or line manager? Does your answer depend on the life-cycle phase? The level of the WBS? Project manager's "faith" in the line manager?

10–24 Should a client have the right to communicate directly to the project staff (i.e., project office) rather than directly to the project manager, or should this be at the discretion of the project manager?

10–25 Your company has assigned one of its vice presidents to function as your project sponsor. Unfortunately, your sponsor refuses to make any critical decisions, always "passing the buck" back to you. What should you do? What are your alternatives and the pros and cons of each? Why might an executive sponsor act in this manner?

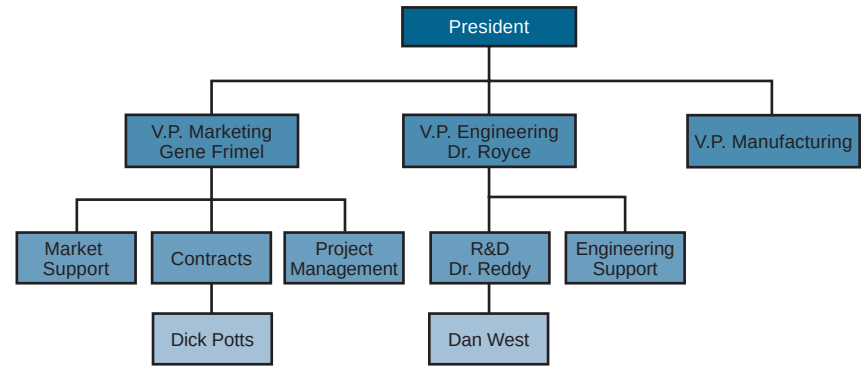
CASE STUDY

*CORWIN CORPORATION**

By June 2003, Corwin Corporation had grown into a $950 million per year corporation with an international reputation for manufacturing low-cost, high-quality rubber components. Corwin maintained more than a dozen different product lines, all of which were sold as off-the-shelf

*Revised, 2007.

Exhibit 10–1. Organizational chart for Corwin Corporation



items in department stores, hardware stores, and automotive parts distributors. The name "Corwin" was now synonymous with "quality." This provided management with the luxury of having products that maintained extremely long life cycles.

Organizationally, Corwin had maintained the same structure for more than fifteen years (see Exhibit 10–1). The top management of Corwin Corporation was highly conservative and believed in a marketing approach to find new markets for existing product lines rather than to explore for new products. Under this philosophy, Corwin maintained a small R&D group whose mission was simply to evaluate state-of-the-art technology and its application to existing product lines.

Corwin's reputation was so good that they continually received inquiries about the manufacturing of specialty products. Unfortunately, the conservative nature of Corwin's management created a "do not rock the boat" atmosphere opposed to taking any type of risks. A management policy was established to evaluate all specialty-product requests. The policy required answering the following questions:

- Will the specialty product provide the same profit margin (20 percent) as existing product lines?
- What is the total projected profitability to the company in terms of follow-on contracts?
- Can the specialty product be developed into a product line?
- Can the specialty product be produced with minimum disruption to existing product lines and manufacturing operations?

These stringent requirements forced Corwin to no-bid more than 90 percent of all specialty-product inquiries.

Corwin Corporation was a marketing-driven organization, although manufacturing often had different ideas. Almost all decisions were made by marketing with the exception of product pricing and estimating, which was a joint undertaking between manufacturing and marketing. Engineering was considered as merely a support group to marketing and manufacturing.

For specialty products, the project managers would always come out of marketing even during the R&D phase of development. The company's approach was that if the specialty product should mature into a full product line, then there should be a product line manager assigned right at the onset.

The Peters Company Project

In 2000, Corwin accepted a specialty-product assignment from Peters Company because of the potential for follow-on work. In 2001 and 2002, and again in 2003, profitable follow-on contracts were received, and a good working relationship developed, despite Peter's reputation for being a difficult customer to work with.

On December 7, 2002, Gene Frimel, the vice president of marketing at Corwin, received a rather unusual phone call from Dr. Frank Delia, the marketing vice president at Peters Company.

Delia: "Gene, I have a rather strange problem on my hands. Our R&D group has $250,000 committed for research toward development of a new rubber product material, and we simply do not have the available personnel or talent to undertake the project. We have to go outside. We'd like your company to do the work. Our testing and R&D facilities are already overburdened."

Frimel: "Well, as you know, Frank, we are not a research group even though we've done this once before for you. And furthermore, I would never be able to sell our management on such an undertaking. Let some other company do the R&D work and then we'll take over on the production end."

Delia: "Let me explain our position on this. We've been burned several times in the past. Projects like this generate several patents, and the R&D company almost always requires that our contracts give them royalties or first refusal for manufacturing rights."

Frimel: "I understand your problem, but it's not within our capabilities. This project, if undertaken, could disrupt parts of our organization. We're already operating lean in engineering."

Delia: "Look, Gene! The bottom line is this: We have complete confidence in your manufacturing ability to such a point that we're willing to commit to a five-year production contract if the product can be developed. That makes it extremely profitable for you."

Frimel: "You've just gotten me interested. What additional details can you give me?"

Delia: "All I can give you is a rough set of performance specifications that we'd like to meet. Obviously, some trade-offs are possible."

Frimel: "When can you get the specification sheet to me?"

Delia: "You'll have it tomorrow morning. I'll ship it overnight express."

Frimel: "Good! I'll have my people look at it, but we won't be able to get you an answer until after the first of the year. As you know, our plant is closed down for the last two weeks in December, and most of our people have already left for extended vacations."

Delia: "That's not acceptable! My management wants a signed, sealed, and delivered contract by the end of this month. If this is not done, corporate will reduce our budget for 2003 by $250,000, thinking that we've bitten off more than we can chew. Actually, I need your answer within forty-eight hours so that I'll have some time to find another source."

Frimel: "You know, Frank, today is December 7, Pearl Harbor Day. Why do I feel as though the sky is about to fall in?"

Delia: "Don't worry, Gene! I'm not going to drop any bombs on you. Just remember, all that we have available is $250,000, and the contract must be a firm-fixed-price effort. We anticipate a six-month project with $125,000 paid on contract signing and the balance at project termination."

Frimel: "I still have that ominous feeling, but I'll talk to my people. You'll hear from us with a go or no-go decision within forty-eight hours. I'm scheduled to go on a cruise in the Caribbean, and my wife and I are leaving this evening. One of my people will get back to you on this matter."

Gene Frimel had a problem. All bid and no-bid decisions were made by a four-man committee composed of the president and the three vice presidents. The president and the vice president for manufacturing were on vacation. Frimel met with Dr. Royce, the vice president of engineering, and explained the situation.

Royce: "You know, Gene, I totally support projects like this because it would help our technical people grow intellectually. Unfortunately, my vote never appears to carry any weight."

Frimel: "The profitability potential as well as the development of good customer relations makes this attractive, but I'm not sure we want to accept such a risk. A failure could easily destroy our good working relationship with Peters Company."

Royce: "I'd have to look at the specification sheets before assessing the risks, but I would like to give it a shot."

Frimel: "I'll try to reach our president by phone."

By late afternoon, Frimel was fortunate enough to be able to contact the president and received a reluctant authorization to proceed. The problem now was how to prepare a proposal within the next two or three days and be prepared to make an oral presentation to Peters Company.

Frimel: "The Boss gave his blessing, Royce, and the ball is in your hands. I'm leaving for vacation, and you'll have total responsibility for the proposal and presentation. Delia wants the presentation this weekend. You should have his specification sheets tomorrow morning."

Royce: "Our R&D director, Dr. Reddy, left for vacation this morning. I wish he were here to help me price out the work and select the project manager. I assume that, in this case, the project manager will come out of engineering rather than marketing."

Frimel: "Yes, I agree. Marketing should not have any role in this effort. It's your baby all the way. And as for the pricing effort, you know our bid will be for $250,000. Just work backwards to justify the numbers. I'll assign one of our contracting people to assist you in the pricing. I hope I can find someone who has experience in this type of effort. I'll call Delia and tell him we'll bid it with an unsolicited proposal."

Royce selected Dan West, one of the R&D scientists, to act as the project leader. Royce had severe reservations about doing this without the R&D director, Dr. Reddy, being actively involved. With Reddy on vacation, Royce had to make an immediate decision.

On the following morning, the specification sheets arrived and Royce, West, and Dick Potts, a contracts man, began preparing the proposal. West prepared the direct labor man-hours, and Royce provided the costing data and pricing rates. Potts, being completely unfamiliar with this type of effort, simply acted as an observer and provided legal advice when necessary. Potts allowed Royce to make all decisions even though the contracts man was considered the official representative of the president.

Finally completed two days later, the proposal was actually a ten-page letter that simply contained the cost summaries (see Exhibit 10–2) and the engineering intent. West estimated that *thirty tests* would be required. The test matrix described only the test conditions for the first

Exhibit 10–2. Proposal cost summaries

Direct labor and support	$ 30,000
Testing (30 tests at $2,000 each)	60,000
Overhead at 100%	90,000
Materials	30,000
G&A (general and administrative, 10%)	21,000
Total	$231,000
Profit	19,000
Total	$250,000

five tests. The remaining twenty-five test conditions would be determined at a later date, jointly by Peters and Corwin personnel.

On Sunday morning, a meeting was held at Peters Company, and the proposal was accepted. Delia gave Royce a letter of intent authorizing Corwin Corporation to begin working on the project immediately. The final contract would not be available for signing until late January, and the letter of intent simply stated that Peters Company would assume all costs until such time that the contract was signed or the effort terminated.

West was truly excited about being selected as the project manager and being able to interface with the customer, a luxury that was usually given only to the marketing personnel. Although Corwin Corporation was closed for two weeks over Christmas, West still went into the office to prepare the project schedules and to identify the support he would need in the other areas, thinking that if he presented this information to management on the first day back to work, they would be convinced that he had everything under control.

The Work Begins . . .

On the first working day in January 2003, a meeting was held with the three vice presidents and Dr. Reddy to discuss the support needed for the project. (West was not in attendance at this meeting, although all participants had a copy of his memo.)

Reddy: "I think we're heading for trouble in accepting this project. I've worked with Peters Company previously on R&D efforts, and they're tough to get along with. West is a good man, but I would never have assigned him as the project leader. His expertise is in managing internal rather than external projects. But, no matter what happens, I'll support West the best I can."

Royce: "You're too pessimistic. You have good people in your group and I'm sure you'll be able to give him the support he needs. I'll try to look in on the project every so often. West will still be reporting to you for this project. Try not to burden him too much with other work. This project is important to the company."

West spent the first few days after vacation soliciting the support that he needed from the other line groups. Many of the other groups were upset that they had not been informed earlier and were unsure as to what support they could provide. West met with Reddy to discuss the final schedules.

Reddy: "Your schedules look pretty good, Dan. I think you have a good grasp on the problem. You won't need very much help from me. I have a lot of work to do on other activities, so I'm just going to be in the background on this project. Just drop me a note every once in a while telling me what's going on. I don't need anything formal. Just a paragraph or two will suffice."

By the end of the third week, all of the raw materials had been purchased, and initial formulations and testing were ready to begin. In addition, the contract was ready for signature. The contract contained a clause specifying that Peters Company had the right to send an in-house representative into Corwin Corporation for the duration of the project. Peters Company informed Corwin that Patrick Ray would be the in-house representative, reporting to Delia, and would assume his responsibilities on or about February 15.

By the time Pat Ray appeared at Corwin Corporation, West had completed the first three tests. The results were not what was expected, but gave promise that Corwin was heading in the right direction. Pat Ray's interpretation of the tests was completely opposite to that of West. Ray thought that Corwin was "way off base," and redirection was needed.

Ray: "Look, Dan! We have only six months to do this effort and we shouldn't waste our time on marginally acceptable data. These are the next five tests I'd like to see performed."

West: "Let me look over your request and review it with my people. That will take a couple of days, and, in the meanwhile, I'm going to run the other two tests as planned."

Ray's arrogant attitude bothered West. However, West decided that the project was too important to "knock heads" with Ray and simply decided to cater to Ray the best he could. This was not exactly the working relationship that West expected to have with the in-house representative.

West reviewed the test data and the new test matrix with engineering personnel, who felt that the test data were inconclusive as yet and preferred to withhold their opinion until the results of the fourth and fifth tests were made available. Although this displeased Ray, he agreed to wait a few more days if it meant getting Corwin Corporation on the right track.

The fourth and fifth tests appeared to be marginally acceptable just as the first three were. Corwin's engineering people analyzed the data and made their recommendations.

West: "Pat, my people feel that we're going in the right direction and that our path has greater promise than your test matrix."

Ray: "As long as we're paying the bills, we're going to have a say in what tests are conducted. Your proposal stated that we would work together in developing the other test conditions. Let's go with my test matrix. I've already reported back to my boss that the first five tests were failures and that we're changing the direction of the project."

West: "I've already purchased $30,000 worth of raw materials. Your matrix uses other materials and will require additional expenditures of $12,000."

Ray: "That's your problem. Perhaps you shouldn't have purchased all of the raw materials until we agreed on the complete test matrix."

During the month of February, West conducted fifteen tests, all under Ray's direction. The tests were scattered over such a wide range that no valid conclusions could be drawn. Ray continued sending reports back to Delia confirming that Corwin was not producing beneficial results and there was no indication that the situation would reverse itself. Delia ordered Ray to take any steps necessary to ensure a successful completion of the project.

Ray and West met again as they had done for each of the past forty-five days to discuss the status and direction of the project.

Ray: "Dan, my boss is putting tremendous pressure on me for results, and thus far I've given him nothing. I'm up for promotion in a couple of months and I can't let this project stand in my way. It's time to completely redirect the project."

West: "Your redirection of the activities is playing havoc with my scheduling. I have people in other departments who just cannot commit to this continual rescheduling. They blame me for not communicating with them when, in fact, I'm embarrassed to."

Ray: "Everybody has their problems. We'll get this problem solved. I spent this morning working with some of your lab people in designing the next fifteen tests. Here are the test conditions."

West: "I certainly would have liked to be involved with this. After all, I thought I was the project manager. Shouldn't I have been at the meeting?"

Ray: "Look, Dan! I really like you, but I'm not sure that you can handle this project. We need some good results immediately, or my neck will be stuck out for the next four months. I don't want that. Just have your lab personnel start on these tests, and we'll get along fine. Also, I'm planning on spending a great deal of time in your lab area. I want to observe the testing personally and talk to your lab personnel."

West: "We've already conducted twenty tests, and you're scheduling another fifteen tests. I priced out only thirty tests in the proposal. We're heading for a cost-overrun condition."

Ray: "Our contract is a firm-fixed-price effort. Therefore, the cost overrun is your problem."

West met with Dr. Reddy to discuss the new direction of the project and potential cost overruns. West brought along a memo projecting the costs through the end of the third month of the project (see Exhibit 10–3).

Dr. Reddy: "I'm already overburdened on other projects and won't be able to help you out. Royce picked you to be the project manager because he felt that you could do the job. Now, don't let him down. Send me a brief memo next month explaining the situation, and I'll see what I can do. Perhaps the situation will correct itself."

Exhibit 10–3. Projected cost summary at the end of the third month

	Original Proposal Cost Summary for Six-Month Project	**Total Project Costs Projected at End of Third Month**
Direct labor/support	$ 30,000	$ 15,000
Testing	60,000 (30 tests)	70,000 (35 tests)
Overhead	90,000 (100%)	92,000 (120%)*
Materials	30,000	50,000
G&A	21,000 (10%)	22,700 (10%)
Totals	$231,000	$249,700

*Total engineering overhead was estimated at 100%, whereas the R&D overhead was 120%.

During the month of March, the third month of the project, West received almost daily phone calls from the people in the lab stating that Pat Ray was interfering with their job. In fact, one phone call stated that Ray had changed the test conditions from what was agreed on in the latest test matrix. When West confronted Ray on his meddling, Ray asserted that Corwin personnel were very unprofessional in their attitude and that he thought this was being carried down to the testing as well. Furthermore, Ray demanded that one of the functional employees be removed immediately from the project because of incompetence. West stated that he would talk to the employee's department manager. Ray, however, felt that this would be useless and said, "Remove him or else!" The functional employee was removed from the project.

By the end of the third month, most Corwin employees were becoming disenchanted with the project and were looking for other assignments. West attributed this to Ray's harassment of the employees. To aggravate the situation even further, Ray met with Royce and Reddy, and demanded that West be removed and a new project manager be assigned.

Royce refused to remove West as project manager, and ordered Reddy to take charge and help West get the project back on track.

Reddy: "You've kept me in the dark concerning this project, West. If you want me to help you, as Royce requested, I'll need all the information tomorrow, especially the cost data. I'll expect you in my office tomorrow morning at 8:00 A.M. I'll bail you out of this mess."

West prepared the projected cost data for the remainder of the work and presented the results to Dr. Reddy (see Exhibit 10–4). Both West and Reddy agreed that the project was now out of control, and severe measures would be required to correct the situation, in addition to more than $250,000 in corporate funding.

Reddy: "Dan, I've called a meeting for 10:00 A.M. with several of our R&D people to completely construct a new test matrix. This is what we should have done right from the start."

West: "Shouldn't we invite Ray to attend this meeting? I'm sure he'd want to be involved in designing the new test matrix."

Reddy: "I'm running this show now, not Ray!! Tell Ray that I'm instituting new policies and procedures for in-house representatives. He's no longer authorized to visit the labs at his own discretion. He must be accompanied by either you or me. If he doesn't like these rules, he can get out. I'm not going to allow that guy to disrupt our organization. We're spending our money now, not his."

Exhibit 10–4. Estimate of total project completion costs

Direct labor/support	$ 47,000*
Testing (60 tests)	120,000
Overhead (120%)	200,000
Materials	103,000
G&A	47,000
	$517,000
Peters contract	250,000
Overrun	$267,000

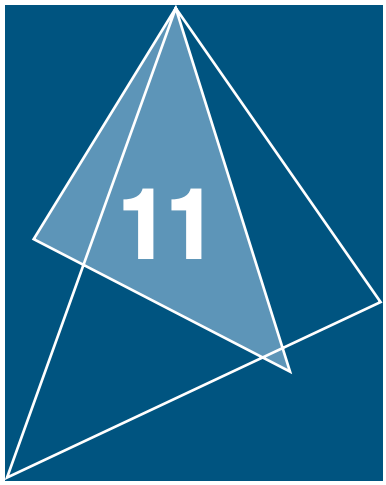
*Includes Dr. Reddy.

West met with Ray and informed him of the new test matrix as well as the new policies and procedures for in-house representatives. Ray was furious over the new turn of events and stated that he was returning to Peters Company for a meeting with Delia.

On the following Monday, Frimel received a letter from Delia stating that Peters Company was officially canceling the contract. The reasons given by Delia were as follows:

1. Corwin had produced absolutely no data that looked promising.
2. Corwin continually changed the direction of the project and did not appear to have a systematic plan of attack.
3. Corwin did not provide a project manager capable of handling such a project.
4. Corwin did not provide sufficient support for the in-house representative.
5. Corwin's top management did not appear to be sincerely interested in the project and did not provide sufficient executive-level support.

Royce and Frimel met to decide on a course of action in order to sustain good working relations with Peters Company. Frimel wrote a strong letter refuting all of the accusations in the Peters letter, but to no avail. Even the fact that Corwin was willing to spend $250,000 of their own funds had no bearing on Delia's decision. The damage was done. Frimel was now thoroughly convinced that a contract should not be accepted on "Pearl Harbor Day."



Planning

Related Case Studies (from Kerzner/*Project Management Case Studies*, 3rd Edition)	Related Workbook Exercises (from Kerzner/*Project Management Workbook and PMP®/CAPM® Exam Study Guide*, 10th Edition)	PMBOK® Guide, 4th Edition, Reference Section for the PMP® Certification Exam
• Quantum Telecom • Concrete Masonry Corporation* • Margo Company • Project Overrun • The Two-Boss Problem • Denver International Airport (DIA)	• The Statement of Work • Technology Forecasting • The Noncompliance Project • Multiple Choice Exam • Crossword Puzzle on Scope Management	• Scope Management

11.0 INTRODUCTION

PMBOK® Guide, 4th Edition
Chapter 5 Scope Management
5.2 Define Scope

The most important responsibilities of a project manager are planning, integrating, and executing plans. Almost all projects, because of their relatively short duration and often prioritized control of resources, require formal, detailed planning. The integration of the planning activities is

* Case Study also appears in Workbook.

necessary because each functional unit may develop its own planning documentation with little regard for other functional units.

Planning, in general, can best be described as the function of selecting the enterprise objectives and establishing the policies, procedures, and programs necessary for achieving them. Planning in a project environment may be described as establishing a predetermined course of action within a forecasted environment. The project's requirements set the major milestones. If line managers cannot commit because the milestones are perceived as unrealistic, the project manager may have to develop alternatives, one of which may be to move the milestones. Upper-level management must become involved in the selection of alternatives.

The project manager is the key to successful project planning. It is desirable that the project manager be involved from project conception through execution. Project planning must be *systematic, flexible* enough to handle unique activities, *disciplined* through reviews and controls, and capable of accepting *multifunctional* inputs. Successful project managers realize that project planning is an iterative process and must be performed throughout the life of the project.

PMBOK® Guide, 4th Edition
5.2 Define Scope

One of the objectives of project planning is to completely define all work required (possibly through the development of a documented project plan) so that it will be readily identifiable to each project participant. This is a necessity in a project environment because:

- If the task is well understood prior to being performed, much of the work can be preplanned.
- If the task is not understood, then during the actual task execution more knowledge is gained that, in turn, leads to changes in resource allocations, schedules, and priorities.
- The more uncertain the task, the greater the amount of information that must be processed in order to ensure effective performance.

These considerations are important in a project environment because each project can be different from the others, requiring a variety of different resources, but having to be performed under time, cost, and performance constraints with little margin for error. Figure 11–1 identifies the type of project planning required to establish an effective monitoring and control system. The boxes at the top represent the planning activities, and the lower boxes identify the "tracking" or monitoring of the planned activities.

There are two proverbs that affect project planning:

- Failing to plan is planning to fail.
- The primary benefit of not planning is that failure will then come as a complete surprise rather than being preceded by periods of worry and depression.

Without proper planning, programs and projects can start off "behind the eight ball." Consequences of poor planning include:

- Project initiation without defined requirements
- Wild enthusiasm
- Disillusionment
- Chaos
- Search for the guilty
- Punishment of the innocent
- Promotion of the nonparticipants

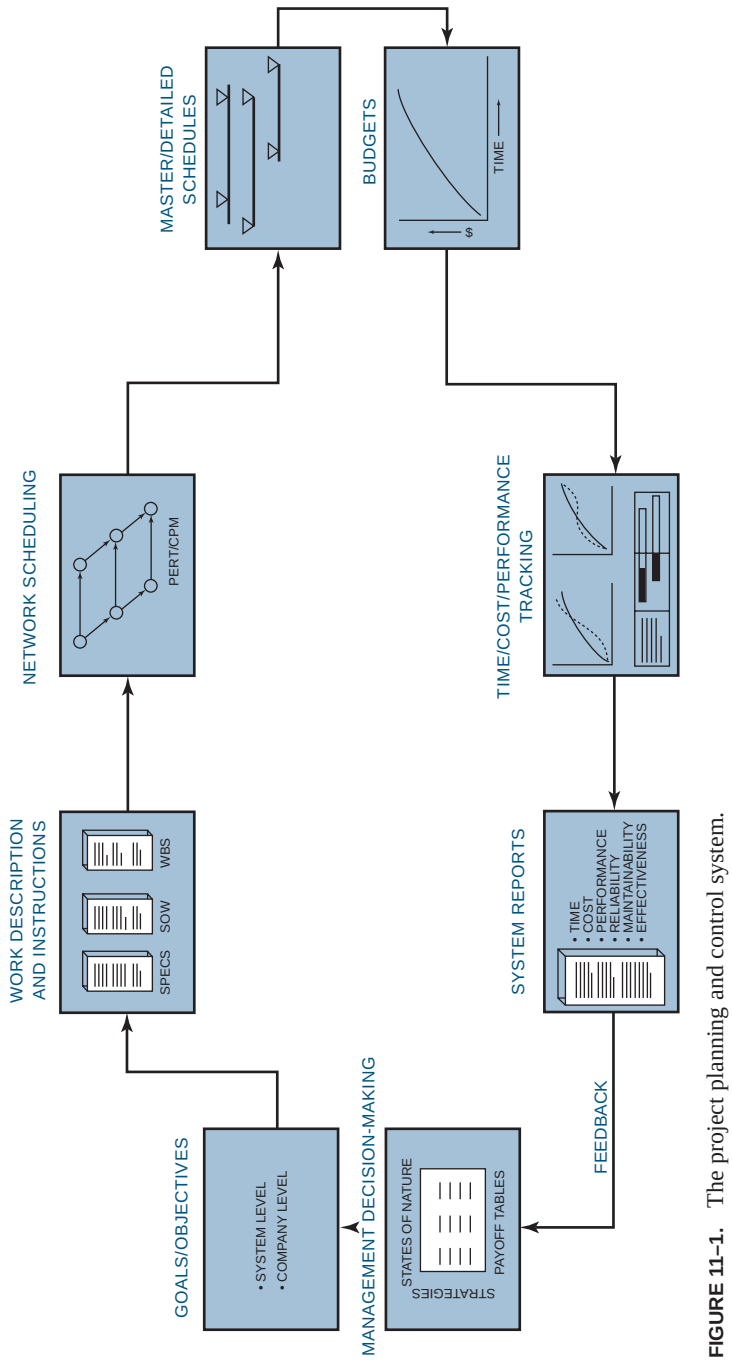


FIGURE 11–1. The project planning and control system.

There are four basic reasons for project planning:

- To eliminate or reduce uncertainty
- To improve efficiency of the operation
- To obtain a better understanding of the objectives
- To provide a basis for monitoring and controlling work

Planning is a continuous process of making entrepreneurial decisions with an eye to the future, and methodically organizing the effort needed to carry out these decisions. Furthermore, systematic planning allows an organization of set goals. The alternative to systematic planning is decision-making based on history. This generally results in reactive management leading to crisis management, conflict management, and fire fighting.

11.1 VALIDATING THE ASSUMPTIONS

Planning begins with an understanding of the assumptions. Quite often, the assumptions are made by marketing and sales personnel and then approved by senior management as part of the project selection and approval process. The expectations for the final results are based upon the assumptions made.

Why is it that, more often than not, the final results of a project do not satisfy senior management's expectations? At the beginning of a project, it is impossible to ensure that the benefits expected by senior management will be realized at project completion. While project length is a critical factor, the real culprit is changing assumptions.

Assumptions must be documented at project initiation using the project charter as a possible means. Throughout the project, the project manager must revalidate and challenge the assumptions. Changing assumptions may mandate that the project be terminated or redirected toward a different set of objectives.

A project management plan is based upon the assumptions described in the project charter. But there are additional assumptions made by the team that are inputs to the project management plan.[1] One of the primary reasons companies use a project charter is that project managers were most often brought on board well after the project selection process and approval process were completed. As a result, project managers were needed to know what assumptions were considered.

Enterprise Environmental Factors

These are assumptions about the external environmental conditions that can affect the success of the project, such as interest rates, market conditions, changing customer demands and requirements, changes in technology, and even government policies.

1. See *A Guide to the Project Management Body of Knowledge®*, 4th ed., 2008, Figure 4-4.

Organizational Process Assets

These are assumptions about present or future company assets that can impact the success of the project such as the capability of your enterprise project management methodology, the project management information system, forms, templates, guidelines, checklists, and the ability to capture and use lessons learned data and best practices.

11.2 GENERAL PLANNING

PMBOK® Guide, 4th Edition
Chapter 5 Scope Management
1.6 General Management Knowledge and Skills

Planning is determining what needs to be done, by whom, and by when, in order to fulfill one's assigned responsibility. There are nine major components of the planning phase:

- *Objective:* a goal, target, or quota to be achieved by a certain time
- *Program:* the strategy to be followed and major actions to be taken in order to achieve or exceed objectives
- *Schedule:* a plan showing when individual or group activities or accomplishments will be started and/or completed
- *Budget:* planned expenditures required to achieve or exceed objectives
- *Forecast:* a projection of what will happen by a certain time
- *Organization:* design of the number and kinds of positions, along with corresponding duties and responsibilities, required to achieve or exceed objectives
- *Policy:* a general guide for decision-making and individual actions
- *Procedure:* a detailed method for carrying out a policy
- *Standard:* a level of individual or group performance defined as adequate or acceptable

An item that has become important in recent years is documenting assumptions that go into the objectives or the project/subsidiary plans. As projects progress, even for short-term projects, assumptions can change because of the economy, technological advances, or market conditions. These changes can invalidate original assumptions or require that new assumptions be made. These changes could also mandate that projects be canceled. Companies are now validating assumptions during gate review meetings. Project charters now contain sections for documenting assumptions.

Several of these factors require additional comment. Forecasting what will happen may not be easy, especially if predictions of environmental reactions are required. For example, planning is customarily defined as either strategic, tactical, or operational. Strategic planning is generally for five years or more, tactical can be for one to five years, and operational is the here and now of six months to one year. Although most projects are operational, they can be considered as strategic, especially if spin-offs or follow-up work is promising. Forecasting also requires an understanding of strengths and weaknesses as found in:

- The competitive situation
- Marketing

- Research and development
- Production
- Financing
- Personnel
- The management structure

If project planning is strictly operational, then these factors may be clearly definable. However, if strategic or long-range planning is necessary, then the future economic outlook can vary, say, from year to year, and replanning must be done at regular intervals because the goals and objectives can change. (The procedure for this can be seen in Figure 11–1.)

The last three factors, policies, procedures, and standards, can vary from project to project because of their uniqueness. Each project manager can establish project policies, provided that they fall within the broad limits set forth by top management.

Project policies must often conform closely to company policies, and are usually similar in nature from project to project. Procedures, on the other hand, can be drastically different from project to project, even if the same activity is performed. For example, the signing off of manufacturing plans may require different signatures on two selected projects even though the same end-item is being produced.

Planning varies at each level of the organization. At the individual level, planning is required so that cognitive simulation can be established before irrevocable actions are taken. At the working group or functional level, planning must include:

- Agreement on purpose
- Assignment and acceptance of individual responsibilities
- Coordination of work activities
- Increased commitment to group goals
- Lateral communications

At the organizational or project level, planning must include:

- Recognition and resolution of group conflict on goals
- Assignment and acceptance of group responsibilities
- Increased motivation and commitment to organizational goals
- Vertical and lateral communications
- Coordination of activities between groups

The logic of planning requires answers to several questions in order for the alternatives and constraints to be fully understood. A list of questions would include:

- Prepare environmental analysis
  - Where are we?
  - How and why did we get here?

- Set objectives
  - Is this where we want to be?
  - Where would we like to be? In a year? In five years?
- List alternative strategies
  - Where will we go if we continue as before?
  - Is that where we want to go?
  - How could we get to where we want to go?
- List threats and opportunities
  - What might prevent us from getting there?
  - What might help us to get there?
- Prepare forecasts
  - Where are we capable of going?
  - What do we need to take us where we want to go?
- Select strategy portfolio
  - What is the best course for us to take?
  - What are the potential benefits?
  - What are the risks?
- Prepare action programs
  - What do we need to do?
  - When do we need to do it?
  - How will we do it?
  - Who will do it?
- Monitor and control
  - Are we on course? If not, why?
  - What do we need to do to be on course?
  - Can we do it?

One of the most difficult activities in the project environment is to keep the planning on target. These procedures can assist project managers during planning activities:

- Let functional managers do their own planning. Too often operators are operators, planners are planners, and never the twain shall meet.
- Establish goals before you plan. Otherwise short-term thinking takes over.
- Set goals for the planners. This will guard against the nonessentials and places your effort where there is payoff.
- Stay flexible. Use people-to-people contact, and stress fast response.
- Keep a balanced outlook. Don't overreact, and position yourself for an upturn.
- Welcome top-management participation. Top management has the capability to make or break a plan, and may well be the single most important variable.
- Beware of future spending plans. This may eliminate the tendency to underestimate.
- Test the assumptions behind the forecasts. This is necessary because professionals are generally too optimistic. Do not depend solely on one set of data.

- Don't focus on today's problems. Try to get away from crisis management and fire fighting.
- Reward those who dispel illusions. Avoid the Persian messenger syndrome (i.e., beheading the bearer of bad tidings). Reward the first to come forth with bad news.

11.3 LIFE-CYCLE PHASES

PMBOK® Guide, 4th Edition
Chapter 2 Project Life Cycle and Organization
2.1 Characteristics of Project Phases

Project planning takes place at two levels. The first level is the corporate cultural approach; the second method is the individual's approach. The corporate cultural approach breaks the project down into life-cycle phases, such as those shown in Table 2–6. The life-cycle phase approach is *not* an attempt to put handcuffs on the project manager but to provide a methodology for uniformity in project planning. Many companies, including government agencies, prepare checklists of activities that should be considered in each phase. These checklists are for consistency in planning. The project manager can still exercise his own planning initiatives within each phase.

A second benefit of life-cycle phases is control. At the end of each phase there is a meeting of the project manager, sponsor, senior management, and even the customer, to assess the accomplishments of this life-cycle phase and to get approval for the next phase. These meetings are often called critical design reviews, "on-off ramps," and "gates." In some companies, these meetings are used to firm up budgets and schedules for the follow-on phases. In addition to monetary considerations, life-cycle phases can be used for manpower deployment and equipment/facility utilization. Some companies go so far as to prepare project management policy and procedure manuals where all information is subdivided according to life-cycle phasing. Life-cycle phase decision points eliminate the problem where project managers do not ask for phase funding, but rather ask for funds for the whole project before the true scope of the project is known. Several companies have even gone so far as to identify the types of decisions that can be made at each end-of-phase review meeting. They include:

- Proceed with the next phase based on an approved funding level
- Proceed to the next phase but with a new or modified set of objectives
- Postpone approval to proceed based on a need for additional information
- Terminate project

Consider a company that utilizes the following life-cycle phases:

- Conceptualization
- Feasibility
- Preliminary planning
- Detail planning
- Execution
- Testing and commissioning

The conceptualization phase includes brainstorming and common sense and involves two critical factors: (1) identify and define the problem, and (2) identify and define potential solutions.

In a brainstorming session, *all* ideas are recorded and none are discarded. The brainstorming session works best if there is no formal authority present and if it lasts thirty to sixty minutes. Sessions over sixty minutes will produce ideas that may resemble science fiction.

The feasibility study phase considers the technical aspects of the conceptual alternatives and provides a firmer basis on which to decide whether to undertake the project.

The purpose of the feasibility phase is to:

- Plan the project development and implementation activities.
- Estimate the probable elapsed time, staffing, and equipment requirements.
- Identify the probable costs and consequences of investing in the new project.

If practical, the feasibility study results should evaluate the alternative conceptual solutions along with associated benefits and costs.

The objective of this step is to provide management with the predictable results of implementing a specific project and to provide generalized project requirements. This, in the form of a feasibility study report, is used as the basis on which to decide whether to proceed with the costly requirements, development, and implementation phases.

User involvement during the feasibility study is critical. The user must supply much of the required effort and information, and, in addition, must be able to judge the impact of alternative approaches. Solutions must be operationally, technically, and economically feasible. Much of the economic evaluation must be substantiated by the user. Therefore, the primary user must be highly qualified and intimately familiar with the workings of the organization and should come from the line operation.

The feasibility study also deals with the technical aspects of the proposed project and requires the development of conceptual solutions. Considerable experience and technical expertise are required to gather the proper information, analyze it, and reach practical conclusions.

Improper technical or operating decisions made during this step may go undetected or unchallenged throughout the remainder of the process. In the worst case, such an error could result in the termination of a valid project—or the continuation of a project that is not economically or technically feasible.

In the feasibility study phase, it is necessary to define the project's basic approaches and its boundaries or scope. A typical feasibility study checklist might include:

- Summary level
  - Evaluate alternatives
  - Evaluate market potential
  - Evaluate cost effectiveness
  - Evaluate producibility
  - Evaluate technical base
- Detail level
  - A more specific determination of the problem
  - Analysis of the state-of-the-art technology

- Assessment of in-house technical capabilities
- Test validity of alternatives
- Quantify weaknesses and unknowns
- Conduct trade-off analysis on time, cost, and performance

- Prepare initial project goals and objectives
- Prepare preliminary cost estimates and development plan

The end result of the feasibility study is a management decision on whether to terminate the project or to approve its next phase. Although management can stop the project at several later phases, the decision is especially critical at this point, because later phases require a major commitment of resources. All too often, management review committees approve the continuation of projects merely because termination at this point might cast doubt on the group's judgment in giving earlier approval.

The decision made at the end of the feasibility study should identify those projects that are to be terminated. Once a project is deemed feasible and is approved for development, it must be prioritized with previously approved projects waiting for development (given a limited availability of capital or other resources). As development gets under way, management is given a series of checkpoints to monitor the project's actual progress as compared to the plan.

The third life-cycle phase is either preliminary planning or "defining the requirements." This is the phase where the effort is officially defined as a project. In this phase, we should consider the following:

- General scope of the work
- Objectives and related background
- Contractor's tasks
- Contractor end-item performance requirements
- Reference to related studies, documentation, and specifications
- Data items (documentation)
- Support equipment for contract end-item
- Customer-furnished property, facilities, equipment, and services
- Customer-furnished documentation
- Schedule of performance
- Exhibits, attachments, and appendices

These elements can be condensed into four core documents, as will be shown in Section 11.7. Also, it should be noted that the word "customer" can be an internal customer, such as the user group or your own executives.

The table below shows the percentage of *direct* labor hours/dollars that are spent in each phase:

Phase	Percent of Direct Labor Dollars
Conceptualization	5
Feasibility study	10
Preliminary planning	15
Detail planning	20
Execution	40
Commissioning	10

The interesting fact from this table is that as much as 50 percent of the direct labor hours and dollars can be spent before execution begins. The reason for this is simple: Quality must be planned for and designed in. Quality cannot be inspected into the project. Companies that spend less than these percentages usually find quality problems in execution.

11.4 PROPOSAL PREPARATION

There is always a question of what to do with a project manager between assignments. For companies that survive on competitive bidding, the assignment is clear: The project manager writes proposals for future work. This takes place during the feasibility study, when the company must decide whether to bid on the job. There are four ways in which proposal preparation can occur:

- *Project manager prepares entire proposal.* This occurs frequently in small companies. In large organizations, the project manager may not have access to all available data, some of which may be company proprietary, and it may not be in the best interest of the company to have the project manager spend all of his time doing this.
- *Proposal manager prepares entire proposal*. This can work as long as the project manager is allowed to review the proposal before delivery to the customer and feels committed to its direction.
- *Project manager prepares proposal but is assisted by a proposal manager.* This is common, but again places tremendous pressure on the project manager.
- *Proposal manager prepares proposal but is assisted by a project manager.* This is the preferred method. The proposal manager maintains maximum authority and control until such time as the proposal is sent to the customer, at which point the project manager takes charge. The project manager is on board right from the start, although his only effort may be preparing the technical volume of the proposal and perhaps part of the management volume.

11.5 KICKOFF MEETINGS

The typical launch of a project begins with a kickoff meeting involving the major players responsible for planning, including the project manager, assistant project managers for certain areas of knowledge, subject matter experts (SME), and functional leads. A typical sequence is shown in Figure 11–2.

There can be multiple kickoff meetings based upon the size, complexity, and time requirements for the project. The major players are usually authorized by their functional areas to make decisions concerning timing, costs, and resource requirements.

Some of the items discussed in the initial kickoff meeting include:

- Wage and salary administration, if applicable
- Letting the employees know that their boss will be informed as to how well or how poorly they perform

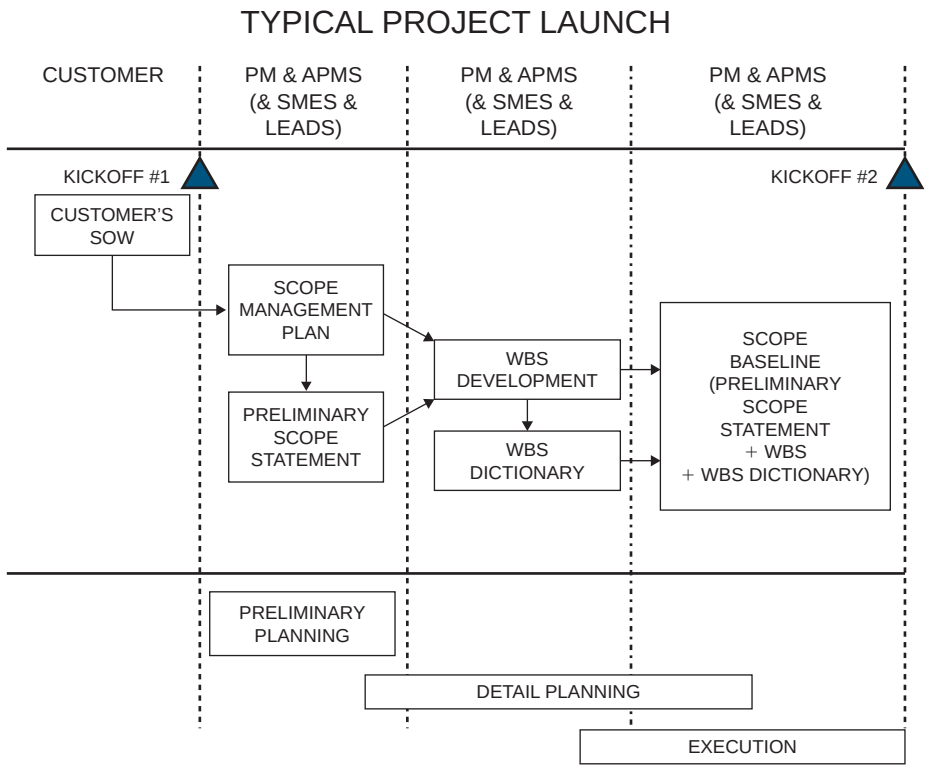


Figure 11–2. Typical project launch.

- Initial discussion of the scope of the project including both the technical objective and the business objective
- The definition of success on this project
- The assumptions and constraints as identified in the project charter
- The project's organizational chart (if known at that time)
- The participants' roles and responsibilities

For a small or short-term project, estimates on cost and duration may be established in the kickoff meeting. In this case, there may be little need to establish a cost estimating schedule. But where the estimating cycle is expected to take several weeks, and where inputs will be required from various organizations and/or disciplines, an essential tool is an estimating schedule. In this case, there may be a need for a prekickoff meeting simply to determine the estimates. The minimum key milestones in a cost estimating schedule are (1) a "kickoff" meeting; (2) a "review of ground rules" meeting; (3) "resources input and review" meeting; and (4) summary meetings and presentations. Descriptions of these meetings and their approximate places in the estimating cycle follow.[2]

2. R. D. Stewart, *Cost Estimating* (New York: Wiley, 1982), pp. 56–57.

The Prekickoff Meeting

The very first formal milestone in an estimate schedule is the estimate kickoff meeting. This is a meeting of all the individuals who are expected to have an input to the cost estimate. It usually includes individuals who are proficient in technical disciplines involved in the work to be estimated; business-oriented individuals who are aware of the financial factors to be considered in making the estimate; project-oriented individuals who are familiar with the project ground rules and constraints; and, finally, the cost estimator or cost estimating team. The estimating team may not include any of the team members responsible for execution of the project.

Sufficient time should be allowed in the kickoff meeting to describe all project ground rules, constraints, and assumptions; to hand out technical specifications, drawings, schedules, and work element descriptions and resource estimating forms; and to discuss these items and answer any questions that might arise. It is also an appropriate time to clarify estimating assignments among the various disciplines represented in the event that organizational charters are not clear as to who should support which part of the estimate. This kickoff meeting may be 6 weeks to 3 months prior to the estimate completion date to allow sufficient time for the overall estimating process. If the estimate is being made in response to a request for quotation or request for bid, copies of the request for quotation document will be distributed and its salient points discussed.

The Review of Ground Rules Meeting

Several days after the estimate kickoff meeting, when the participants have had the opportunity to study the material, a review of ground rules meeting should be conducted. In this meeting the estimate manager answers questions regarding the conduct of the cost estimate, assumptions, ground rules, and estimating assignments. If the members of the estimating team are experienced in developing resource estimates for their respective disciplines, very little discussion may be needed. However, if this is the first estimating cycle for one or more of the estimating team members, it may be necessary to provide these team members with additional information, guidance, and instruction on estimating tools and methods. If the individuals who will actually perform the work are doing the estimating (which is actually the best arrangement for getting a realistic estimate), more time and support may be needed than would experienced estimators.

The Resources Input and Review Meeting

Several weeks after the kickoff and review of ground rules meetings, each team member that has a resources (man-hour and/or materials) input is asked to present his or her input before the entire estimating team. Thus starts one of the most valuable parts of the estimating process: the interaction of team members to reduce duplications, overlaps, and omissions in resource data.

The most valuable aspect of a team estimate is the synergistic effect of team interaction. In any multidisciplinary activity, it is the synthesis of information and actions that produces wise decisions rather than the mere volume of data. In this review meeting the estimator of each discipline area has the opportunity to justify and explain the rationale for his estimates in view of his peers, an activity that tends to iron out inconsistencies, overstatements, and incompatibilities in resources estimates. Occasionally, inconsistencies, overlaps, duplications, and omissions will be so significant that a second input and review meeting will be required to collect and properly synthesize all inputs for an estimate.

Summary Meetings and Presentations

Once the resources inputs have been collected, adjusted, and "priced," the cost estimate is presented to the estimating team as a "dry run" for the final presentation to the company's management or to the requesting organization. This dry run can produce visibility into further inconsistencies or errors that have crept into the estimate during the process of consolidation and reconciliation. The final review with the requesting organization or with the company's management could also bring about some changes in the estimate due to last minute changes in ground rules or budget-imposed cost ceilings.

11.6 UNDERSTANDING PARTICIPANTS' ROLES

Companies that have histories of successful plans also have employees who fully understand their roles in the planning process. Good up-front planning may not eliminate the need for changes, but may reduce the number of changes required. The responsibilities of the major players are as follows:

- Project manager will define:
  - Goals and objectives
  - Major milestones
  - Requirements
  - Ground rules and assumptions
  - Time, cost, and performance constraints
  - Operating procedures
  - Administrative policy
  - Reporting requirements
- Line manager will define:
  - Detailed task descriptions to implement objectives, requirements, and milestones
  - Detailed schedules and manpower allocations to support budget and schedule
  - Identification of areas of risk, uncertainty, and conflict
- Senior management (project sponsor) will:
  - Act as the negotiator for disagreements between project and line management
  - Provide clarification of critical issues
  - Provide communication link with customer's senior management

Successful planning requires that project, line, and senior management are in agreement with the plan.

11.7 PROJECT PLANNING

PMBOK® Guide, 4th Edition
Chapter 5 Project Scope Management
5.2 Define Scope

Successful project management, whether in response to an in-house project or a customer request, must utilize effective planning techniques. The first step is understanding the project objectives. These goals may be to develop expertise in a given area, to become competitive, to modify an existing facility for later use, or simply to keep key personnel employed.

The objectives are generally not independent; they are all interrelated, both implicitly and explicitly. Many times it is not possible to satisfy all objectives. At this point, management must prioritize the objectives as to which are strategic and which are not. Typical problems with developing objectives include:

- Project objectives/goals are not agreeable to all parties.
- Project objectives are too rigid to accommodate changing priorities.
- Insufficient time exists to define objectives well.
- Objectives are not adequately quantified.
- Objectives are not documented well enough.
- Efforts of client and project personnel are not coordinated.
- Personnel turnover is high.

Once the objectives are clearly defined, four questions must be considered:

- What are the major elements of the work required to satisfy the objectives, and how are these elements interrelated?
- Which functional divisions will assume responsibility for accomplishment of these objectives and the major-element work requirements?
- Are the required corporate and organizational resources available?
- What are the information flow requirements for the project?

If the project is large and complex, then careful planning and analysis must be accomplished by both the direct- and indirect-labor-charging organizational units. The project organizational structure must be designed to fit the project; work plans and schedules must be established so that maximum allocation of resources can be made; resource costing and accounting systems must be developed; and a management information and reporting system must be established.

Effective total program planning cannot be accomplished unless all of the necessary information becomes available at project initiation. These information requirements are:

- The statement of work (SOW)
- The project specifications
- The milestone schedule
- The work breakdown structure (WBS)

The statement of work (SOW) is a narrative description of the work to be accomplished. It includes the objectives of the project, a brief description of the work, the funding constraint if one exists, and the specifications and schedule. The schedule is a “gross” schedule and includes such things as the:

- Start date
- End date
- Major milestones
- Written reports (data items)

Written reports should always be identified so that if functional input is required, the functional manager will assign an individual who has writing skills.

The last major item is the work breakdown structure. The WBS is the breaking down of the statement of work into smaller elements for better visibility and control. Each of these planning items is described in the following sections.

11.8 THE STATEMENT OF WORK

PMBOK® Guide, 4th Edition
5.2.3 Scope Definition
5.2.3.1 Project Scope Statement
12.1.3.2 Contract Statement of Work

The PMBOK® Guide addresses four elements related to scope:

- **Scope:** Scope is the summation of all deliverables required as part of the project. This includes all products, services, and results.
- **Project Scope:** This is the work that must be completed to achieve the final scope of the project, namely the products, services, and end results. (Previously, in Section 2.7, we differentiated between project scope and product scope.)
- **Scope Statement:** This is a document that provides the basis for making future decisions such as scope changes. The intended use of the document is to make sure that all stakeholders have a common knowledge of the project scope. Included in this document are the objectives, description of the deliverables, end result or product, and justification for the project. The scope statement addresses seven questions: who, what, when, why, where, how, and how many. This document validates the project scope against the statement of work provided by the customer.
- **Statement of Work:** This is a narrative description of the end results to be provided under the contract. For the remainder of this section, we will focus our attention on the statement of work.

The statement of work (SOW) is a narrative description of the work required for the project. The complexity of the SOW is determined by the desires of top management, the customer, and/or the user groups. For projects internal to the company, the SOW is prepared by the project office with input from the user groups because the project office is usually composed of personnel with writing skills.

For projects external to the organization, as in competitive bidding, the contractor may have to prepare the SOW for the customer because the customer may not have people trained in SOW preparation. In this case, as before, the contractor would submit the SOW to the customer for approval. It is also quite common for the project manager to rewrite a customer's SOW so that the contractor's line managers can price out the effort.

In a competitive bidding environment, there are two SOWs—the SOW used in the proposal and a contract statement of work (CSOW). There might also be a proposal WBS and a contract work breakdown structure (CWBS). Special care must be taken by contract and negotiation teams to discover all discrepancies between the SOW/WBS and CSOW/CWBS, or additional costs may be incurred. A good (or winning) proposal is *no guarantee* that the customer or contractor understands the SOW. For large projects, fact-finding is usually required before final negotiations because it is *essential* that both the customer and the

contractor understand and agree on the SOW, what work is required, what work is proposed, the factual basis for the costs, and other related elements. In addition, it is imperative that there be agreement between the final CSOW and CWBS.

SOW preparation is not as easy as it sounds. Consider the following:

- The SOW says that you are to conduct a *minimum* of fifteen tests to determine the material properties of a new substance. You price out twenty tests just to "play it safe." At the end of the fifteenth test, the customer says that the results are inconclusive and that you must run another fifteen tests. The cost overrun is $40,000.
- The Navy gives you a contract in which the SOW states that the prototype must be tested in "water." You drop the prototype into a swimming pool to test it. Unfortunately, the Navy's definition of "water" is the Atlantic Ocean, and it costs you $1 million to transport all of your test engineers and test equipment to the Atlantic Ocean.
- You receive a contract in which the SOW says that you must transport goods across the country using "aerated" boxcars. You select boxcars that have open tops so that air can flow in. During the trip, the train goes through an area of torrential rains, and the goods are ruined.

These three examples show that misinterpretations of the SOW can result in losses of hundreds of millions of dollars. Common causes of misinterpretation are:

- Mixing tasks, specifications, approvals, and special instructions
- Using imprecise language ("nearly," "optimum," "approximately," etc.)
- No pattern, structure, or chronological order
- Wide variation in size of tasks
- Wide variation in how to describe details of the work
- Failing to get third-party review

Misinterpretations of the statement of work can and will occur no matter how careful everyone has been. The result is creeping scope, or, as one telecommunications company calls it, "creeping elegance." The best way to control creeping scope is with a good definition of the requirements up front, if possible.

Today, both private industry and government agencies are developing manuals on SOW preparation. The following is adapted from a NASA publication on SOW preparation[3]:

- The project manager or his designees should review the documents that authorize the project and define its objectives, and also review contracts and studies leading to the present level of development. As a convenience, a bibliography of related studies should be prepared together with samples of any similar SOWs, and compliance specifications.
- A copy of the WBS should be obtained. At this point coordination between the CWBS elements and the SOW should commence. Each task element of the preliminary CWBS should be explained in the SOW, and related coding should be used.

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3. Adapted from *Statement of Work Handbook* NHB5600.2, National Aeronautics and Space Administration, February 1975.

- The project manager should establish a SOW preparation team consisting of personnel he deems appropriate from the program or project office who are experts in the technical areas involved, and representatives from procurement, financial management, fabrication, test, logistics, configuration management, operations, safety, reliability, and quality assurance, plus any other area that may be involved in the contemplated procurement.
- Before the team actually starts preparation of the SOW, the project manager should brief program management as to the structure of the preliminary CWBS and the nature of the contemplated SOW. This briefing is used as a baseline from which to proceed further.
- The project manager may assign identified tasks to team members and identify compliance specifications, design criteria, and other requirements documentation that must be included in the SOW and assign them to responsible personnel for preparation. Assigned team members will identify and obtain copies of specifications and technical requirements documents, engineering drawings, and results of preliminary and/or related studies that may apply to various elements of the proposed procurement.
- The project manager should prepare a detailed checklist showing the mandatory items and the selected optional items as they apply to the main body or the appendixes of the SOW.
- The project manager should emphasize the use of preferred parts lists; standard subsystem designs, both existing and under development; available hardware in inventory; off-the-shelf equipment; component qualification data; design criteria handbooks; and other technical information available to design engineers to prevent deviations from the best design practices.
- Cost estimates (manning requirements, material costs, software requirements, etc.) developed by the cost estimating specialists should be reviewed by SOW contributors. Such reviews will permit early trade-off consideration on the desirability of requirements that are not directly related to essential technical objectives.
- The project manager should establish schedules for submission of coordinated SOW fragments from each task team member. He must assure that these schedules are compatible with the schedule for the request for proposal (RFP) issuance. The statement of work should be prepared sufficiently early to permit full project coordination and to ensure that all project requirements are included. It should be completed in advance of RFP preparation.

SOW preparation manuals also contain guides for editors and writers[4]:

- Every SOW that exceeds two pages in length should have a table of contents conforming to the CWBS coding structure. There should rarely be items in the SOW that are not shown on the CWBS; however, it is not absolutely necessary to restrict items to those cited in the CWBS.

4. See note 3.

- Clear and precise task descriptions are essential. The SOW writer should realize that his or her efforts will have to be read and interpreted by persons of varied background (such as lawyers, buyers, engineers, cost estimators, accountants, and specialists in production, transportation, security, audit, quality, finance, and contract management). A good SOW states precisely the product or service desired. The clarity of the SOW will affect administration of the contract, since it defines the scope of work to be performed. Any work that falls outside that scope will involve new procurement with probable increased costs.
- The most important thing to keep in mind when writing a SOW is the most likely effect the written work will have upon the reader. Therefore, every effort must be made to avoid ambiguity. All obligations of the government should be carefully spelled out. If approval actions are to be provided by the government, set a time limit. If government-furnished equipment (GFE) and/or services, etc., are to be provided, state the nature, condition, and time of delivery, if feasible.
- Remember that any provision that takes control of the work away from the contractor, even temporarily, may result in relieving the contractor of responsibility.
- In specifying requirements, use active rather than passive terminology. Say that the contractor shall conduct a test rather than that a test should be conducted. In other words, when a firm requirement is intended, use the mandatory term "shall" rather than the permissive term "should."
- Limit abbreviations to those in common usage. Provide a list of all pertinent abbreviations and acronyms at the beginning of the SOW. When using a term for the first time, spell it out and show the abbreviation or acronym in parentheses following the word or words.
- When it is important to define a division of responsibilities between the contractor, other agencies, etc., a separate section of the SOW (in an appropriate location) should be included and delineate such responsibilities.
- Include procedures. When immediate decisions cannot be made, it may be possible to include a procedure for making them (e.g., "as approved by the contracting officer," or "the contractor shall submit a report each time a failure occurs").
- Do not overspecify. Depending upon the nature of the work and the type of contract, the ideal situation may be to specify results required or end-items to be delivered and let the contractor propose his best method.
- Describe requirements in sufficient detail to assure clarity, not only for legal reasons, but for practical application. It is easy to overlook many details. It is equally easy to be repetitious. Beware of doing either. For every piece of deliverable hardware, for every report, for every immediate action, do not specify that something be done "as necessary." Rather, specify whether the judgment is to be made by the contractor or by the government. Be aware that these types of contingent actions may have an impact on price as well as schedule. Where expensive services, such as technical liaison, are to be furnished, do not say "as required." Provide a ceiling on the extent of such services, or work out a procedure (e.g., a level of effort, pool of man-hours) that will ensure adequate control.
- Avoid incorporating extraneous material and requirements. They may add unnecessary cost. Data requirements are common examples of problems in this area.

Screen out unnecessary data requirements, and specify only what is essential and when. It is recommended that data requirements be specified separately in a data requirements appendix or equivalent.

- Do not repeat detailed requirements or specifications that are already spelled out in applicable documents. Instead, incorporate them by reference. If amplification, modification, or exceptions are required, make specific reference to the applicable portions and describe the change.

Some preparation documents also contain checklists for SOW preparation.[5] A checklist is furnished below to provide considerations that SOW writers should keep in mind in preparing statements of work:

- Is the SOW (when used in conjunction with the preliminary CWBS) specific enough to permit a contractor to make a tabulation and summary of manpower and resources needed to accomplish each SOW task element?
- Are specific duties of the contractor stated so he will know what is required, and can the contracting officer's representative, who signs the acceptance report, tell whether the contractor has complied?
- Are all parts of the SOW so written that there is no question as to what the contractor is obligated to do, and when?
- When it is necessary to reference other documents, is the proper reference document described? Is it properly cited? Is all of it really pertinent to the task, or should only portions be referenced? Is it cross-referenced to the applicable SOW task element?
- Are any specifications or exhibits applicable in whole or in part? If so, are they properly cited and referenced to the appropriate SOW element?
- Are directions clearly distinguishable from general information?
- Is there a time-phased data requirement for each deliverable item? If elapsed time is used, does it specify calendar or work days?
- Are proper quantities shown?
- Have headings been checked for format and grammar? Are subheadings comparable? Is the text compatible with the title? Is a multidecimal or alphanumeric numbering system used in the SOW? Can it be cross-referenced with the CWBS?
- Have appropriate portions of procurement regulations been followed?
- Has extraneous material been eliminated?
- Can SOW task/contract line items and configuration item breakouts at lower levels be identified and defined in sufficient detail so they can be summarized to discrete third-level CWBS elements?
- Have all requirements for data been specified separately in a data requirements appendix or its equivalent? Have all extraneous data requirements been eliminated?
- Are security requirements adequately covered if required?
- Has its availability to contractors been specified?

5. See note 3.

Finally, there should be a management review of the SOW preparation interpretation[6]:

> During development of the Statement of Work, the project manager should ensure adequacy of content by holding frequent reviews with project and functional specialists to determine that technical and data requirements specified do conform to the guidelines herein and adequately support the common system objective. The CWBS/SOW matrix should be used to analyze the SOW for completeness. After all comments and inputs have been incorporated, a final team review should be held to produce a draft SOW for review by functional and project managers. Specific problems should be resolved and changes made as appropriate. A final draft should then be prepared and reviewed with the program manager, contracting officer, or with higher management if the procurement is a major acquisition. The final review should include a briefing on the total RFP package. If other program offices or other Government agencies will be involved in the procurement, obtain their concurrence also.

11.9 PROJECT SPECIFICATIONS

PMBOK® Guide, 4th Edition
5.2 Define Scope
12.1.3.2 Contract Statement of Work

A specification list as shown in Table 11–1 is separately identified or called out as part of the statement of work. Specifications are used for man-hour, equipment, and material estimates. Small changes in a specification can cause large cost overruns.

Another reason for identifying the specifications is to make sure that there are no surprises for the customer downstream. The specifications should be the most current revision. It is not uncommon for a customer to hire outside agencies to evaluate the technical proposal and to make sure that the proper specifications are being used.

Specifications are, in fact, standards for pricing out a proposal. If specifications do not exist or are not necessary, then work standards should be included in the proposal. The work standards can also appear in the cost volume of the proposal. Labor justification backup sheets may or may not be included in the proposal, depending on RFP/RFQ (request for quotation) requirements.

Several years ago, a government agency queried contractors as to why some government programs were costing so much money. The main culprit turned out to be the specifications. Typical specifications contain twice as many pages as necessary, do not stress quality enough, are loaded with unnecessary designs and schematics, are difficult to read and update, and are obsolete before they are published. Streamlining existing specifications is a costly and time-consuming effort. The better alternative is to educate those people involved in specification preparation so that future specifications will be reasonably correct.

6. *Statement of Work Handbook* NHB5600.2, National Aeronautics and Space Administration, February 1975.

TABLE 11–1. SPECIFICATION FOR STATEMENT OF WORK

Description	Specification No.
Civil	100 (Index)
• Concrete	101
• Field equipment	102
• Piling	121
• Roofing and siding	122
• Soil testing	123
• Structural design	124
Electrical	200 (Index)
• Electrical testing	201
• Heat tracing	201
• Motors	209
• Power systems	225
• Switchgear	226
• Synchronous generators	227
HVAC	300 (Index)
• Hazardous environment	301
• Insulation	302
• Refrigeration piping	318
• Sheetmetal ductwork	319
Installation	400 (Index)
• Conveyors and chutes	401
• Fired heaters and boilers	402
• Heat exchangers	403
• Reactors	414
• Towers	415
• Vessels	416
Instruments	500 (Index)
• Alarm systems	501
• Control valves	502
• Flow instruments	503
• Level gages	536
• Pressure instruments	537
• Temperature instruments	538
Mechanical equipment	600 (Index)
• Centrifugal pumps	601
• Compressors	602
• High-speed gears	603
• Material handling equipment	640
• Mechanical agitators	641
• Steam turbines	642
Piping	700 (Index)
• Expansion joints	701
• Field pressure testing	702
• Installation of piping	703
• Pipe fabrication specs	749
• Pipe supports	750
• Steam tracing	751
Project administration	800 (Index)
• Design drawings	801
• Drafting standards	802
• General requirements	803
• Project coordination	841
• Reporting procedure	842
• Vendor data	843

(*continues*)

TABLE 11–1. SPECIFICATION FOR STATEMENT OF WORK (*Continued*)

Description	Specification No.
Vessels	900 (Index)
• Fireproofing	901
• Painting	902
• Reinforced tanks	948
• Shell and tube heat exchangers	949
• Steam boilers	950
• Vessel linings	951

11.10 MILESTONE SCHEDULES

PMBOK® Guide, 4th Edition
Chapter 6 Time Management

Project milestone schedules contain such information as:

- Project start date
- Project end date
- Other major milestones
- Data items (deliverables or reports)

Project start and end dates, if known, must be included. Other major milestones, such as review meetings, prototype available, procurement, testing, and so on, should also be identified. The last topic, data items, is often overlooked. There are two good reasons for preparing a separate schedule for data items. First, the separate schedule will indicate to line managers that personnel with writing skills may have to be assigned. Second, data items require direct-labor man-hours for writing, typing, editing, retyping, proofing, graphic arts, and reproduction. Many companies identify on the data item schedules the approximate number of pages per data item, and each data item is priced out at a cost per page, say $500/page. Pricing out data items separately often induces customers to require fewer reports.

The steps required to prepare a report, after the initial discovery work or collection of information, include:

- Organizing the report
- Writing
- Typing
- Editing
- Retyping
- Proofing
- Graphic arts
- Submittal for approvals
- Reproduction and distribution

Typically, 6–8 hours of work are required per page. At a burdened hourly rate of $80/hour, it is easy for the cost of documentation to become exorbitant.

11.11 WORK BREAKDOWN STRUCTURE

PMBOK® Guide, 4th Edition
5.3 Create WBS

The successful accomplishment of both contract and corporate objectives requires a plan that defines all effort to be expended, assigns responsibility to a specially identified organizational element, and establishes schedules and budgets for the accomplishment of the work. The preparation of this plan is the responsibility of the program manager, who is assisted by the program team assigned in accordance with program management system directives. The detailed planning is also established in accordance with company budgeting policy before contractural efforts are initiated.

In planning a project, the project manager must structure the work into small elements that are:

- Manageable, in that specific authority and responsibility can be assigned
- Independent, or with minimum interfacing with and dependence on other ongoing elements
- Integratable so that the total package can be seen
- Measurable in terms of progress

The first major step in the planning process after project requirements definition is the development of the work breakdown structure (WBS). A WBS is a product-oriented family tree subdivision of the hardware, services, and data required to produce the end product. The WBS is structured in accordance with the way the work will be performed and reflects the way in which project costs and data will be summarized and eventually reported. Preparation of the WBS also considers other areas that require structured data, such as scheduling, configuration management, contract funding, and technical performance parameters. The WBS is the single most important element because it provides a common framework from which:

- The total program can be described as a summation of subdivided elements.
- Planning can be performed.
- Costs and budgets can be established.
- Time, cost, and performance can be tracked.
- Objectives can be linked to company resources in a logical manner.
- Schedules and status-reporting procedures can be established.
- Network construction and control planning can be initiated.
- The responsibility assignments for each element can be established.

The work breakdown structure acts as a vehicle for breaking the work down into smaller elements, thus providing a greater probability that every major and minor activity

will be accounted for. Although a variety of work breakdown structures exist, the most common is the six-level indented structure shown below:

	Level	*Description*
Managerial levels	1	Total program
	2	Project
	3	Task
Technical levels	4	Subtask
	5	Work package
	6	Level of effort

Level 1 is the total program and is composed of a set of projects. The summation of the activities and costs associated with each project must equal the total program. Each project, however, can be broken down into tasks, where the summation of all tasks equals the summation of all projects, which, in turn, comprises the total program. The reason for this subdivision of effort is simply ease of control. Program management therefore becomes synonymous with the integration of activities, and the project manager acts as the integrator, using the work breakdown structure as the common framework.

Careful consideration must be given to the design and development of the WBS. From Figure 11–3, the work breakdown structure can be used to provide the basis for:

- The responsibility matrix
- Network scheduling
- Costing
- Risk analysis
- Organizational structure
- Coordination of objectives
- Control (including contract administration)

The upper three levels of the WBS are normally specified by the customer (if part of an RFP/RFQ) as the summary levels for reporting purposes. The lower levels are generated by the contractor for in-house control. Each level serves a vital purpose: Level 1 is generally used for the authorization and release of all work, budgets are prepared at level 2, and schedules are prepared at level 3. Certain characteristics can now be generalized for these levels:

- The top three levels of the WBS reflect integrated efforts and should not be related to one specific department. Effort required by departments or sections should be defined in subtasks and work packages.
- The summation of all elements in one level must be the sum of all work in the next lower level.
- Each element of work should be assigned to one and only one level of effort. For example, the construction of the foundation of a house should be included in one project (or task), not extended over two or three. (At level 5, the work packages should be identifiable and homogeneous.)

PMBOK® Guide, 4th Edition
Figure 5–6 Sample WBS

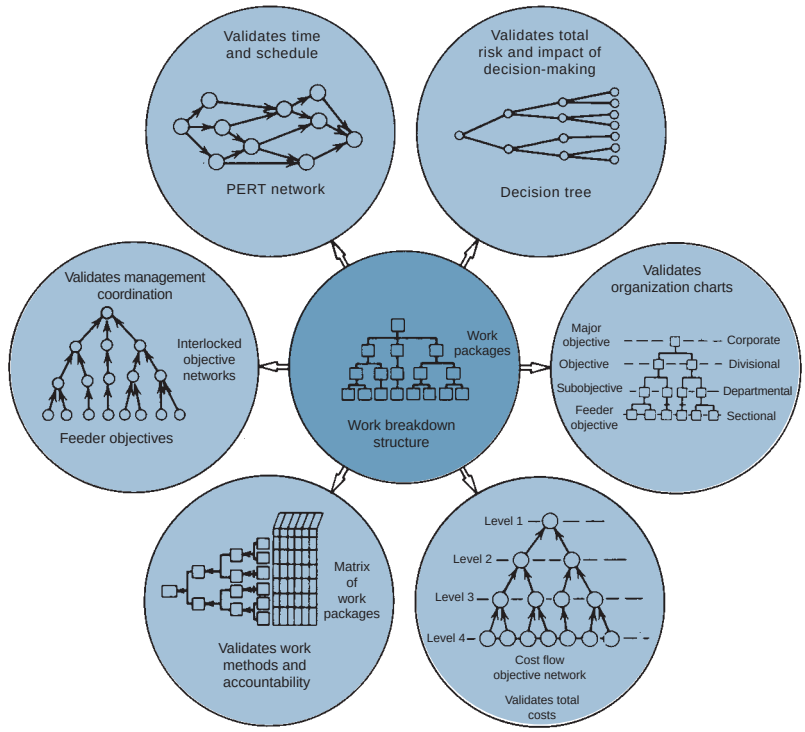


FIGURE 11–3. Work breakdown structure for objective control and evaluation. *Source:* Paul Mali, *Managing by Objectives* (New York: Wiley, 1972), p. 163. Copyright © 1972 by John Wiley & Sons. Reprinted by permission of the publisher.

- The level at which the project is managed is generally called the work package level. Actually, the work package can exist at any level below level one.
- The WBS must be accompanied by a description of the scope of effort required, or else only those individuals who issue the WBS will have a complete understanding of what work has to be accomplished. It is common practice to reproduce the customer's statement of work as the description for the WBS.
- It is often the best policy for the project manager, regardless of his technical expertise, to allow all of the line managers to assess the risks in the SOW. After all, the line managers are usually the recognized experts in the organization.

Project managers normally manage at the top three levels of the WBS and prefer to provide status reports to management at these levels also. Some companies are trying to standardize reporting to management by requiring the top three levels of the WBS to be the same for every project, the only differences being in levels 4–6. For companies with a great deal of similarity among projects, this approach has merit. For most companies, however, the differences between projects make it almost impossible to standardize the top levels of the WBS.

The work package is the critical level for managing a work breakdown structure, as shown in Figure 11–4. However, it is possible that the actual management of the work packages is supervised and performed by the line managers with status reporting provided to the project manager at higher levels of the WBS.

Work packages are natural subdivisions of cost accounts and constitute the basic building blocks used by the contractor in planning, controlling, and measuring contract performance. A work package is simply a low-level task or job assignment. It describes the work to be accomplished by a specific performing organization or a group of cost centers and serves as a vehicle for monitoring and reporting progress of work. Documents that authorize and assign work to a performing organization are designated by various names throughout industry. "Work package" is the generic term used in the criteria to identify discrete tasks that have definable end results. Ideal work packages are 80 hours and 2–4 weeks. However, this may not be possible on large projects.

It is not necessary that work package documentation contain complete, stand-alone descriptions. Supplemental documentation may augment the work package descriptions. However, the work package descriptions must permit cost account managers and work package supervisors to understand and clearly distinguish one work package effort from another. In the review of work package documentation, it may be necessary to obtain explanations from personnel routinely involved in the work, rather than requiring the work package descriptions to be completely self-explanatory.

Short-term work packages may help evaluate accomplishments. Work packages should be natural subdivisions of effort planned according to the way the work will be done. However, when work packages are relatively short, little or no assessment of work-in-process is required and the evaluation of status is possible mainly on the basis of work package completions. The longer the work packages, the more difficult and subjective the work-in-process assessment becomes unless the packages are subdivided by objective indicators such as discrete milestones with preassigned budget values or completion percentages.

In setting up the work breakdown structure, tasks should:

- Have clearly defined start and end dates
- Be usable as a communications tool in which results can be compared with expectations
- Be estimated on a "total" time duration, not when the task must start or end
- Be structured so that a minimum of project office control and documentation (i.e., forms) is necessary

For large projects, planning will be time phased at the work package level of the WBS. The work package has the following characteristics:

- Represents units of work at the level where the work is performed
- Clearly distinguishes one work package from all others assigned to a single functional group
- Contains clearly defined start and end dates that are representative of physical accomplishment (This is accomplished after scheduling has been completed.)

PMBOK® Guide, 4th Edition
Figure 5–6 Work Packages
Organizational Procedures Links

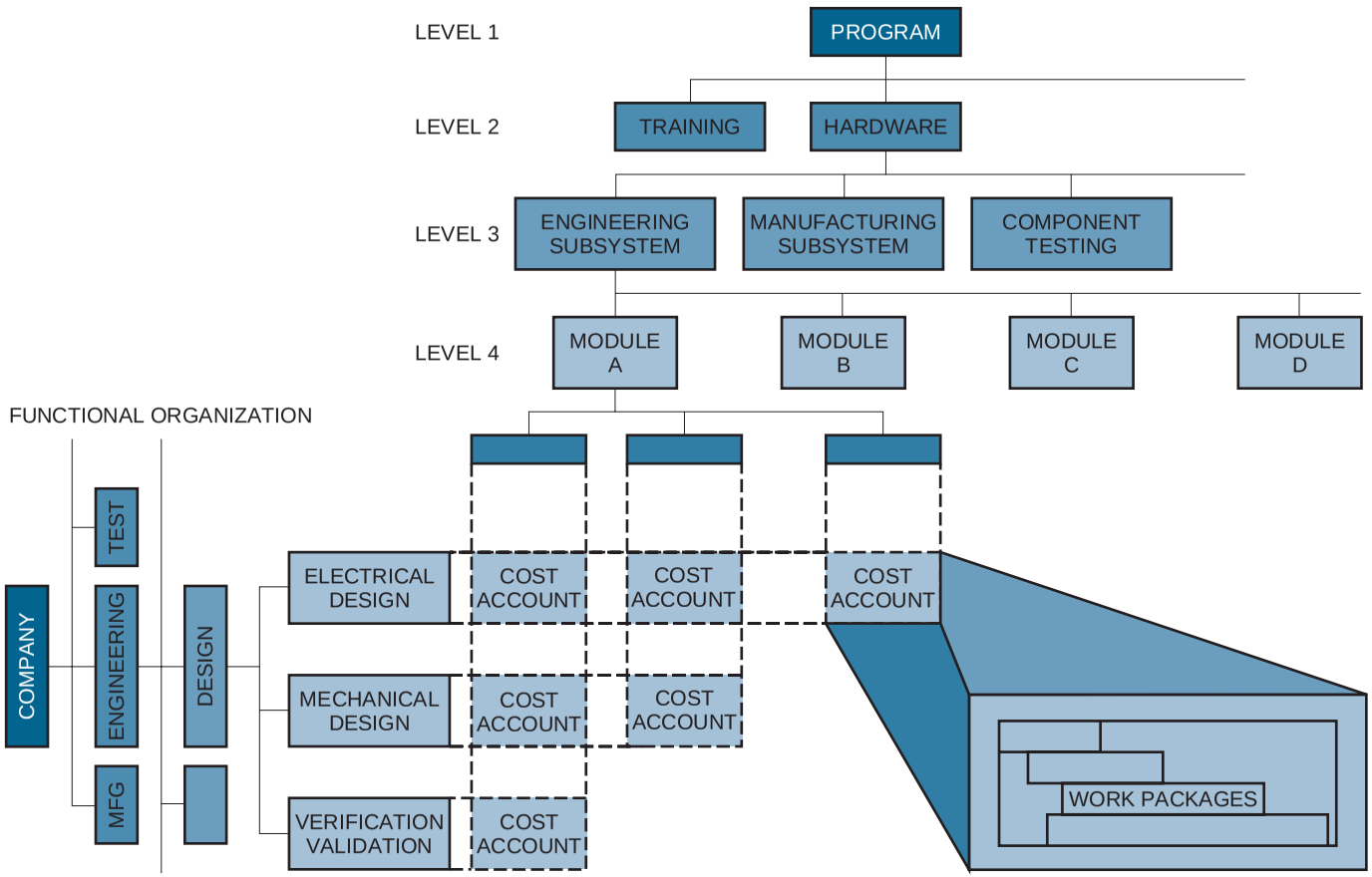


FIGURE 11–4. The cost account intersection.

- Specifies a budget in terms of dollars, man-hours, or other measurable units
- Limits the work to be performed to relatively short periods of time to minimize the work-in-process effort

Table 11–2 shows a simple work breakdown structure with the associated numbering system following the work breakdown. The first number represents the total program (in this case, it is represented by 01), the second number represents the project, and the third number identifies the task. Therefore, number 01-03-00 represents project 3 of program 01, whereas 01-03-02 represents task 2 of project 3. This type of numbering system is not standard; each company may have its own system, depending on how costs are to be controlled.

The preparation of the work breakdown structure is not easy. The WBS is a communications tool, providing detailed information to different levels of management. If it does not contain enough levels, then the integration of activities may prove difficult. If too many levels exist, then unproductive time will be made to have the same number of levels for all projects, tasks, and so on. Each major work element should be considered by itself. Remember, the WBS establishes the number of required networks for cost control.

For many programs, the work breakdown structure is established by the customer. If the contractor is required to develop a WBS, then certain guidelines must be considered including:

- The complexity and technical requirements of the program (i.e., the statement of work)
- The program cost
- The time span of the program
- The contractor's resource requirements
- The contractor's and customer's internal structure for management control and reporting
- The number of subcontracts

TABLE 11–2. WORK BREAKDOWN STRUCTURE FOR NEW PLANT CONSTRUCTION AND START-UP

Program: New Plant Construction and Start-up	01-00-00
Project 1: Analytical Study	01-01-00
Task 1: Marketing/Production Study	01-01-01
Task 2: Cost Effectiveness Analysis	01-01-02
Project 2: Design and Layout	01-02-00
Task 1: Product Processing Sketches	01-02-01
Task 2: Product Processing Blueprints	01-02-02
Project 3: Installation	01-03-00
Task 1: Fabrication	01-03-01
Task 2: Setup	01-03-02
Task 3: Testing and Run	01-03-03
Project 4: Program Support	01-04-00
Task 1: Management	01-04-01
Task 2: Purchasing Raw Materials	01-04-02

Applying these guidelines serves only to identify the complexity of the program. These data must then be subdivided and released, together with detailed information, to the different levels of the organization. The WBS should follow specified criteria because, although preparation of the WBS is performed by the program office, the actual work is performed by the doers, not the planners. Both the doers and the planners must be in agreement as to what is expected. A sample listing of criteria for developing a work breakdown structure is shown below:

- The WBS and work description should be easy to understand.
- All schedules should follow the WBS.
- No attempt should be made to subdivide work arbitrarily to the lowest possible level. The lowest level of work should not end up having a ridiculous cost in comparison to other efforts.
- Since scope of effort can change during a program, every effort should be made to maintain flexibility in the WBS.
- The WBS can act as a list of discrete and tangible milestones so that everyone will know when the milestones were achieved.
- The level of the WBS can reflect the "trust" you have in certain line groups.
- The WBS can be used to segregate recurring from nonrecurring costs.
- Most WBS elements (at the lowest control level) range from 0.5 to 2.5 percent of the total project budget.

11.12 WBS DECOMPOSITION PROBLEMS

There is a common misconception that WBS decomposition is an easy task to perform. In the development of the WBS, the top three levels or management levels are usually roll-up levels. Preparing templates at these levels is becoming common practice. However, at levels 4–6 of the WBS, templates may not be appropriate. There are reasons for this.

- Breaking the work down to extremely small and detailed work packages may require the creation of hundreds or even thousands of cost accounts and charge numbers. This could increase the management, control, and reporting costs of these small packages to a point where the costs exceed the benefits. Although a typical work package may be 200–300 hours and approximately two weeks in duration, consider the impact on a large project, which may have more than one million direct labor hours.
- Breaking the work down to small work packages can provide accurate cost control if, and only if, the line managers can determine the costs at this level of detail. Line managers must be given the right to tell project managers that costs *cannot* be determined at the requested level of detail.
- The work breakdown structure is the basis for scheduling techniques such as the Arrow Diagramming Method and the Precedence Diagramming Method. At low levels of the WBS, the interdependencies between activities can become so complex that meaningful networks cannot be constructed.

One solution to the above problems is to create "hammock" activities, which encompass several activities where exact cost identification cannot or may not be accurately determined. Some projects identify a "hammock" activity called management support (or project office), which includes overall project management, data items, management reserve, and possibly procurement. The advantage of this type of hammock activity is that the charge numbers are under the *direct* control of the project manager.

There is a common misconception that the typical dimensions of a work package are approximately 80 hours and less than two weeks to a month. Although this may be true on small projects, this would necessitate millions of work packages on large jobs and this may be impractical, even if line managers could control work packages of this size.

From a cost control point of view, cost analysis down to the fifth level is advantageous. However, it should be noted that the cost required to prepare cost analysis data to each lower level may increase exponentially, especially if the customer requires data to be presented in a specified format that is not part of the company's standard operating procedures. The level-5 work packages are normally for in-house control only. Some companies bill customers separately for each level of cost reporting below level 3.

The WBS can be subdivided into subobjectives with finer divisions of effort as we go lower into the WBS. By defining subobjectives, we add greater understanding and, it is hoped, clarity of action for those individuals who will be required to complete the objectives. Whenever work is structured, understood, easily identifiable, and within the capabilities of the individuals, there will almost always exist a high degree of confidence that the objective can be reached.

Work breakdown structures can be used to structure work for reaching such objectives as lowering cost, reducing absenteeism, improving morale, and lowering scrap factors. The lowest subdivision now becomes an end-item or subobjective, not necessarily a work package as described here. However, since we are describing project management, for the remainder of the text we will consider the lowest level as the work package.

Once the WBS is established and the program is "kicked off," it becomes a very costly procedure to either add or delete activities, or change levels of reporting because of cost control. Many companies do not give careful forethought to the importance of a properly developed WBS, and ultimately they risk cost control problems downstream. One important use of the WBS is that it serves as a cost control standard for any future activities that may follow on or may just be similar. One common mistake made by management is the combining of direct support activities with administrative activities. For example, the department manager for manufacturing engineering may be required to provide administrative support (possibly by attending team meetings) throughout the duration of the program. If the administrative support is spread out over each of the projects, a false picture is obtained as to the actual hours needed to accomplish each project in the program. If one of the projects should be canceled, then the support man-hours for the total program would be reduced when, in fact, the administrative and support functions may be constant, regardless of the number of projects and tasks.

Quite often work breakdown structures accompanying customer RFPs contain much more scope of effort, as specified by the statement of work, than the existing funding will support. This is done intentionally by the customer in hopes that a contractor may be willing to "buy in." If the contractor's price exceeds the customer's funding limitations, then

the scope of effort must be reduced by eliminating activities from the WBS. By developing a separate project for administrative and indirect support activities, the customer can easily modify his costs by eliminating the direct support activities of the canceled effort.

Before we go on, there should be a brief discussion of the usefulness and applicability of the WBS system. Many companies and industries have been successful in managing programs without the use of work breakdown structures, especially on repetitive-type programs. As was the case with the SOW, there are also preparation guides for the WBS[7]:

- Develop the WBS structure by subdividing the total effort into discrete and logical subelements. Usually a program subdivides into projects, major systems, major subsystems, and various lower levels until a manageable-size element level is reached. Wide variations may occur, depending upon the type of effort (e.g., major systems development, support services, etc.). Include more than one cost center and more than one contractor if this reflects the actual situation.
- Check the proposed WBS and the contemplated efforts for completeness, compatibility, and continuity.
- Determine that the WBS satisfies both functional (engineering/manufacturing/test) and program/project (hardware, services, etc.) requirements, including recurring and nonrecurring costs.
- Check to determine if the WBS provides for logical subdivision of all project work.
- Establish assignment of responsibilities for all identified effort to specific organizations.
- Check the proposed WBS against the reporting requirements of the organizations involved.

PMBOK® Guide, 4th Edition
5.3.3.1 WBS

There are also checklists that can be used in the preparation of the WBS[8]:

- Develop a preliminary WBS to not lower than the top three levels for solicitation purposes (or lower if deemed necessary for some special reason).
- Assure that the contractor is required to extend the preliminary WBS in response to the solicitation, to identify and structure all contractor work to be compatible with his organization and management system.
- Following negotiations, the CWBS included in the contract should not normally extend lower than the third level.
- Assure that the negotiated CWBS structure is compatible with reporting requirements.

7. Source: *Handbook for Preparation of Work Breakdown Structures*, NHB5610.1, National Aeronautics and Space Administration, February 1975.

8. See note 7.

- Assure that the negotiated CWBS is compatible with the contractor's organization and management system.
- Review the CWBS elements to ensure correlation with:
  - The specification tree
  - Contract line items
  - End-items of the contract
  - Data items required
  - Work statement tasks
  - Configuration management requirements
- Define CWBS elements down to the level where such definitions are meaningful and necessary for management purposes (WBS dictionary).
- Specify reporting requirements for selected CWBS elements if variations from standard reporting requirements are desired.
- Assure that the CWBS covers measurable effort, level of effort, apportioned effort, and subcontracts, if applicable.
- Assure that the total costs at a particular level will equal the sum of the costs of the constituent elements at the next lower level.

On simple projects, the WBS can be constructed as a "tree diagram" (see Figure 11–5) or according to the logic flow. In Figure 11–5, the tree diagram can follow the work or even the organizational structure of the company (i.e., division, department, section, unit). The second method is to create a logic flow (see Figure 12–21) and cluster certain elements to represent tasks and projects. In the tree method, lower-level functional units may be

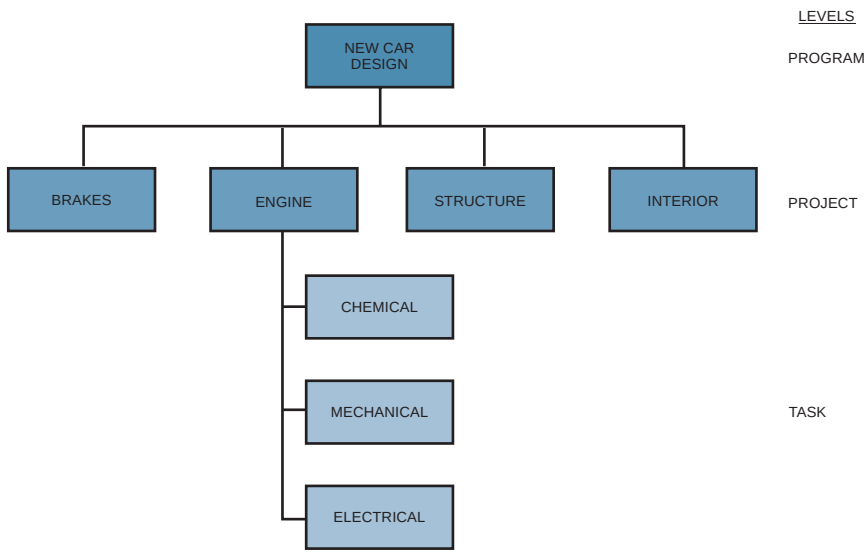


FIGURE 11–5. WBS tree diagram.

assigned to one, and only one, work element, whereas in the logic flow method the lower-level functional units may serve several WBS elements.

A tendency exists to develop guidelines, policies, and procedures for project management, but not for the development of the WBS. Some companies have been marginally successful in developing a "generic" methodology for levels 1, 2, and 3 of the WBS to use on all projects. The differences appear in levels 4, 5, and 6.

The table below shows the three most common methods for structuring the WBS:

	Method		
Level	**Flow**	**Life Cycle**	**Organization**
Program	Program	Program	Program
Project	System	Life cycle	Division
Task	Subsystem	System	Department
Subtask	People	Subsystem	Section
Work package	People	People	People
Level of effort	People	People	People

The flow method breaks the work down into systems and major subsystems. This method is well suited for projects less than two years in length. For longer projects, we use the life-cycle method, which is similar to the flow method. The organization method is used for projects that may be repetitive or require very little integration between functional units.

11.13 ROLE OF THE EXECUTIVE IN PROJECT SELECTION

PMBOK® Guide, 4th Edition
Chapter 4 Integration
4.1.2 Develop Project Charter
Tools and Techniques

A prime responsibility of senior management (and possibly project sponsors) is the selection of projects. Most organizations have an established selection criteria, which can be subjective, objective, quantitative, qualitative, or simply a seat-of-the-pants guess. In any event, there should be a valid reason for selecting the project.

From a financial perspective, project selection is basically a two-part process. First, the organization will conduct a feasibility study to determine whether the project *can* be done. The second part is to perform a benefit-to-cost analysis to see whether the company *should* do it.

The purpose of the feasibility study is to validate that the project meets feasibility of cost, technological, safety, marketability, and ease of execution requirements. The company may use outside consultants or subject matter experts (SMEs) to assist in both feasibility studies and benefit-to-cost analyses. A project manager may not be assigned until after the feasibility study is completed.

As part of the feasibility process during project selection, senior management often solicits input from SMEs and lower-level managers through rating models. The rating models normally identify the business and/or technical criteria against which the ratings

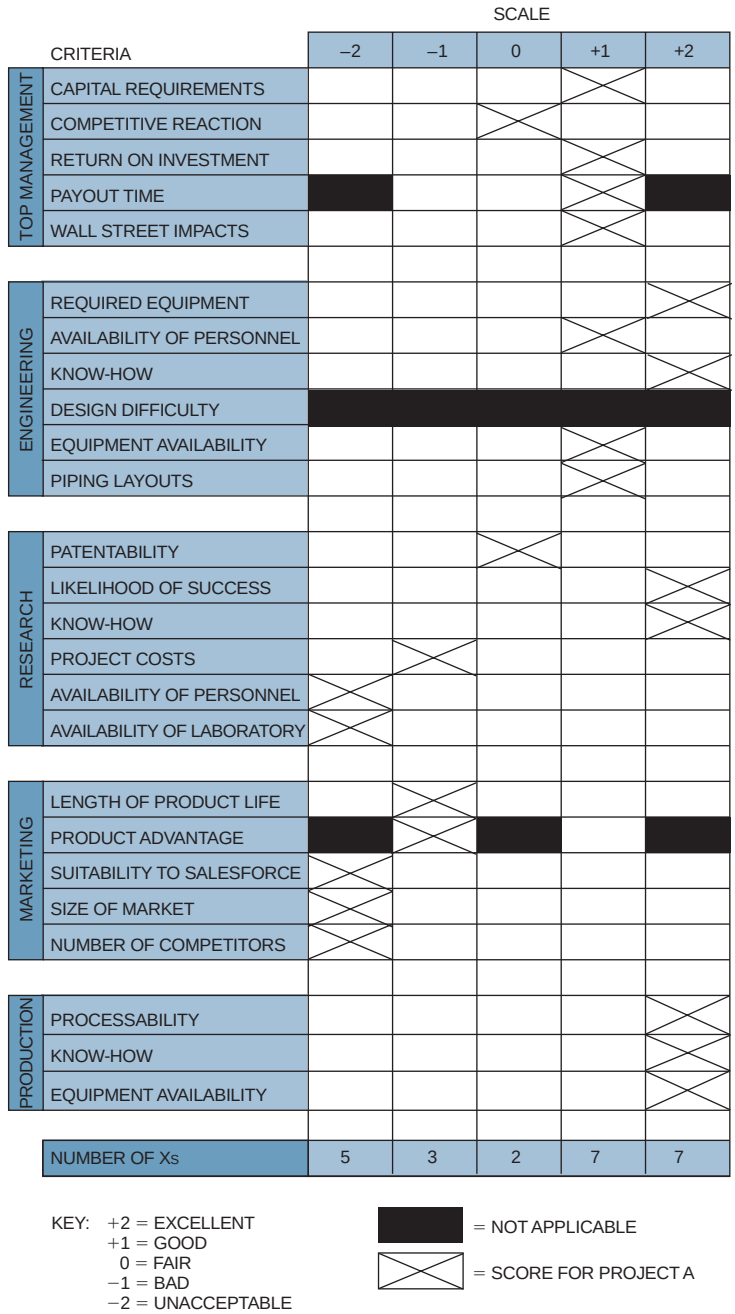


FIGURE 11–6. Illustration of a scaling model for one project, Project A. *Source:* William E. Souder, *Project Selection and Economic Appraisal*, p. 66.

will be made. Figure 11–6 shows a scaling model for a single project. Figure 11–7 shows a checklist rating system to evaluate three projects at once. Figure 11–8 shows a scoring model for multiple projects using weighted averages.

If the project is deemed feasible and a good fit with the strategic plan, then the project is prioritized for development along with other projects. Once feasibility is determined, a benefit-to-cost analysis is performed to validate that the project will, if executed correctly, provide the required financial and nonfinancial benefits. Benefit-to-cost analyses require significantly more information to be scrutinized than is usually available during a feasibility study. This can be an expensive proposition.

PMBOK® Guide, 4th Edition
5.2.2 Scope Definition
5.2.2.2 Product Analysis

Estimating benefits and costs in a timely manner is very difficult. Benefits are often defined as:

- Tangible benefits for which dollars may be reasonably quantified and measured.
- Intangible benefits that may be quantified in units other than dollars or may be identified and described subjectively.

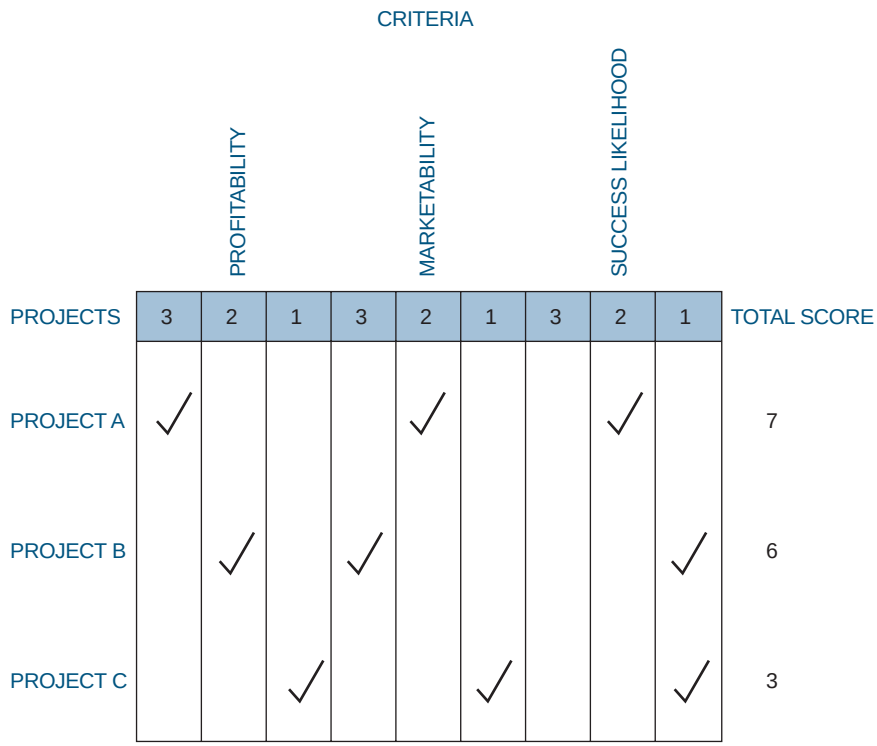


FIGURE 11–7. Illustration of a checklist for three projects. *Source:* William Souder, *Project Selection and Economic Appraisal*, p. 68.

CRITERIA	PROFITABILITY	PATENTABILITY	MARKETABILITY	PRODUCEABILITY
CRITERION WEIGHTS	4	3	2	1

PROJECTS	CRITERION SCORES*				TOTAL WEIGHTED SCORE
PROJECT D	10	6	4	3	69
PROJECT E	5	10	10	5	75
PROJECT F	3	7	10	10	63

TOTAL WEIGHTED SCORE = Σ (CRITERION SCORE × CRITERION WEIGHT)

* SCALE: 10 = EXCELLENT; 1 = UNACCEPTABLE

FIGURE 11–8. Illustration of a scoring model. *Source:* William Souder, *Project Selection and Economic Appraisal*, p. 69.

Costs are significantly more difficult to quantify. The minimum costs that must be determined are those that specifically are used for comparison to the benefits. These include:

- The current operating costs or the cost of operating in today's circumstances.
- Future period costs that are expected and can be planned for.
- Intangible costs that may be difficult to quantify. These costs are often omitted if quantification would contribute little to the decision-making process.

TABLE 11–3. FEASIBILITY STUDY AND BENEFIT-COST ANALYSIS

	Feasibility Study	**Benefit-Cost Analysis**
Basic Question	*Can We Do It?*	*Should We Do It?*
Life-Cycle Phase	Preconceptual	Conceptual
PM Selected	Usually not yet	Usually identified but partial involvement
Analysis	Qualitative	Quantitative
Critical Factors for Go/No-Go	• Technical • Cost • Quality • Safety • Ease of performance • Economical • Legal	• Net present value • Discounted cash flow • Internal rate of return • Return on investment • Probability of success • Reality of assumptions and constraints
Executive Decision Criteria	Strategic fit	Benefits exceed costs by required margin

There must be careful documentation of all known constraints and assumptions that were made in developing the costs and the benefits. Unrealistic or unrecognized assumptions are often the cause of unrealistic benefits. The go or no-go decision to continue with a project could very well rest upon the validity of the assumptions.

Table 11–3 shows the major differences between feasibility studies and benefit-to-cost analyses.

Today, the project manager may end up participating in the project selection process. In Chapter 1, we discussed the new breed of project manager, namely a person that has excellent business skills as well as project management skills. These business skills now allow us to bring the project manager on board the project at the beginning of the initiation phase rather than at the end of the initiation phase because the project manager can now make a valuable contribution to the project selection process. The project manager can be of assistance during project selection by providing business case knowledge including:

- Opportunity options (sales volume, market share, and follow-on business)
- Resource requirements (team knowledge requirements and skill set)
- Refined project costs
- Refined savings
- Benefits (financial, strategic, payback)
- Project metrics (key performance indicators and critical success factors)
- Benefits realization (consistency with the corporate business plan)
- Risks
- Exit strategies
- Organizational readiness and strengths
- Schedule/milestones
- Overall complexity
- Technology complexity and constraints, if any[9]

9. For additional factors that can influence project selection decision making, see J. R. Meredith and S. J. Mantel, Jr., *Project Management,* 3rd ed., (New York: Wiley, 1995), pp. 44–46.

11.14 ROLE OF THE EXECUTIVE IN PLANNING

Executives are responsible for selecting the project manager, and the person chosen should have planning expertise. Not all technical specialists are good planners. Likewise, some people that are excellent in execution have minimal planning skills. Executives must make sure that whomever is assigned as the project manager has both planning and execution skills. In addition, executives must take an active role during project planning activities especially if they also function as project sponsors.[10]

Executives must not arbitrarily set unrealistic milestones and then "force" line managers to fulfill them. Both project and line managers should try to adhere to unrealistic milestones, but if a line manager says he cannot, executives should comply because the line manager is supposedly the expert.

Executives should interface with project and line personnel during the planning stage in order to define the requirements and establish reasonable deadlines. Executives must realize that creating an unreasonable deadline may require the reestablishment of priorities, and, of course, changing priorities can push milestones backward.

11.15 THE PLANNING CYCLE

Previously, we stated that perhaps the most important reason for structuring projects into life-cycle phases is to provide management with control of the critical decision points in order to:

- Avoid commitment of major resources too early
- Preserve future options
- Maximize benefits of each project in relation to all other projects
- Assess risks

On long-term projects, phasing can be overdone, resulting in extra costs and delays. To prevent this, many project-driven companies resort to other types of systems, such as a management cost and control system (MCCS). No program or project can be efficiently organized and managed without some form of management cost and control system. Figure 11–9 shows the five phases of a management cost and control system. The first phase constitutes the planning cycle, and the next four phases identify the operating cycle.

Figure 11–10 shows the activities included in the planning cycle. The work breakdown structure serves as the initial control from which all planning emanates. The WBS acts as a vital artery for communications and operations in all phases. A comprehensive analysis of management cost and control systems is presented in Chapter 15.

10. Although this section is called "The Role of the Executive in Planning," it also applies to line management if project sponsorship is pushed down to the middle-management level or lower. This is quite common in highly mature project management organizations where senior management has sufficient faith in line management's ability to serve as project sponsors.

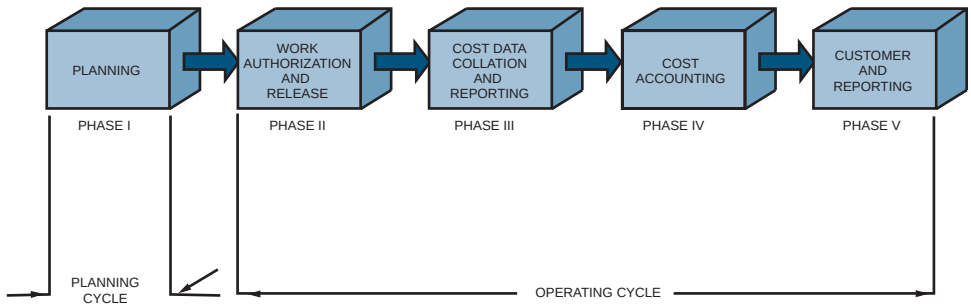


FIGURE 11–9. Phases of a management cost and control system.

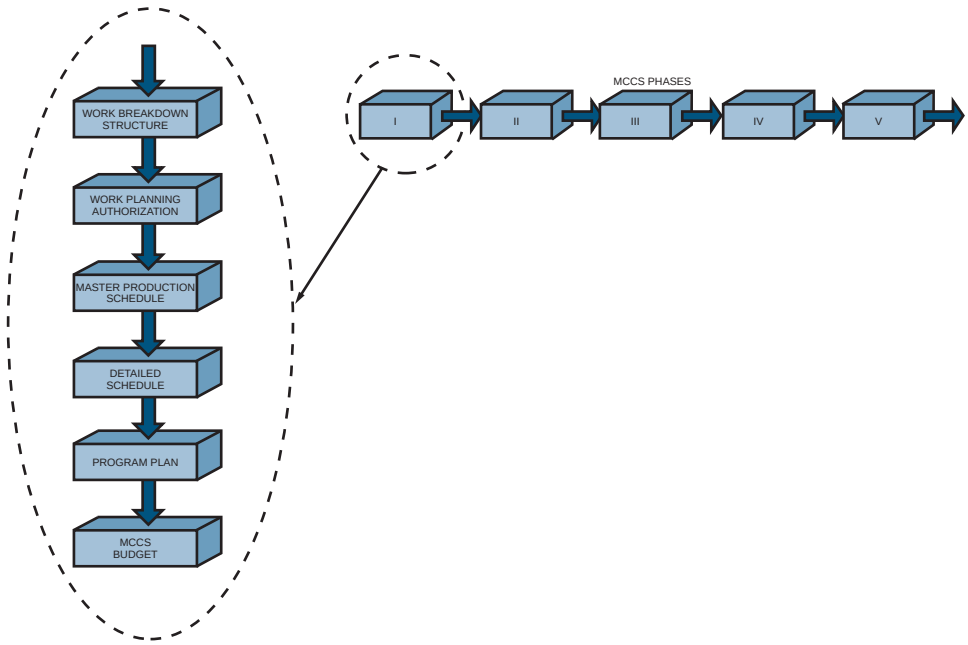


FIGURE 11–10. The planning cycle of a management cost and control system.

11.16 WORK PLANNING AUTHORIZATION

PMBOK® Guide, 4th Edition
4.3.2 Direct and Manage Project Execution

After receipt of a contract, some form of authorization is needed before work can begin, even in the planning stage. Both work authorization and work planning authorization are used to release funds, but for different purposes. Work planning authorization releases funds (primarily for functional management) so that scheduling, costs, budgets, and all other types of plans can be prepared prior to the release of operational cycle funds, which hereafter shall be referred to simply as work authorization. Both forms of authorization require the same paperwork. In many companies this work authorization is identified as a subdivided work description (SWD), which is a narrative description of the effort to be performed by the cost center

(division-level minimum). This package establishes the work to be performed, the period of performance, and possibly the maximum number of hours available. The SWD is multipurpose in that it can be used to release contract funds, authorize planning, describe activities as identified in the WBS, and, last but not least, release work.

The SWD is one of the key elements in the planning of a program as shown in Figure 11–10. Contract control and administration releases the contract funds by issuing a SWD, which sets forth general contractual requirements and authorizes program management to proceed. Program management issues the SWD to set forth the contractual guidelines and requirements for the functional units. The SWD specifies how the work will be performed, which functional organizations will be involved, and who has what specific responsibilities, and authorizes the utilization of resources within a given time period.

The SWD authorizes both the program team and functional management to begin work. As shown in Figure 11–10, the SWD provides direct input to Phase II of the MCCS. Phase I and Phase II can and do operate simultaneously because it is generally impossible for program office personnel to establish plans, procedures, and schedules without input from the functional units.

The subdivided work description package is used by the operating organizations to further subdivide the effort defined by the WBS into small segments or work packages.

Many people contend that if the data in the work authorization document are different from what was originally defined in the proposal, the project is in trouble right at the start. This may not be the case, because most projects are priced out assuming "unlimited" resources, whereas the hours and dollars in the work authorization document are based upon "limited" resources. This situation is common for companies that thrive on competitive bidding.

11.17 WHY DO PLANS FAIL?

No matter how hard we try, planning is not perfect, and sometimes plans fail. Typical reasons include:

- Corporate goals are not understood at the lower organizational levels.
- Plans encompass too much in too little time.
- Financial estimates are poor.
- Plans are based on insufficient data.
- No attempt is being made to systematize the planning process.
- Planning is performed by a planning group.
- No one knows the ultimate objective.
- No one knows the staffing requirements.
- No one knows the major milestone dates, including written reports.
- Project estimates are best guesses, and are not based on standards or history.
- Not enough time has been given for proper estimating.
- No one has bothered to see if there will be personnel available with the necessary skills.
- People are not working toward the same specifications.
- People are consistently shuffled in and out of the project with little regard for schedule.

Why do these situations occur? If corporate goals are not understood, it is because corporate executives have been negligent in providing the necessary strategic information and feedback. If a plan fails because of extreme optimism, then the responsibility lies with both the project and line managers for not assessing risk. Project managers should ask the line managers if the estimates are optimistic or pessimistic, and expect an honest answer. Erroneous financial estimates are the responsibility of the line manager. If the project fails because of a poor definition of the requirements, then the project manager is totally at fault.

Sometimes project plans fail because simple details are forgotten or overlooked. Examples of this might be:

- Neglecting to tell a line manager early enough that the prototype is not ready and that rescheduling is necessary.
- Neglecting to see if the line manager can still provide additional employees for the next two weeks because it was possible to do so six months ago.

Sometimes plans fail because the project manager "bites off more than he can chew," and then something happens, such as his becoming ill. Many projects have failed because the project manager was the only one who knew what was going on and then got sick.

11.18 STOPPING PROJECTS

PMBOK® Guide, 4th Edition
4.6 Close Projects

There are always situations in which projects have to be stopped. Nine reasons for stopping are:

- Final achievement of the objectives
- Poor initial planning and market prognosis
- A better alternative is found
- A change in the company interest and strategy
- Allocated time is exceeded
- Budgeted costs are exceeded
- Key people leave the organization
- Personal whims of management
- Problem too complex for the resources available

Today most of the reasons why projects are not completed on time and within cost are behavioral rather than quantitative. They include:

- Poor morale
- Poor human relations
- Poor labor productivity
- No commitment by those involved in the project

The last item appears to be the cause of the first three items in many situations.

Once the reasons for cancellation are defined, the next problem concerns how to stop the project. Some of the ways are:

- Orderly planned termination
- The "hatchet" (withdrawal of funds and removal of personnel)

- Reassignment of people to higher priority tasks
- Redirection of efforts toward different objectives
- Burying it or letting it die on the vine (i.e., not taking any official action)

There are three major problem areas to be considered in stopping projects:

- Worker morale
- Reassignment of personnel
- Adequate documentation and wrap-up

11.19 HANDLING PROJECT PHASEOUTS AND TRANSFERS

PMBOK® Guide, 4th Edition
4.4 Monitor and Control Project Work

By definition, projects (and even life cycle phases) have an end point. Closing out is a very important phase in the project life cycle, which should follow particular disciplines and procedures with the objective of:

- Effectively bringing the project to closure according to agreed-on contractual requirements
- Preparing for the transition of the project into the next operational phase, such as from production to field installation, field operation, or training
- Analyzing overall project performance with regard to financial data, schedules, and technical efforts
- Closing the project office, and transferring or selling off all resources originally assigned to the project, including personnel
- Identifying and pursuing follow-on business

Although most project managers are completely cognizant of the necessity for proper planning for project start-up, many project managers neglect planning for project termination. Planning for project termination includes:

- Transferring responsibility
- Completion of project records
  - Historic reports
  - Postproject analysis
- Documenting results to reflect “as built” product or installation
- Acceptance by sponsor/user
- Satisfying contractual requirements
- Releasing resources
  - Reassignment of project office team members
  - Disposition of functional personnel
  - Disposition of materials
- Closing out work orders (financial closeout)
- Preparing for financial payments

Project success or failure often depends on management's ability to handle personnel issues properly during this final phase. If job assignments beyond the current project look undesirable or uncertain to project team members, a great deal of anxiety and conflict may develop that diverts needed energy to job hunting, foot dragging, or even sabotage. Project personnel may engage in job searches on their own and may leave the project prematurely. This creates a glaring void that is often difficult to patch.

Given business realities, it is difficult to transfer project personnel under ideal conditions. The following suggestions may increase organizational effectiveness and minimize personal stress when closing out a project:

- Carefully plan the project closeout on the part of both project and functional managers. Use a checklist to prepare the plan.
- Establish a simple project closeout procedure that identifies the major steps and responsibilities.
- Treat the closeout phase like any other project, with clearly delineated tasks, agreed-on responsibilities, schedules, budgets, and deliverable items or results.
- Understand the interaction of behavioral and organizational elements in order to build an environment conducive to teamwork during this final project phase.
- Emphasize the overall goals, applications, and utilities of the project as well as its business impact.
- Secure top-management involvement and support.
- Be aware of conflict, fatigue, shifting priorities, and technical or logistic problems. Try to identify and deal with these problems when they start to develop. Communicating progress through regularly scheduled status meetings is the key to managing these problems.
- Keep project personnel informed of upcoming job opportunities. Resource managers should discuss and negotiate new assignments with personnel and involve people already in the next project.
- Be aware of rumors. If a reorganization or layoff is inevitable, the situation should be described in a professional manner or people will assume the worst.
- Assign a contract administrator dedicated to company-oriented projects. He will protect your financial position and business interests by following through on customer sign-offs and final payment.

11.20 DETAILED SCHEDULES AND CHARTS

The scheduling of activities is the first major requirement of the program office after program go-ahead. The program office normally assumes full responsibility for activity scheduling if the activity is not too complex. For large programs, functional management input is required before scheduling can be completed. Depending on program size and contractual requirements, the program office may have a staff member whose sole responsibility is to continuously develop and update activity schedules to track program work. The resulting information is supplied to program office personnel, functional management, team members, and the customer.

Activity scheduling is probably the single most important tool for determining how company resources should be integrated. Activity schedules are invaluable for projecting time-phased resource utilization requirements, providing a basis for visually tracking performance and estimating costs. The schedules serve as master plans from which both the customer and management have an up-to-date picture of operations.

Certain guidelines should be followed in the preparation of schedules, regardless of the projected use or complexity:

- All major events and dates must be clearly identified. If a statement of work is supplied by the customer, those dates shown on the accompanying schedules must be included. If for any reason the customer's milestone dates cannot be met, the customer should be notified immediately.
- The exact sequence of work should be defined through a network in which interrelationships between events can be identified.
- Schedules should be directly relatable to the work breakdown structure. If the WBS is developed according to a specific sequence of work, then it becomes an easy task to identify work sequences in schedules using the same numbering system as in the WBS. The minimum requirement should be to show where and when all tasks start and finish.
- All schedules must identify the time constraints and, if possible, should identify those resources required for each event.

Although these four guidelines relate to schedule preparation, they do not define how complex the schedules should be. Before preparing schedules, three questions should be considered:

- How many events or activities should each network have?
- How much of a detailed technical breakdown should be included?
- Who is the intended audience for this schedule?

Most organizations develop multiple schedules: summary schedules for management and planners and detailed schedules for the doers and lower-level control. The detailed schedules may be strictly for interdepartmental activities. Program management must approve all schedules down through the first three levels of the work breakdown structure. For lower-level schedules (i.e., detailed interdepartmental), program management may or may not request a sign of approval.

One of the most difficult problems to identify in schedules is a hedge position. A hedge position is a situation in which the contractor may not be able to meet a customer's milestone date without incurring a risk, or may not be able to meet activity requirements following a milestone date because of contractual requirements. To illustrate a common hedge position, consider Example 11–1 below.

Example 11–1. Condor Corporation is currently working on a project that has three phases: design, development, and qualification of a certain component. Contractual requirements with the customer specify that no components will be fabricated for the development phase until the design review meeting is held following the design phase.

Condor has determined that if it does not begin component fabrication prior to the design review meeting, then the second and third phases will slip. Condor is willing to accept the risk that should specifications be unacceptable during the design review meeting, the costs associated with preauthorization of fabrication will be incurred. How should this be shown on a schedule? (The problems associated with performing unauthorized work are not being considered here.)

The solution is not easy. Condor must show on the master production schedule that component fabrication will begin early, at the contractor's risk. This should be followed up by a contractual letter in which both the customer and contractor understand the risks and implications.

Detailed schedules are prepared for almost every activity. It is the responsibility of the program office to marry all of the detailed schedules into one master schedule to verify that all activities can be completed as planned. The preparation sequence for schedules (and also for program plans) is shown in Figure 11–11. The program office submits a request for detailed schedules to the functional managers and the functional managers prepare summary schedules, detailed schedules, and, if time permits, interdepartmental schedules. Each functional manager then reviews his schedules with the program office. The program office, together with the functional program team members, integrates all of the plans and schedules and verifies that all contractual dates can be met.

Before the schedules are submitted to publications, rough drafts of each schedule and plan should be reviewed with the customer. This procedure accomplishes the following:

- Verifies that nothing has fallen through the cracks
- Prevents immediate revisions to a published document and can prevent embarrassing moments
- Minimizes production costs by reducing the number of early revisions
- Shows customers early in the program that you welcome their help and input into the planning phase

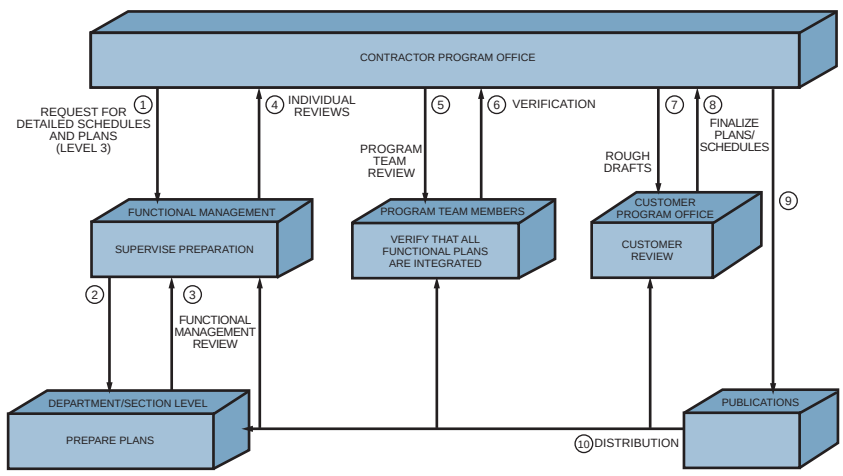


FIGURE 11–11. Preparation sequence for schedules and program plans.

After the document is published, it should be distributed to all program office personnel, functional team members, functional management, and the customer. Examples of detailed schedules are shown in Chapter 13.

In addition to the detailed schedules, the program office, with input provided by functional management, must develop organization charts. The charts show who has responsibility for each activity and display the formal (and often the informal) lines of communication. Examples were shown in Section 4.11.

The program office may also establish linear responsibility charts (LRCs). In spite of the best attempts by management, many functions in an organization may overlap between functional units. Also, management might wish to have the responsibility for a certain activity given to a functional unit that normally would not have that responsibility. This is a common occurrence on short-duration programs where management desires to cut costs and red tape.

Project personnel should keep in mind why the schedule was developed. The primary objective is usually to coordinate activities to complete the project with the:

- Best time
- Least cost
- Least risk

There are also secondary objectives of scheduling:

- Studying alternatives
- Developing an optimal schedule
- Using resources effectively
- Communicating
- Refining the estimating criteria
- Obtaining good project control
- Providing for easy revisions

Large projects, especially long-term efforts, may require a "war room." War rooms generally have only one door and no windows. All of the walls are covered with large schedules, perhaps printed on blueprint paper, and each wall could have numerous sliding panels. The schedules and charts on each wall could be updated on a daily basis. The room would be used for customer briefings, team meetings, and any other activities related specifically to this project.

11.21 MASTER PRODUCTION SCHEDULING

The release of the planning SWD, as shown in Figure 11–10, authorizes the manufacturing units to prepare a master production schedule from which detailed analysis of the utilization of company resources can be seen and tracked.

Master production scheduling is not a new concept. Earliest material control systems used a "quarterly ordering system" to produce a master production schedule (MPS) for plant production. This system uses customer order backlogs to develop a production plan over a

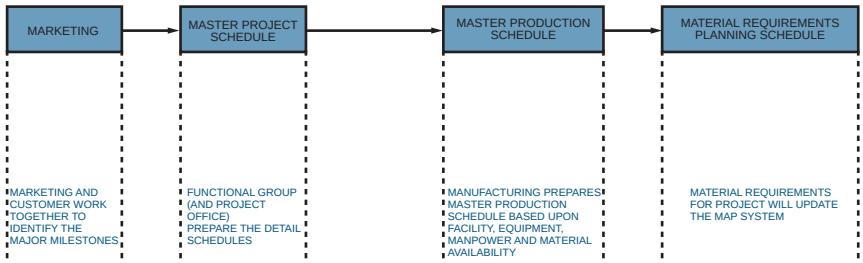


FIGURE 11–12. Material requirements planning interrelationships.

three-month period. The production plan is then exploded manually to determine what parts must be purchased or manufactured at the proper time. However, rapidly changing customer requirements and fluctuating lead times, combined with a slow response to these changes, can result in the disruption of master production scheduling.[11]

Master Production Schedule Definition

A *master production schedule* is a statement of what will be made, how many units will be made, and when they will be made. It is a production plan, not a sales plan. The MPS considers the total demand on a plant's resources, including finished product sales, spare (repair) part needs, and interplant needs. The MPS must also consider the capacity of the plant and the requirements imposed on vendors. Provisions are made in the overall plan for each manufacturing facility's operation. All planning for materials, manpower, plant, equipment, and financing for the facility is driven by the master production schedule.

Objectives of the MPS

Objectives of master production scheduling are:

- To provide top management with a means to authorize and control manpower levels, inventory investment, and cash flow
- To coordinate marketing, manufacturing, engineering, and finance activities by a common performance objective
- To reconcile marketing and manufacturing needs
- To provide an overall measure of performance
- To provide data for material and capacity planning

The development of a master production schedule is a very important step in a planning cycle. Master production schedules directly tie together personnel, materials, equipment, and facilities, as shown in Figure 11–12. Master production schedules also identify key dates to the customer, should he wish to visit the contractor during specific operational periods.

11. The master production schedule is being discussed here because of its importance in the planning cycle. The MPS cannot be fully utilized without effective inventory control procedures.

11.22 PROJECT PLAN

PMBOK® Guide, 4th Edition
Chapter 5 Project Scope Management
Chapter 4 Integration Management
3.2 Planning Process Group

A project plan is fundamental to the success of any project. For large and often complex projects, customers may require a project plan that documents all activities within the program. The project plan then serves as a guideline for the lifetime of the project and may be revised as often as once a month, depending on the circumstances and the type of project (i.e., research and development projects require more revisions to the project plan than manufacturing or construction projects). The project plan provides the following framework:

- Eliminates conflicts between functional managers
- Eliminates conflicts between functional management and program management
- Provides a standard communications tool throughout the lifetime of the project (It should be geared to the work breakdown structure)
- Provides verification that the contractor understands the customer's objectives and requirements
- Provides a means for identifying inconsistencies in the planning phase
- Provides a means for early identification of problem areas and risks so that no surprises occur downstream
- Contains all of the schedules defined in Section 11.18 as a basis for progress analysis and reporting

Development of a project plan can be time-consuming and costly. All levels of the organization participate. The upper levels provide summary information, and the lower levels provide the details. The project plan, like activity schedules, does not preclude departments from developing their own plans.

The project plan must identify how the company resources will be integrated. The process is similar to the sequence of events for schedule preparation, shown in Figure 11–11. Since the project plan must explain the events in Figure 11–11, additional iterations are required, which can cause changes in a project. This can be seen in Figure 11–13.

The project plan is a standard from which performance can be measured by the customer and the project and functional managers. The plan serves as a cookbook by answering these questions for all personnel identified with the project:

- What will be accomplished?
- How will it be accomplished?
- Where will it be accomplished?
- When will it be accomplished?
- Why will it be accomplished?

The answers to these questions force both the contractor and the customer to take a hard look at:

- Project requirements
- Project management

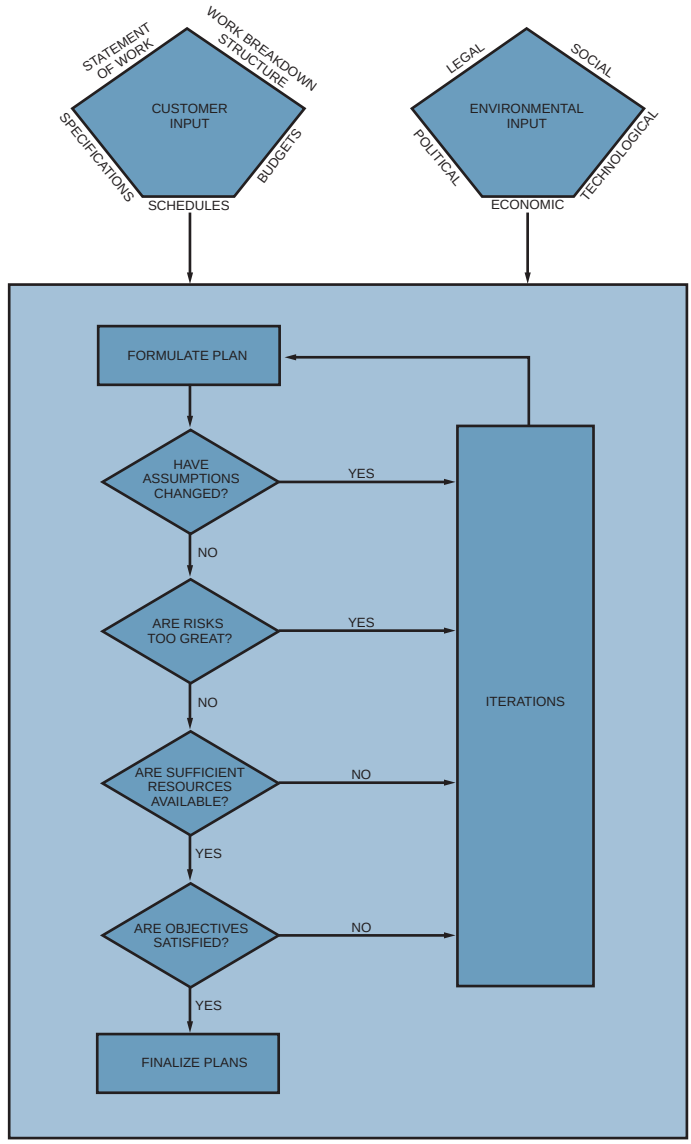


FIGURE 11–13. Iterations for the planning process.

- Project schedules
- Facility requirements
- Logistic support
- Financial support
- Manpower and organization

The project plan is more than just a set of instructions. It is an attempt to eliminate crisis by preventing anything from "falling through the cracks." The plan is documented and approved by both the customer and the contractor to determine what data, if any, are missing and the probable resulting effect. As the project matures, the project plan is revised to account for new or missing data. The most common reasons for revising a plan are:

- "Crashing" activities to meet end dates
- Trade-off decisions involving manpower, scheduling, and performance
- Adjusting and leveling manpower requests

The makeup of the project plan may vary from contractor to contractor.[12] Most project plans can be subdivided into four main sections: introduction, summary and conclusions, management, and technical. The complexity of the information is usually up to the discretion of the contractor, provided that customer requirements, as may be specified in the statement of work, are satisfied.

The introductory section contains the definition of the project and the major parts involved. If the project follows another, or is an outgrowth of similar activities, this is indicated, together with a brief summary of the background and history behind the project.

The summary and conclusion section identifies the targets and objectives of the project and includes the necessary "lip service" on how successful the project will be and how all problems can be overcome. This section must also include the project master schedule showing how all projects and activities are related. The total project master schedule should include the following:

- An appropriate scheduling system (bar charts, milestone charts, network, etc.)
- A listing of activities at the project level or lower
- The possible interrelationships between activities (can be accomplished by logic networks, critical path networks, or PERT networks)
- Activity time estimates (a natural result of the item above)

The summary and conclusion chapter is usually the second section in the project plan so that upper-level customer management can have a complete overview of the project without having to search through the technical information.

The management section of the project plan contains procedures, charts, and schedules as follows:

- The assignment of key personnel to the project is indicated. This usually refers only to the project office personnel and team members, since under normal operations these will be the only individuals interfacing with customers.

12. Cleland and King define fourteen subsections for a program plan. This detail appears more applicable to the technical and management volumes of a proposal. They do, however, provide a more detailed picture than presented here. See David I. Cleland and William R. King, *Systems Analysis and Project Management* (New York: McGraw-Hill, 1975), pp. 371–380.

- Manpower, planning, and training are discussed to assure customers that qualified people will be available from the functional units.
- A linear responsibility chart might also be included to identify to customers the authority relationships that will exist in the program.

Situations exist in which the management section may be omitted from the proposal. For a follow-up program, the customer may not require this section if management's positions are unchanged. Management sections are also not required if the management information was previously provided in the proposal or if the customer and contractor have continuous business dealings.

The technical section may include as much as 75 to 90 percent of the program plan, especially if the effort includes research and development, and may require constant updating as the project matures. The following items can be included as part of the technical section:

- A detailed breakdown of the charts and schedules used in the project master schedule, possibly including schedule/cost estimates.
- A listing of the testing to be accomplished for each activity. (It is best to include the exact testing matrices.)
- Procedures for accomplishment of the testing. This might also include a description of the key elements in the operations or manufacturing plans, as well as a listing of the facility and logistic requirements.
- Identification of materials and material specifications. (This might also include system specifications.)
- An attempt to identify the risks associated with specific technical requirements (not commonly included). This assessment tends to scare management personnel who are unfamiliar with the technical procedures, so it should be omitted if possible.

The project plan, as used here, contains a description of all phases of the project. For many projects, especially large ones, detailed planning is required for all major events and activities. Table 11–4 identifies the type of individual plans that may be required in place of a (total) project plan. These are often called subsidiary plans.

The project plan, once agreed on by the contractor and customer, is then used to provide project direction. This is shown in Figure 11–14. If the project plan is written clearly, then any functional manager or supervisor should be able to identify what is expected of him. The project plan should be distributed to each member of the project team, all functional managers and supervisors interfacing with the project, and all key functional personnel.

One final note need be mentioned concerning the legality of the project plan. The project plan may be specified contractually to satisfy certain requirements as identified in the customer's statement of work. The contractor retains the right to decide how to accomplish this, unless, of course, this is also identified in the SOW. If the SOW specifies that quality assurance testing will be accomplished on fifteen end-items from the production line, then fifteen is the minimum number that must be tested. The project plan may show that twenty-five items are to be tested. If the contractor develops cost overrun problems, he may wish to revert to the SOW and test only fifteen items. Contractually, he may do this without

TABLE 11–4. TYPES OF PLANS

Type of Plan	Description
Budget	How much money is allocated to each event?
Configuration management	How are technical changes made?
Facilities	What facilities resources are available?
Logistics support	How will replacements be handled?
Management	How is the program office organized?
Manufacturing	What are the time-phase manufacturing events?
Procurement	What are my sources? Should I make or buy? If vendors are not qualified, how shall I qualify them?
Quality assurance	How will I guarantee specifications will be met?
Research/development	What are the technical activities?
Scheduling	Are all critical dates accounted for?
Tooling	What are my time-phased tooling requirements?
Training	How will I maintain qualified personnel?
Transportation	How will goods and services be shipped?

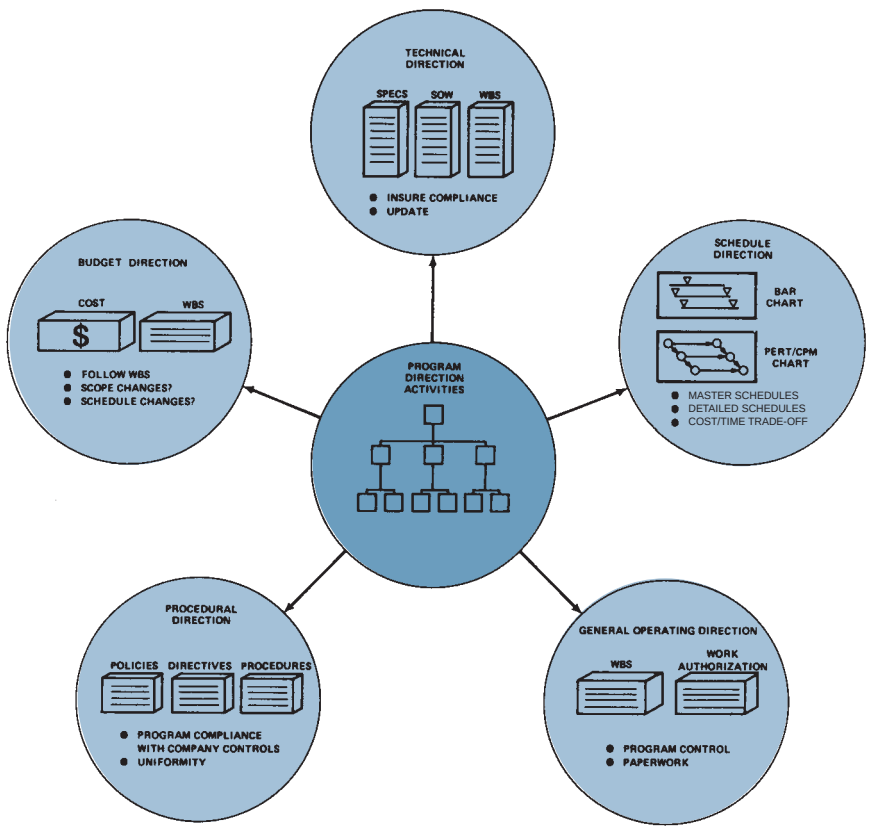


FIGURE 11–14. Project direction activities.

informing the customer. In most cases, however, the customer is notified, and the project is revised.

11.23 TOTAL PROJECT PLANNING

PMBOK® Guide, 4th Edition
Chapter 5 Project Scope Management
Chapter 4 Integration Management
3.2 Planning Process Group

The difference between the good project manager and the poor project manager is often described in one word: planning. Project planning involves planning for:

- Schedule development
- Budget development
- Project administration (see Section 5.3)
- Leadership styles (interpersonal influences; see Section 5.4)
- Conflict management (see Chapter 7)

The first two items involve the quantitative aspects of planning. Planning for project administration includes the development of the linear responsibility chart.

Although each project manager has the authority and responsibility to establish project policies and procedures, they must fall within the general guidelines established by top management.

Linear responsibility charts can result from customer-imposed requirements above and beyond normal operations. For example, the customer may require as part of his quality control requirements that a specific engineer supervise and approve all testing of a certain item, or that another individual approve all data released to the customer over and above program office approval. Customer requirements similar to those identified above require LRCs and can cause disruptions and conflicts within an organization.

Several key factors affect the delegation of authority and responsibility both from upper-level management to project management, and from project management to functional management. These key factors include:

- The maturity of the project management function
- The size, nature, and business base of the company
- The size and nature of the project
- The life cycle of the project
- The capabilities of management at all levels

Once agreement has been reached on the project manager's authority and responsibility, the results may be documented to delineate that role regarding:

- Focal position
- Conflict between the project manager and functional managers
- Influence to cut across functional and organizational lines
- Participation in major management and technical decisions
- Collaboration in staffing the project
- Control over allocation and expenditure of funds
- Selection of subcontractors

- Rights in resolving conflicts
- Input in maintaining the integrity of the project team
- Establishment of project plans
- Provisions for a cost-effective information system for control
- Provisions for leadership in preparing operational requirements
- Maintenance of prime customer liaison and contact
- Promotion of technological and managerial improvements
- Establishment of project organization for the duration
- Elimination of red tape

Documenting the project manager's authority is necessary in some situations because:

- All interfacing must be kept as simple as possible.
- The project manager must have the authority to "force" functional managers to depart from existing standards and possibly incur risk.
- Gaining authority over those elements of a program that are not under the project manager's control is essential. This is normally achieved by earning the respect of the individuals concerned.
- The project manager should not attempt to fully describe the exact authority and responsibilities of the project office personnel or team members. Problem-solving rather than role definition should be encouraged.

Although documenting project authority is undesirable, it may be necessary, especially if project initiation and planning require a formal project chart. In such a case, a letter such as that shown in Table 11–5 may suffice.

Power and authority are often discussed as though they go hand in hand. Authority comes from people above you, perhaps by delegation, whereas power comes from people below you. You can have authority without power or power without authority.

In a traditional organizational structure, most individuals maintain position power. The higher up you sit, the more power you have. But in project management, the reporting level of the project might be irrelevant, especially if a project sponsor exists. In project management, the project manager's power base emanates from his

- Expertise (technical or managerial)
- Credibility with employees
- Sound decision-making ability

The last item is usually preferred. If the project manager is regarded as a sound decision-maker, then the employees normally give the project manager a great deal of power over them.

Leadership styles refer to the interpersonal influence modes that a project manager can use. Project managers may have to use several different leadership styles, depending on the makeup of the project personnel. Conflict management is important because if the project manager can predict what conflicts will occur and when they are most likely to occur, he may be able to plan for the resolution of the conflicts through project administration.

Figure 11–15 shows the complete project planning phase for the quantitative portions. The object, of course, is to develop a project plan that shows complete distribution of

PMBOK® Guide, 4th Edition
4.1 Develop Project Charter

TABLE 11–5. PROJECT CHARTER

ELECTRODYNAMICS
12 Oak Avenue
Cleveland, Ohio 44114

11 June 2001

To: Distribution
From: L. White, Executive Vice President
Subject: Project Charter for the Acme Project

Mr. Robert L. James has been assigned as the Project Manager for the Acme Project.

Responsibility

Mr. James will be responsible for ensuring that all key milestones are met within the time, cost, and performance constraints of his project, while adhering to proper quality control standards. Furthermore, the project manager must work closely with line managers to ensure that all assigned resources are used effectively and efficiently, and that the project is properly staffed.

Additionally, the project manager will be responsible for:

1. All formal communications between the customer and contractor.
2. Preparation of a project plan that is realistic, and acceptable by both the customer and contractor.
3. Preparation of all project data items.
4. Keeping executive management informed as to project status through weekly (detailed) and monthly (summary) status reporting.
5. Ensuring that all functional employees and managers are kept informed as to their responsibilities on the project and all revisions imposed by the customer or parent organization.
6. Comparing actual to predicted cost and performance, and taking corrective action when necessary.
7. Maintaining a plan that continuously displays the project's time, cost, and performance as well as resource commitments made by the functional managers.

Authority

To ensure that the project meets its objectives, Mr. James is authorized to manage the project and issue directives in accordance to the policies and procedures section of the company's *Project Management Manual*. Additional directives may be issued through the office of the executive vice-president.

The program manager's authority also includes:

1. Direct access to the customer on all matters pertaining to the Acme Project.
2. Direct access to Electrodynamics' executive management on all matters pertaining to the Acme Project.
3. Control and distribution of all project dollars, including procurement, such that company and project cash flow limitations are adhered to.
4. To revise the project plan as needed, and with customer approval.
5. To require periodic functional status reporting.
6. To monitor the time, cost, and performance activities in the functional departments and ensure that all problems are promptly identified, reported, and solved.
7. To cut across all functional lines and to interface with all levels of management as necessary to meet project requirements.
8. To renegotiate with functional managers for changes in personnel assignments.
9. Delegating responsibilities and authority to functional personnel, provided that the line manager is in approval that the employee can handle this authority/responsibility level.

Any questions regarding the above policies should be directed to the undersigned.

L. White
Executive Vice-President

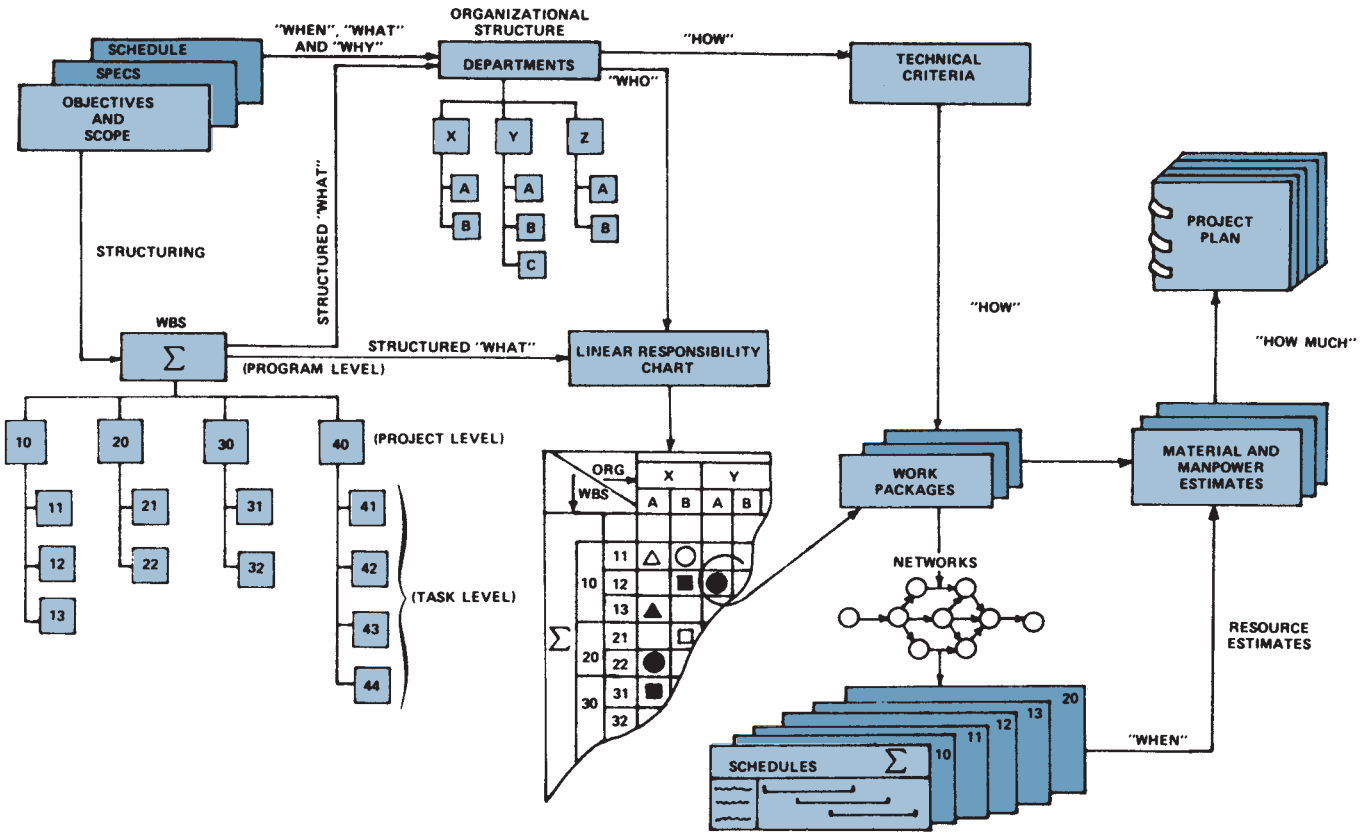


FIGURE 11–15. Project planning.

resources and the corresponding costs. The figure represents an iterative process. The project manager begins with a coarse (arrow diagram) network, and then decides on the work breakdown structure. The WBS is essential to the arrow diagram and should be constructed so that reporting elements and levels are easily identifiable. Eventually, there will be an arrow diagram and detailed chart for each element in the WBS. If there is too much detail, the project manager can refine the diagram by combining all logic into one plan and can then decide on the work assignments. There is a risk here that, by condensing the diagrams as much as possible, there may be a loss of clarity. As shown in Figure 11–15, all the charts and schedules can be integrated into one summary-level figure. This can be accomplished at each WBS level until the desired plan is achieved.

Finally, project, line, and executive management must analyze other internal and external variables before finalizing these schedules. These variables include:

- Introduction or acceptance of the product in the marketplace
- Present or planned manpower availability
- Economic constraints of the project
- Degree of technical difficulty
- Manpower availability
- Availability of personnel training
- Priority of the project

In small companies and projects, certain items in Figure 11–15 may be omitted, such as the LRCs.

11.24 THE PROJECT CHARTER

PMBOK® Guide, 4th Edition
4.1 Develop Project Charter

The original concept behind the project charter was to document the project manager's authority and responsibility, especially for projects implemented away from the home office. Today, the project charter is more of an internal legal document identifying to the line managers and their personnel the project manager's authority and responsibility and the management- and/or customer-approved scope of the project.

Theoretically, the sponsor prepares the charter and affixes his/her signature, but in reality, the project manager may prepare it for the sponsor's signature. At a minimum, the charter should include:

- Identification of the project manager and his/her authority to apply resources to the project
- The business purpose that the project was undertaken to address, including all assumptions and constraints
- Summary of the conditions defining the project
- Description of the project
- Objectives and constraints on the project
- Project scope (inclusions and exclusions)
- Key stakeholders and their roles

- Risks
- Involvement by certain stakeholders

The PMBOK® Guide provides a framework for the project charter. What is somewhat unfortunate is that every company seems to have its own idea of what should be included in a charter. The contents of a charter are often dependent upon where in the evolution and life cycle of a project the charter is prepared. (See *Advanced Project Management: Best Practices on Implementation* by Harold Kerzner, John Wiley & Sons, New York, 2004, pp. 101–102, 120, 629–630.) Some companies such as Computer Associates use both a full charter (closely aligned to the PMBOK® Guide) and an abbreviated charter based upon the size and complexity of the project.

The charter is a "legal" agreement between the project manager and the company. Some companies supplement the charter with a "contract" that functions as an agreement between the project and the line organizations.

Some companies have converted the charter into a highly detailed document containing:

- The scope baseline/scope statement
  - Scope and objectives of the project (SOW)
  - Specifications
  - WBS (template levels)
  - Timing
  - Spending plan (S-curve)
- The management plan
  - Resource requirements and manloading (if known)
  - Resumés of key personnel
  - Organizational relationships and structure
  - Responsibility assignment matrix
  - Support required from other organizations
  - Project policies and procedures
  - Change management plan
  - Management approval of above

When the project charter contains a scope baseline and management plan, the project charter may function as the project plan. This is not really an effective use of the charter, but it may be acceptable on certain types of projects for internal customers.

11.25 MANAGEMENT CONTROL

PMBOK® Guide, 4th Edition
4.5 Integrated Change Control

Because the planning phase provides the fundamental guidelines for the remainder of the project, careful management control must be established. In addition, since planning is an ongoing activity for a variety of different programs, management guidelines must be established on a company-wide basis in order to achieve unity and coherence.

All functional organizations and individuals working directly or indirectly on a program are responsible for identifying, to the project manager, scheduling and planning

TABLE 11–6. PLANNING AND REQUIREMENTS POLICIES

Program Manager	Functional Manager	Relationship
Requests the preparation of the program master schedules and provides for integration with the division composite schedules.	Develops the details of the program plans and requirements in conjunction with the program manager. Provides proposal action in support of program manager requirements and the program master schedule.	Program planning and scheduling is a functional specialty; the program manager utilizes the services of the specialist organizations. The specialists retain their own channels to the general manager but must keep the program manager informed.
Defines work to be accomplished through preparation of the subdivided work description package.		
Provides program guidance and direction for the preparation of program plans that establish program cost, schedule, and technical performance; and that define the major events and tasks to ensure the orderly progress of the program.	With guidance furnished by the program manager, participates in the preparation of program plans, schedules, and work release documents which cover cost, schedule, and technical performance; and which define major events and tasks. Provides supporting detail plans and schedules.	Program planning is also a consultative operation and is provided guidelines by the program manager. Functional organizations initiate supporting plans for program manager approval, or react to modify plans to maintain currency. Functional organizations also initiate planning studies involving trade-offs and alternative courses of action for presentation to the program manager.
Establishes priorities within the program. Obtains relative program priorities between programs managed by other programs from the director, program management, manager, marketing and product development, or the general manager as specified by the policy.	Negotiates priorities with program managers for events and tasks to be performed by his organization.	The program manager and program team members are oriented to his program, whereas the functional organizations and the functional managers are “function” and multiprogram oriented. The orientation of each director, manager, and team member

		must be mutually recognized to preclude unreasonable demands and conflicting priorities. Priority conflicts that cannot be resolved must be referred to the general manager.
Approves program contractual data requirements.	Conducts analysis of contractual data requirements. Develops data plans including contractor data requirements list and obtains program manager approval.	
Remains alert to new contract requirements, government regulations and directives that might affect the work, cost, or management of the program.	Remains alert to new contract requirements, government regulations, and directives that might affect the work, cost, or management of his organization on any program.	
Provides early technical requirements definitions, and substantiates make-or-buy recommendations. Participates in the formulation of the make-or-buy plan for the program.	Provides the necessary make-or-buy data; substantiates estimates and recommendations in the area of functional specialty.	Make-or-buy concurrence and approvals are obtained in accordance with current Policies and Procedures.
Approves the program bill of material for need and compliance with program need and requirements.	Prepares the program bill of material.	
Directs data management including maintenance of current and historical files on programmed contractual data requirements.		

TABLE 11–7. SCHEDULING POLICIES

Program Manager	Functional Manager	Relationship
Provides contractual data requirements and guidance for construction of program master schedules.	The operations directorate shall construct the program master schedule. Data should include but not be limited to engineering plans, manufacturing plans, procurement plans, test plans, quality plans, and provide time spans for accomplishment of work elements defined in the work breakdown structure to the level of definition visible in the planned subdivided work description package.	The operations directorate constructs the program master schedule with data received from functional organizations and direction from the program manager. Operations shall coordinate program master schedule with functional organizations and secure program manager's approval prior to release.
Concurs with detail schedules construction by functional organizations.	Constructs detail program schedules and working schedules in consonance with program manager–approved program master schedule. Secures program manager concurrence and forwards copies to the program manager.	Program manager monitors the functional organization's detail schedules for compliance with program master schedules and reports variance items that may impact division operations to the director, program management.
Provides corrective action decisions and direction as required at any time a functional organization fails to meet program master schedule requirements or when, by analysis, performance indicated by detail schedule monitoring threatens to impact the program master schedule.		

problems that require corrective action during both the planning cycle and the operating cycle. The program manager bears the ultimate and final responsibility for identifying requirements for corrective actions. Management policies and directives are written specifically to assist the program manager in defining the requirements. Without clear definitions during the planning phase, many projects run off in a variety of directions.

Many companies establish planning and scheduling management policies for the project and functional managers, as well as a brief description of how they should interface. Table 11–6 identifies a typical management policy for planning and requirements, and Table 11–7 describes scheduling management policies.

11.26 THE PROJECT MANAGER–LINE MANAGER INTERFACE

PMBOK® Guide, 4th Edition
1.6 Interpersonal Skills

The utilization of management controls, such as those outlined in Section 11.25, does not necessarily guarantee successful project planning. Good project planning, as well as other project functions, requires a good working relationship between the project and line managers. At this interface:

- The project manager answers these questions:
  - What is to be done? (using the SOW, WBS)

- When will the task be done? (using the summary schedule)
- Why will the task be done? (using the SOW)
- How much money is available? (using the SOW)

- The line manager answers these questions:
  - How will the task be done? (i.e., technical criteria)
  - Where will the task be done? (i.e., technical criteria)
  - Who will do the task? (i.e., staffing)

Project managers may be able to tell line managers "how" and "where," provided that the information appears in the SOW as a requirement for the project. Even then, the line manager can take exception based on his technical expertise.

Figures 11–16 and 11–17 show what can happen when project managers overstep their bounds. In Figure 11–16, the manufacturing manager built a brick wall to keep the project managers away from his personnel because the project managers were telling his line people how to do their job. In Figure 11–17, the subproject managers (for simplicity's sake, equivalent to project engineers) would have, as their career path, promotions to assistant project managers (APMs). Unfortunately, the APMs still felt that they were technically

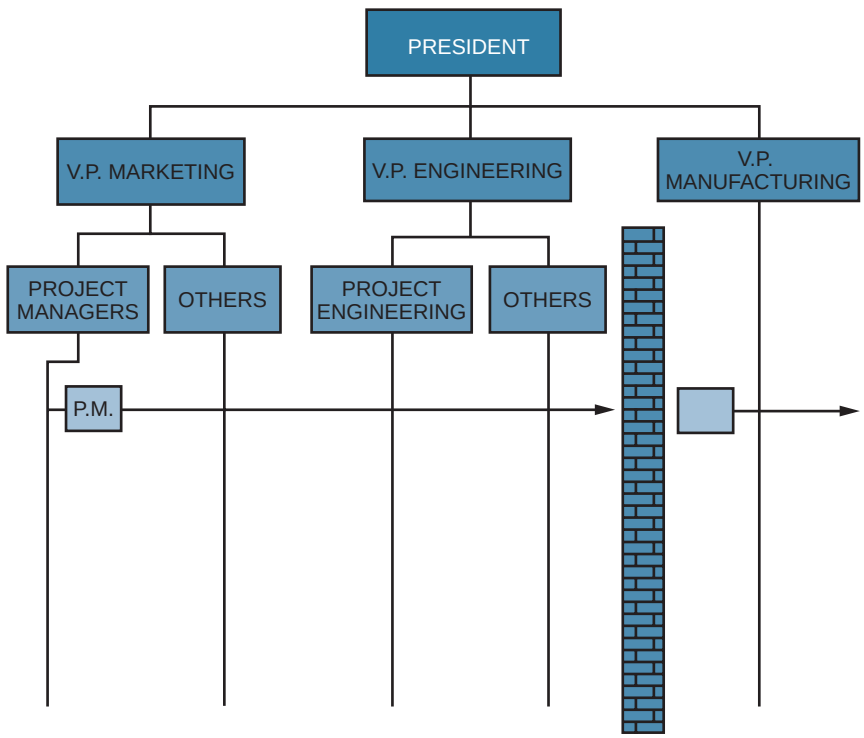


FIGURE 11–16. The brick wall.

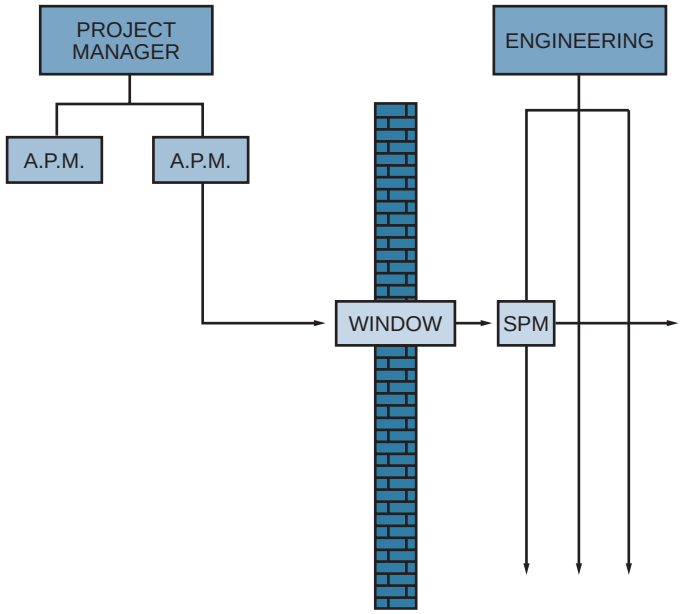


FIGURE 11–17. Modification of the brick wall.

competent enough to give technical direction, and this created havoc for the engineering managers.

The simplest solution to all of these problems is for the project manager to provide the technical direction *through* the line managers. After all, the line managers are supposedly the true technical experts.

11.27 FAST-TRACKING

PMBOK® Guide, 4th Edition
2.1 Characteristics of the Project Life Cycle

Sometimes, no matter how well we plan, something happens that causes havoc on the project. Such is the case when either the customer or management changes the project's constraints. Consider Figure 11–18 and let us assume that the execution time for the construction of the project is one year. To prepare the working drawings and specifications down through level 5 of the WBS would require an additional 35 percent of the expected execution time, and if a feasibility study is required, then an additional 40 percent will be added on. In other words, if the execution phase of the project is one year, then the entire project is almost two years.

Now, let us assume that management wishes to keep the end date fixed but the start date is delayed because of lack of adequate funding. How can this be accomplished *without* sacrificing the quality? The answer is to fast-track the project. Fast-tracking a project means that activities that are normally done in series are done in parallel. An example of

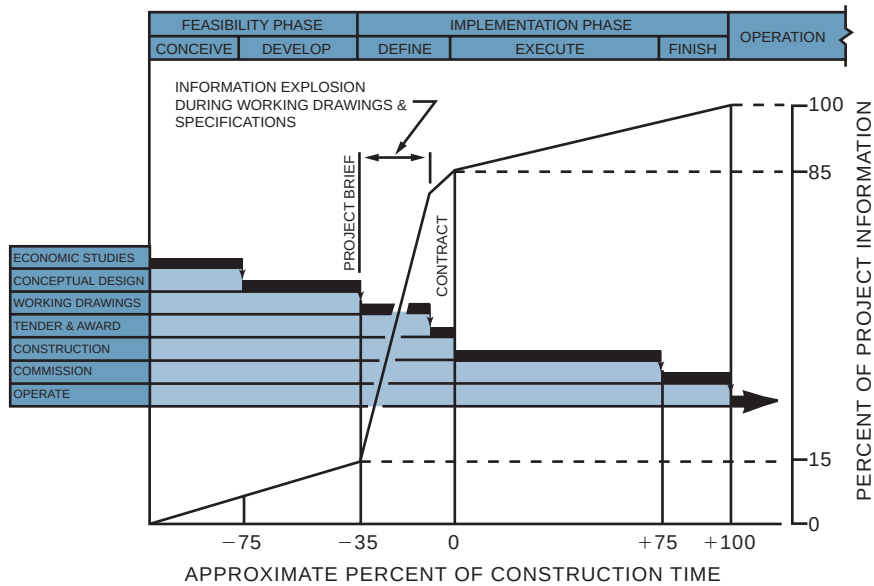


FIGURE 11–18. The information explosion. *Source:* R. M. Wideman, *Cost Control of Capital Projects* (Vancouver, B.C.: A.E.W. Services of Canada, 1983), p. 22.

this is when construction begins before detail design is completed. (See Chapter 2, Table 2–5 on life-cycle phases.)

Fast-tracking a job can accelerate the schedule but requires that additional risks be taken. If the risks materialize, then either the end date will slip or expensive rework will be needed. Almost all project-driven companies fast-track projects, but there is danger when fast-tracking becomes a way of life.

11.28 CONFIGURATION MANAGEMENT

PMBOK® Guide, 4th Edition
4.5 Integrated Change Control

A critical tool employed by a project manager is configuration management or configuration change control. As projects progress downstream through the various life-cycle phases, the cost of engineering changes can grow boundlessly. It is not uncommon for companies to bid on proposals at 40 percent below their own cost hoping to make up the difference downstream with engineering changes. It is also quite common for executives to "encourage" project managers to seek out engineering changes because of their profitability.

Configuration management is a control technique, through an orderly process, for formal review and approval of configuration changes. If properly implemented, configuration management provides

- Appropriate levels of review and approval for changes
- Focal points for those seeking to make changes
- A single point of input to contracting representatives in the customer's and contractor's office for approved changes

At a minimum, the configuration control committee should include representation from the customer, contractor, and line group initiating the change. Discussions should answer the following questions:

- What is the cost of the change?
- Do the changes improve quality?
- Is the additional cost for this quality justifiable?
- Is the change necessary?
- Is there an impact on the delivery date?

Changes cost money. Therefore, it is imperative that configuration management be implemented correctly. The following steps can enhance the implementation process:

- Define the starting point or "baseline" configuration
- Define the "classes" of changes
- Define the necessary controls or limitations on both the customer and contractor
- Identify policies and procedures, such as
  - Board chairman
  - Voters/alternatives
  - Meeting time
  - Agenda
  - Approval forums
  - Step-by-step processes
  - Expedition processes in case of emergencies

Effective configuration control pleases both customer and contractor. Overall benefits include:

- Better communication among staff
- Better communication with the customer
- Better technical intelligence
- Reduced confusion for changes
- Screening of frivolous changes
- Providing a paper trail

As a final note, it must be understood that configuration control, as used here, is not a replacement for design review meetings or customer interface meetings. These meetings are still an integral part of all projects.

11.29 ENTERPRISE PROJECT MANAGEMENT METHODOLOGIES

Enterprise project management methodologies can enhance the project planning process as well as providing some degree of standardization and consistency.

Companies have come to the realization that enterprise project management methodologies work best if the methodology is based upon templates rather than rigid policies and

procedures. The International Institute for Learning has created a Unified Project Management Methodology (UPMM™) with templates categorized according to the PMBOK® Guide Areas of Knowledge[13]:

Communication
- Project Charter
- Project Procedures Document
- Project Change Requests Log
- Project Status Report
- PM Quality Assurance Report
- Procurement Management Summary
- Project Issues Log
- Project Management Plan
- Project Performance Report

Cost
- Project Schedule
- Risk Response Plan and Register
- Work Breakdown Structure (WBS)
- Work Package
- Cost Estimates Document
- Project Budget
- Project Budget Checklist

Human Resources
- Project Charter
- Work Breakdown Structure (WBS)
- Communications Management Plan
- Project Organization Chart
- Project Team Directory
- Responsibility Assignment Matrix (RAM)
- Project Management Plan
- Project Procedures Document
- Kickoff Meeting Checklist
- Project Team Performance Assessment
- Project Manager Performance Assessment

Integration
- Project Procedures Overview
- Project Proposal
- Communications Management Plan

13. Unified Project Management Methodology (UPMM™) is registered, copyrighted, and owned by International Institute for Learning, Inc., © 2005; reproduced by permission.

Procurement Plan
Project Budget
Project Procedures Document
Project Schedule
Responsibility Assignment Matrix (RAM)
Risk Response Plan and Register
Scope Statement
Work Breakdown Structure (WBS)
Project Management Plan
Project Change Requests Log
Project Issues Log
Project Management Plan Changes Log
Project Performance Report
Lessons Learned Document
Project Performance Feedback
Product Acceptance Document
Project Charter
Closing Process Assessment Checklist
Project Archives Report

Procurement

Project Charter
Scope Statement
Work Breakdown Structure (WBS)
Procurement Plan
Procurement Planning Checklist
Procurement Statement of Work (SOW)
Request for Proposal Document Outline
Project Change Requests Log
Contract Formation Checklist
Procurement Management Summary

Quality

Project Charter
Project Procedures Overview
Work Quality Plan
Project Management Plan
Work Breakdown Structure (WBS)
PM Quality Assurance Report
Lessons Learned Document
Project Performance Feedback
Project Team Performance Assessment
PM Process Improvement Document

Risk

Procurement Plan
Project Charter

Project Procedures Document
Work Breakdown Structure (WBS)
Risk Response Plan and Register

Scope
Project Scope Statement
Work Breakdown Structure (WBS)
Work Package
Project Charter

Time
Activity Duration Estimating Worksheet
Cost Estimates Document
Risk Response Plan and Register Medium
Work Breakdown Structure (WBS)
Work Package
Project Schedule
Project Schedule Review Checklist

11.30 PROJECT AUDITS

In recent years, the necessity for a structured independent review of various parts of a business, including projects, has taken on a more important role. Part of this can be attributed to the Sarbanes–Oxley law compliance requirements. These independent reviews are audits that focus on either discovery or decision-making. The audits can be scheduled or random and can be performed by in-house personnel or external examiners.

There are several types of audits. Some common types include:

- **Performance Audits:** These audits are used to appraise the progress and performance of a given project. The project manager, project sponsor, or an executive steering committee can conduct this audit.
- **Compliance Audits:** These audits are usually performed by the project management office (PMO) to validate that the project is using the project management methodology properly. Usually the PMO has the authority to perform the audit but may not have the authority to enforce compliance.
- **Quality Audits:** These audits ensure that the planned project quality is being met and that all laws and regulations are being followed. The quality assurance group performs this audit.
- **Exit Audits:** These audits are usually for projects that are in trouble and may need to be terminated. Personnel external to the project, such as an exit champion or an executive steering committee, conduct the audits.
- **Best Practices Audits:** These audits can be conducted at the end of each life-cycle phase or at the end of the project. Some companies have found that project managers may not be the best individuals to perform the audit. In such situations, the company may have professional facilitators trained in conducting best practices reviews.

11.31 STUDYING TIPS FOR THE PMI® PROJECT MANAGEMENT CERTIFICATION EXAM

This section is applicable as a review of the principles to support the knowledge areas and domain groups in the PMBOK® Guide. This chapter addresses:

- Scope Management
- Initiation
- Planning
- Execution
- Monitoring
- Closure

Understanding the following principles is beneficial if the reader is using this text to study for the PMP® Certification Exam:

- Need for effective planning
- Components of a project plan and subsidiary plans
- Need for and components of a statement of work (both proposal and contractual)
- How to develop a work breakdown structure and advantages and disadvantages of highly detailed levels
- Types of work breakdown structures
- Purpose of a work package
- Purpose of configuration management and role of the change control board
- Need for a project charter and components of a project charter
- Need for the project team to be involved in project-planning activities
- That changes to a plan or baseline need to be managed

In Appendix C, the following Dorale Products mini–case studies are applicable:

- Dorale Products (C) [Scope Management]
- Dorale Products (D) [Scope Management]
- Dorale Products (E) [Scope Management]

The following multiple-choice questions will be helpful in reviewing the principles of this chapter:

1. The document that officially sanctions the project is the:
   A. Project charter
   B. Project plan
   C. Feasibility study
   D. Cost-benefit analysis
2. The work breakdown structure “control points” for the management of a project are the:
   A. Milestones
   B. Work packages
   C. Activities
   D. Constraints
3. One of the most common reasons why projects undergo scope changes is:
   A. Poor work breakdown structure
   B. Poorly defined statement of work

C. Lack of resources
D. Lack of funding

4. Which of the following generally cannot be validated using a work breakdown structure?
A. Schedule control
B. Cost control
C. Quality control
D. Risk management

Answer questions 5–8 using the work breakdown structure (WBS) shown below (numbers in parentheses show the dollar value for a particular element):

1.00.00	
1.1.0	($25K)
1.1.1	
1.1.2	($12K)
1.2.0	
1.2.1	($16K)
1.2.2.0	
1.2.2.1	($20K)
1.2.2.2	($30K)

5. The cost of WBS element 1.2.2.0 is:
A. $20K
B. $30K
C. $50K
D. Cannot be determined

6. The cost of WBS element 1.1.1 is:
A. $12K
B. $13K
C. $25K
D. Cannot be determined

7. The cost of the entire program (1.00.00) is:
A. $25K
B. $66K
C. $91K
D. Cannot be determined

8. The work packages in the WBS are at WBS level(s):
A. 2 only
B. 3 only
C. 4 only
D. 3 and 4

9. One of the outputs of the PMBOK® Scope Planning Process is:
A. A project charter
B. A scope statement and management plan
C. A detailed WBS
D. None of the above

10. Which of the following is (are) the benefit(s) of developing a WBS to low levels?
A. Better estimation of costs
B. Better control

C. Less likely that something will "fall through the cracks"
D. All of the above

11. The PMBOK® Scope Verification Process is used to verify that:
A. The budget is correct.
B. The scope is correct.
C. The schedule is correct.
D. A life-cycle phase or the end of the project has been completed successfully.

12. Financial closeout, which is often part of following the Scope Verification Process, is used to:
A. Close out all charge numbers
B. Close out all charge numbers for the work performed and completed
C. Amend the work authorization forms
D. None of the above

13. One of your contractors has sent you an e-mail requesting that they be allowed to conduct only eight tests rather than the ten tests required by the specification. What should the project manager do first?
A. Change the scope baseline
B. Ask the contractor to put forth a change request
C. Look at the penalty clauses in the contract
D. Ask your sponsor for his or her opinion

14. One of your contractors sends you an e-mail request to use high quality raw materials in your project stating that this will be value-added and improve quality. What should the project manager do first?
A. Change the scope baseline
B. Ask the contractor to put forth a change request
C. Ask your sponsor for his or her opinion
D. Change the WBS

15. What are the maximum number of subsidiary plans a program management plan can contain?
A. 10
B. 15
C. 20
D. Unlimited number

16. The change control board, of which you are a member, approves a significant scope change. The first document that the project manager should updated would be the:
A. Scope baseline
B. Schedule
C. WBS
D. Budget

ANSWERS

1. A
2. B
3. B
4. C
5. C

6. B
7. C
8. D
9. B
10. D
11. D
12. B
13. B
14. B
15. D
16. A

PROBLEMS

11–1 Under what conditions would each of the following either not be available or not be necessary for initial planning?

a. Work breakdown structure
b. Statement of work
c. Specifications
d. Milestone schedules

11–2 What planning steps should precede total program scheduling? What steps are necessary?

11–3 How does a project manager determine how complex to make a program plan or how many schedules to include?

11–4 Can objectives always be identified and scheduled?

11–5 Can a WBS always be established for attaining an objective?

11–6 Who determines the work necessary to accomplish an objective?

11–7 What roles does a functional manager play in establishing the first three levels of the WBS?

11–8 Should the length of a program have an impact on whether to set up a separate project or task for administrative support? How about for raw materials?

11–9 Is it possible for the WBS to be designed so that resource allocation is easier to identify?

11–10 If the scope of effort of a project changes during execution of activities, what should be the role of the functional manager?

11–11 What types of conflicts can occur during the planning cycle, and what modes should be used for their resolution?

11–12 What would be the effectiveness of Figure 11–3 if the work packages were replaced by tasks?

11–13 Under what situations or projects would work planning authorization not be necessary?

11–14 On what types of projects could hedge positions be easily identified on a schedule?

11–15 Can activities 5 and 6 of Figure 11–11 be eliminated? What risks does a project manager incur if these activities are eliminated?

11–16 Where in the planning cycle should responsibility charts be prepared? Can you identify this point in Figure 11–11?

11–17 For each one of the decision points in Figure 11–13, who makes the decision? Who must input information? What is the role of the functional manager and the functional team member? Where are strategic variables identified?

11–18 Consider a project in which all project planning is performed by a group. After all planning is completed, including the program plan and schedules, a project manager is selected. Is there anything wrong with this arrangement? Can it work?

11–19 How do the customer and contractor know if each one completely understands the statement of work, the work breakdown structure, and the program plan?

11–20 Should a good project plan formulate methods for anticipating problems?

11–21 Some project managers schedule staff meetings as the primary means for planning and control. Do you agree with this philosophy?

11–22 Paul Mali (*Management by Objectives*, New York: John Wiley, 1972, p. 12) defines MBO as a five-step process:

- Finding the objective
- Setting the objective
- Validating the objective
- Implementing the objective
- Controlling and reporting status of the objective

How can the work breakdown structure be used to accomplish each of the above steps? Would you agree or disagree that the more levels the WBS contains, the greater the understanding and clarity of those steps necessary to complete the objectives?

11–23 Many textbooks on management state that you should plan like you work, by doing one thing at a time. Can this same practice be applied at the project level, or must a project manager plan all activities at once?

11–24 Is it true that project managers set the milestones and functional managers hope they can meet them?

11–25 You have been asked to develop a work breakdown structure for a project. How should you go about accomplishing this? Should the WBS be time-phased, department-phased, division-phased, or some combination?

11–26 You have just been instructed to develop a schedule for introducing a new product into the marketplace. Below are the elements that must appear in your schedule. Arrange these elements into a work breakdown structure (down through level 3), and then draw the arrow diagram. You may feel free to add additional topics as necessary.

- Production layout
- Market testing
- Review plant costs
- Select distributors

- Analyze selling cost
- Analyze customer reactions
- Storage and shipping costs
- Select salespeople
- Train salespeople
- Train distributors
- Literature to salespeople
- Literature to distributors
- Print literature
- Sales promotion
- Sales manual
- Trade advertising
- Lay out artwork
- Approve artwork
- Introduce at trade show
- Distribute to salespeople
- Establish billing procedure
- Establish credit procedure
- Revise cost of production
- Revise selling cost
- Approvals*
- Review meetings*
- Final specifications
- Material requisitions

(* Approvals and review meetings can appear several times.)

11–27 Once a project begins, a good project manager will set up checkpoints. How should this be accomplished? Will the duration of the project matter? Can checkpoints be built into a schedule? If so, how should they be identified?

11–28 Detailed schedules (through WBS levels 3, 4, 5, . . .) are prepared by the functional managers. Should these schedules be shown to the customer?

11–29 The project start-up phase is complete, and you are now ready to finalize the operational plan. Below are six steps that are often part of the finalization procedure. Place them in the appropriate order.

1. Draw diagrams for each individual WBS element.
2. Establish the work breakdown structure and identify the reporting elements and levels.
3. Create a coarse (arrow-diagram) network and decide on the WBS.
4. Refine the diagram by combining all logic into one plan. Then decide on the work assignments.
5. If necessary, try to condense the diagram as much as possible without losing clarity.
6. Integrate diagrams at each level until only one exists. Then begin integration into higher WBS levels until the desired plan is achieved.

11–30 Below are seven factors that must be considered before finalizing a schedule. Explain how a base case schedule can change as a result of each of these:

- Introduction or acceptance of the product in the marketplace
- Present or planned manpower availability
- Economic constraints of the project
- Degree of technical difficulty
- Manpower availability
- Availability of personnel training
- Priority of the project

11–31 You are the project manager of a nine-month effort. You are now in the fifth month of the project and are more than two weeks behind schedule, with very little hope of catching up. The dam breaks in a town near you, and massive flooding and mudslides take place. Fifteen of your key functional people request to take off three days from the following week to help fellow church members dig out. Their functional managers, bless their hearts, have left the entire decision up to you. Should you let them go?

11–32 Once the functional manager and project manager agree on a project schedule, who is responsible for getting the work performed? Who is accountable for getting the work performed? Why the difference, if any?

11–33 Discuss the validity of the following two statements on authority:

a. A good project manager will have more authority than his responsibility calls for.
b. A good project manager should not hold a subordinate responsible for duties that he (the project manager) does not have the authority to enforce.

11–34 Below are twelve instructions. Which are best described as planning, and which are best described as forecasting?

a. Give a complete definition of the work.
b. Lay out a proposed schedule.
c. Establish project milestones.
d. Determine the need for different resources.
e. Determine the skills required for each WBS task or element.
f. Change the scope of the effort and obtain new estimates.
g. Estimate the total time to complete the required work.
h. Consider changing resources.
i. Assign appropriate personnel to each WBS element.
j. Reschedule project resources.
k. Begin scheduling the WBS elements.
l. Change the project priorities.

11–35 A major utility company has a planning group that prepares budgets (with the help of functional groups) and selects the projects to be completed within a given time period. You are assigned as a project manager on one of the projects and find out that it should have been started "last month" in order to meet the completion date. What can you, the project manager, do about this? Should you delay the start of the project to replan the work?

11–36 The director of project management calls you into his office and informs you that one of your fellow project managers has had a severe heart attack midway through a project. You will be taking over his project, which is well behind schedule and overrunning costs. The director of project management then "orders" you to complete the project within time and cost. How do you propose to do it? Where do you start? Should you shut down the project to replan it?

11–37 Planning is often described as establishing, budgeting, scheduling, and resource allocation. Identify these four elements in Figure 11–1.

11–38 A company is undertaking a large development project that requires that a massive "blueprint design tree" be developed. What kind of WBS outline would be best to minimize the impact of having two systems, one for blueprints and one for WBS work?

11–39 A company allows each line organization to perform its own procurement activities (through a centralized procurement office) as long as the procurement funds have been allocated during the project planning phase. The project office does not sign off on these functional procurement requisitions and may not even know about them. Can this system work effectively? If so, under what conditions?

11–40 As part of a feasibility study, you are asked to prepare, with the assistance of functional managers, a schedule and cost summary for a project that will occur three years downstream,

if the project is approved at all. Suppose that three years downstream the project is approved. How does the project manager get functional managers to accept the schedule and cost summary that they themselves prepared three years before?

11–41 "Expecting trouble." Good project managers know what type of trouble can occur at the various stages in the development of a project. The activities in the numbered list below indicate the various stages of a project. The lettered list that follows identifies major problems. For each project stage, select and list all of those problems that are applicable.

1. Request for proposal _____
2. Submittal to customer _____
3. Contract award _____
4. Design review meetings _____
5. Testing the product _____
6. Customer acceptance _____

a. Engineering does not request manufacturing input for end-item producibility.
b. The work breakdown structure is poorly defined.
c. Customer does not fully realize the impact that a technical change will have upon cost and schedule.
d. Time and cost constraints are not compatible with the state of the art.
e. The project–functional interface definition is poor.
f. Improper systems integration has created conflicts and a communications breakdown.
g. Several functional managers did not realize that they were responsible for certain risks.
h. The impact of design changes is not systematically evaluated.

11–42 Table 11–8 identifies twenty-six steps in project planning and control. Below is a description of each of the twenty-six steps. Using this information, fill in columns 1 and 2 (column 2 is a group response). After your instructor provides you with column 3, fill in the remainder of the table.

1. *Develop the linear responsibility chart.* This chart identifies the work breakdown structure and assigns specific authority/responsibility to various individuals as groups in order to be sure that all WBS elements are accounted for. The linear responsibility chart can be prepared with either the titles or names of individuals. Assume that this is prepared after you negotiate for qualified personnel, so that you know either the names or capabilities of those individuals who will be assigned.
2. *Negotiate for qualified functional personnel.* Once the work is decided on, the project manager tries to identify the qualifications for the desired personnel. This then becomes the basis for the negotiation process.
3. *Develop specifications.* This is one of the four documents needed to initially define the requirements of the project. Assume that these are either performance or material specifications, and are provided to you at the initial planning stage by either the customer or the user.
4. *Determine the means for measuring progress.* Before the project plan is finalized and project execution can begin, the project manager must identify the means for measuring progress; specifically, what is meant by an out-of-tolerance condition and what are the tolerances/variances/thresholds for each WBS base case element?
5. *Prepare the final report.* This is the final report to be prepared at the termination of the project.

TABLE 11–8. STEPS IN PROJECT PLANNING AND CONTROL

Activity	Description	Column 1: Your sequence	Column 2: Group sequence	Column 3: Expert's sequence	Column 4: Difference between 1 & 3	Column 5: Difference between 2 & 3
1.	Develop linear responsibility chart					
2.	Negotiate for qualified functional personnel					
3.	Develop specifications					
4.	Determine means for measuring progress					
5.	Prepare final report					
6.	Authorize departments to begin work					
7.	Develop work breakdown structure					
8.	Close out functional work orders					
9.	Develop scope statement and set objectives					
10.	Develop gross schedule					
11.	Develop priorities for each project element					
12.	Develop alternative courses of action					
13.	Develop PERT network					
14.	Develop detailed schedules					
15.	Establish functional personnel qualifications					
16.	Coordinate ongoing activities					
17.	Determine resource requirements					
18.	Measure progress					
19.	Decide upon a basic course of action					
20.	Establish costs for each WBS element					

(*continues*)

TABLE 11–8. STEPS IN PROJECT PLANNING AND CONTROL (*Continued*)

Activity	Description	Column 1: Your sequence	Column 2: Group sequence	Column 3: Expert's sequence	Column 4: Difference between 1 & 3	Column 5: Difference between 2 & 3
21.	Review WBS costs with each functional manager					
22.	Establish a project plan					
23.	Establish cost variances for base case elements					
24.	Price out WBS					
25.	Establish logic network with checkpoints					
26.	Review base case costs with director					

6. *Authorize departments to begin work.* This step authorizes departments to begin the actual execution of the project, *not* the planning. This step occurs generally after the project plan has been established, finalized, and perhaps even approved by the customer or user group. This is the initiation of the work orders for project implementation.
7. *Develop the work breakdown structure.* This is one of the four documents required for project definition in the early project planning stage. Assume that WBS is constructed using a bottom-up approach. In other words, the WBS is constructed from the logic network (arrow diagram) and checkpoints which will eventually become the basis for the PERT/CPM charts (see Activity 25).
8. *Close out functional work orders.* This is where the project manager tries to prevent excessive charging to his project by closing out the functional work orders (i.e., Activity 6) as work terminates. This includes canceling all work orders except those needed to administer the termination of the project and the preparation of the final report.
9. *Develop scope statement and set objectives.* This is the statement of work and is one of the four documents needed in order to identify the requirements of the project. Usually, the WBS is the structuring of the statement of work.
10. *Develop gross schedule.* This is the summary or milestone schedule needed at project initiation in order to define the four requirements documents for the project. The gross schedule includes start and end dates (if known), other major milestones, and data items.
11. *Develop priorities for each project element.* After the base case is identified and alternative courses of action are considered (i.e., contingency planning), the project team performs a sensitivity analysis for each element of the WBS. This may require

assigning priorities for each WBS element, and the highest priorities may *not* necessarily be assigned to elements on the critical path.

12. *Develop alternative courses of action.* Once the base case is known and detailed courses of action (i.e., detailed scheduling) are prepared, project managers conduct "what if" games to develop possible contingency plans.
13. *Develop PERT network.* This is the finalization of the PERT/CPM network and becomes the basis from which detailed scheduling will be performed. The logic for the PERT network can be conducted earlier in the planning cycle (see Activity 25), but the finalization of the network, together with the time durations, are usually based on who has been (or will be) assigned, and the resulting authority/-responsibility of the individual. In other words, the activity time duration is a function not only of the performance standard, but also of the individual's expertise and authority/ responsibility.
14. *Develop detailed schedules.* These are the detailed project schedules, and are constructed from the PERT/CPM chart and the capabilities of the assigned individuals.
15. *Establish functional personnel qualifications.* Once senior management reviews the base case costs and approves the project, the project manager begins the task of conversion from rough to detail planning. This includes identification of the required resources, and then the respective qualifications.
16. *Coordinate ongoing activities.* These are the ongoing activities for project execution, not project planning. These are the activities that were authorized to begin in Activity 6.
17. *Determine resource requirements.* After senior management approves the estimated base case costs obtained during rough planning, detailed planning begins by determining the resource requirements, including human resources.
18. *Measure progress.* As the project team coordinates ongoing activities during project execution, the team monitors progress and prepares status reports.
19. *Decide on a basic course of action.* Once the project manager obtains the rough cost estimates for each WBS element, the project manager puts together all of the pieces and determines the basic course of action.
20. *Establish costs for each WBS element.* After deciding on the base case, the project manager establishes the base case cost for each WBS element in order to prepare for the senior management pricing review meeting. These costs are usually the same as those that were provided by the line managers.
21. *Review WBS costs with each functional manager.* Each functional manager is provided with the WBS and told to determine his role and price out his functional involvement. The project manager then reviews the WBS costs to make sure that everything was accounted for and without duplication of effort.
22. *Establish a project plan.* This is the final step in detail planning. Following this step, project execution begins. (Disregard the situation where project plan development can be run concurrently with project execution.)
23. *Establish cost variances for the base case elements.* Once the priorities are known for each base case element, the project manager establishes the allowable cost variances that will be used as a means for measuring progress. Cost reporting is minimum as long as the actual costs remain within these allowable variances.
24. *Price out the WBS.* This is where the project manager provides each functional manager with the WBS for initial activity pricing.
25. *Establish logic network with checkpoints.* This is the bottom-up approach that is often used as the basis for developing both the WBS and later the PERT/CPM network.

26. *Review base case costs with director.* Here the project manager takes the somewhat rough costs obtained during the WBS functional pricing and review and seeks management's approval to begin detail planning.

11–43 Consider the work breakdown structure shown in Figure 11–19. Can the project be managed from this one sheet of paper assuming that, at the end of each month, the project manager also receives a cost and percent-complete summary?

11–44 During 1992 and 1993, General Motors saved over $2 billion due to the cost-cutting efforts of Mr. Lopez. Rumors spread throughout the auto industry that General Motors was considering a plan to offer subcontractors ten-year contracts in exchange for a 20 percent cost reduction.

These long-term contracts provided both GM and the subcontractors the chance to develop an informal project management relationship based on trust, effective communications, and minimum documentation requirements.

a. Is it conceivable that the cost savings of 20 percent could have been realized entirely from the decrease in formalized documentation?
b. Philosophically, what do you think happened when Mr. Lopez departed GM in the spring of 1993 for a senior position at Volkswagen? Did his informal project management system continue without him? Explain your answer.

11–45 During the recession of 1989–1993, the auto industry began taking extreme cost-cutting measures by downsizing its organizations. The downsizing efforts created project

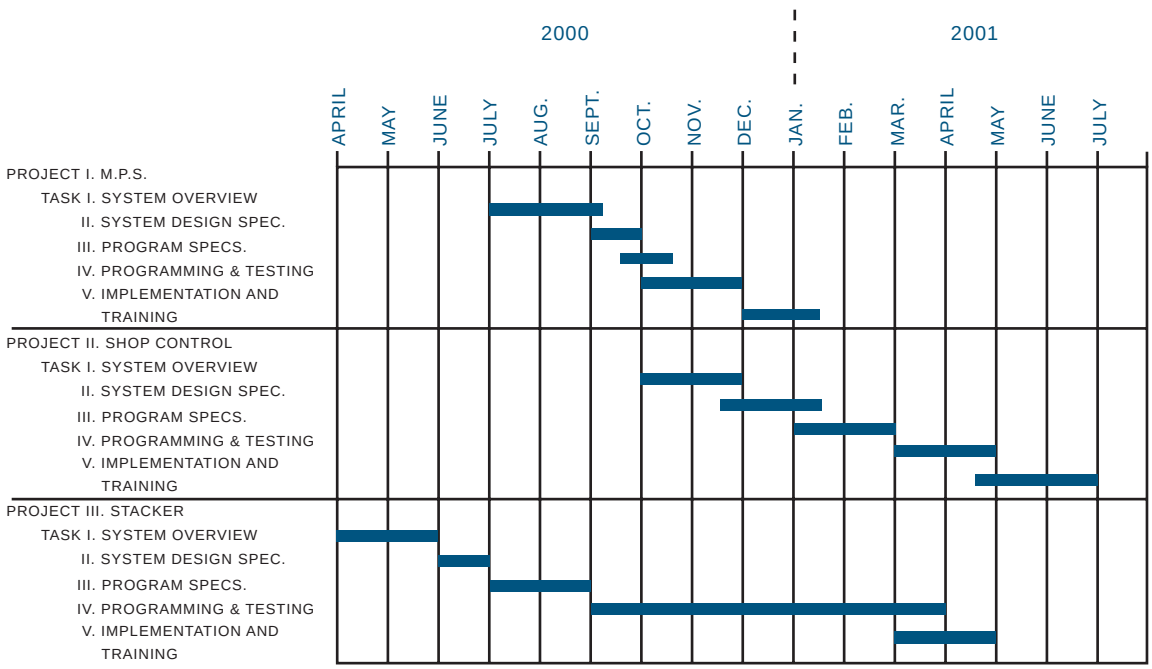
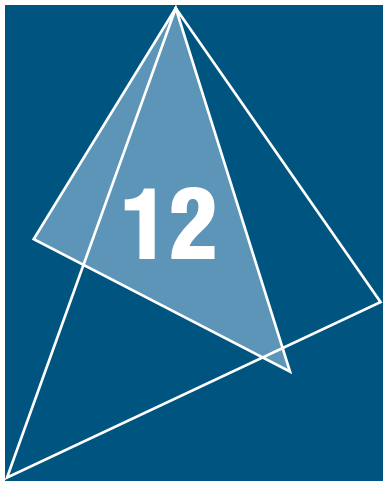


FIGURE 11–19. Work breakdown structure.

management problems for the project engineers in the manufacturing plants. With fewer resources available, more and more of the work had to be outsourced, primarily for services. The manufacturing plants had years of experience in negotiations for parts, but limited experience in negotiations for services. As a result, the service contracts were drastically overrun with engineering changes and schedule slippages. What is the real problem and your recommendation for a solution?

11–46 When to bring the project manager on board has always been a problem. For each of the following situations, identify the advantages and disadvantages.

a. The project manager is brought on board at the beginning of the conceptual phase but acts only as an observer. The project manager neither answers questions nor provides his ideas until the brainstorming session is completed.
b. When brainstorming is completed during the conceptual phase, senior management appoints one of the brainstorming team members to serve as the project manager.



Network Scheduling Techniques

Related Case Studies (from Kerzner/*Project Management Case Studies*, 3rd Edition)	Related Workbook Exercises (from Kerzner/*Project Management Workbook and PMP®/CAPM® Exam Study Guide*, 10th Edition)	PMBOK® Guide, 4th Edition, Reference Section for the PMP® Certification Exam
• Crosby Manufacturing Corporation*	• Crashing the Effort • Multiple Choice Exam • Crossword Puzzle on Time (Schedule) Management	• Time Management

12.0 INTRODUCTION

PMBOK® Guide, 4th Edition
Chapter 6 Project Time Management

Management is continually seeking new and better control techniques to cope with the complexities, masses of data, and tight deadlines that are characteristic of highly competitive industries. Managers also want better methods for presenting technical and cost data to customers.

Scheduling techniques help achieve these goals. The most common techniques are:

PMBOK® Guide, 4th Edition
6.1.3.3 Milestone Lists

- Gantt or bar charts

*Case Study also appears at end of chapter.

PMBOK® Guide, 4th Edition
6.2 Activity Sequencing

- Milestone charts
- Line of balance[1]
- Networks
- Program Evaluation and Review Technique (PERT)
- Arrow Diagram Method (ADM) [Sometimes called the Critical Path Method (CPM)][2]
- Precedence Diagram Method (PDM)
- Graphical Evaluation and Review Technique (GERT)

Advantages of network scheduling techniques include:

- They form the basis for all planning and predicting and help management decide how to use its resources to achieve time and cost goals.
- They provide visibility and enable management to control "one-of-a-kind" programs.
- They help management evaluate alternatives by answering such questions as how time delays will influence project completion, where slack exists between elements, and what elements are crucial to meet the completion date.
- They provide a basis for obtaining facts for decision-making.
- They utilize a so-called time network analysis as the basic method to determine manpower, material, and capital requirements, as well as to provide a means for checking progress.
- They provide the basic structure for reporting information.
- They reveal interdependencies of activities.
- They facilitate "what if" exercises.
- They identify the longest path or critical paths.
- They aid in scheduling risk analysis.

PERT was originally developed in 1958 and 1959 to meet the needs of the "age of massive engineering" where the techniques of Taylor and Gantt were inapplicable. The Special Projects Office of the U.S. Navy, concerned with performance trends on large military development programs, introduced PERT on its Polaris Weapon System in 1958, after the technique had been developed with the aid of the management consulting firm of Booz, Allen, and Hamilton. Since that time, PERT has spread rapidly throughout almost all industries. At about the same time, the DuPont Company initiated a similar technique known as the critical path method (CPM), which also has spread widely, and is particularly concentrated in the construction and process industries.

In the early 1960s, the basic requirements of PERT/time as established by the Navy were as follows:

- All of the individual tasks to complete a program must be clear enough to be put down in a network, which comprises events and activities; i.e., follow the work breakdown structure.
- Events and activities must be sequenced on the network under a highly logical set of ground rules that allow the determination of critical and subcritical paths. Networks may have more than one hundred events, but not fewer than ten.

1. Line of balance is more applicable to manufacturing operations for production line activities. However, it can be used for project management activities where a finite number of deliverables must be produced in a given time period. The reader need only refer to the multitude of texts on production management for more information on this technique.

2. The text uses the term CPM instead of ADM. The reader should understand that they are interchangeable.

- Time estimates must be made for each activity on a three-way basis. Optimistic, most likely, and pessimistic elapsed-time figures are estimated by the person(s) most familiar with the activity.
- Critical path and slack times are computed. The critical path is that sequence of activities and events whose accomplishment will require the greatest time.

A big advantage of PERT lies in its extensive planning. Network development and critical path analysis reveal interdependencies and problems that are not obvious with other planning methods. PERT therefore determines where the greatest effort should be made to keep a project on schedule.

The second advantage of PERT is that one can determine the probability of meeting deadlines by development of alternative plans. If the decision maker is statistically sophisticated, he can examine the standard deviations and the probability of accomplishment data. If there exists a minimum of uncertainty, one may use the single-time approach, of course, while retaining the advantage of network analysis.

A third advantage is the ability to evaluate the effect of changes in the program. For example, PERT can evaluate the effect of a contemplated shift of resources from the less critical activities to the activities identified as probable bottlenecks. PERT can also evaluate the effect of a deviation in the actual time required for an activity from what had been predicted.

Finally, PERT allows a large amount of sophisticated data to be presented in a well-organized diagram from which contractors and customers can make joint decisions.

PERT, unfortunately, is not without disadvantages. The complexity of PERT adds to implementation problems. There exist more data requirements for a PERT-organized reporting system than for most others. PERT, therefore, becomes expensive to maintain and is utilized most often on large, complex programs.

Many companies have taken a hard look at the usefulness of PERT on small projects. The result has been the development of PERT/LOB procedures, which can do the following:

- Cut project costs and time
- Coordinate and expedite planning
- Eliminate idle time
- Provide better scheduling and control of subcontractor activities
- Develop better troubleshooting procedures
- Cut the time required for routine decisions, but allow more time for decision-making

Even with these advantages, many companies should ask whether they actually need PERT because incorporating it may be difficult and costly, even with canned software packages. Criticism of PERT includes:

- Time and labor intensive
- Decision-making ability reduced
- Lacks functional ownership in estimates
- Lacks historical data for time–cost estimates
- Assumes unlimited resources
- Requires too much detail

An in-depth study of PERT would require a course or two by itself. The intent of this chapter is to familiarize the reader with the terminology, capability, and applications of networks.

12.1 NETWORK FUNDAMENTALS

PMBOK® Guide, 4th Edition
6.2 Activity Sequencing
6.2.2 Activity Sequencing Tools and Techniques

The major discrepancy with Gantt, milestone, or bubble charts is the inability to show the interdependencies between events and activities. These interdependencies must be identified so that a master plan can be developed that provides an up-to-date picture of operations at all times.

Interdependencies are shown through the construction of networks. Network analysis can provide valuable information for planning, integration of plans, time studies, scheduling, and resource management. The primary purpose of network planning is to eliminate the need for crisis management by providing a pictorial representation of the total program. The following management information can be obtained from such a representation:

- Interdependencies of activities
- Project completion time
- Impact of late starts
- Impact of early starts
- Trade-offs between resources and time
- "What if" exercises
- Cost of a crash program
- Slippages in planning/performance
- Evaluation of performance

Networks are composed of events and activities. The following terms are helpful in understanding networks:

- **Event:** Equivalent to a milestone indicating when an activity starts or finishes.
- **Activity:** The element of work that must be accomplished.
- **Duration:** The total time required to complete the activity.
- **Effort:** The amount of work that is actually performed within the duration. For example, the duration of an activity could be one month but the effort could be just a two-week period within the duration.
- **Critical Path:** This is the longest path through the network and determines the duration of the project. It is also the shortest amount of time necessary to accomplish the project.

Figure 12–1 shows the standard nomenclature for PERT networks. The circles represent events, and arrows represent activities. The numbers in the circles signify the specific events or accomplishments. The number over the arrow specifies the time needed (hours, days, months), to go from event 6 to event 3. The events need not be numbered in any specific order. However, event 6 must take place before event 3 can be completed (or begun). In Figure 12–2A, event 26 must take place prior to events 7, 18, and 31. In Figure 12–2B, the opposite holds true, and events 7, 18, and 31 must take place prior to event 26. Figure 12–2B is similar to "and gates" used in logic diagrams.[3]

3. PERT diagrams can, in fact, be considered as logic diagrams. Many of the symbols used in PERT have been adapted from logic flow nomenclature.

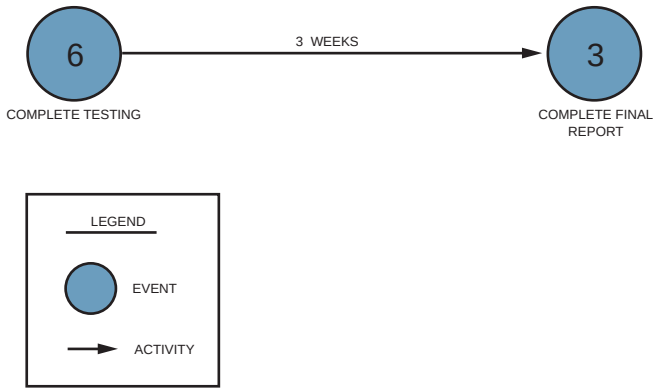


FIGURE 12–1. Standard PERT nomenclature.

In this chapter's introduction we have summarized the advantages and disadvantages of Gantt and milestone charts. These charts, however, can be used to develop the PERT network, as shown in Figure 12–3. The bar chart in Figure 12–3A can be converted to the milestone chart in Figure 12–3B. By then defining the relationship between the events on different bars in the milestone chart, we can construct the PERT chart in Figure 12–3C.

PERT is basically a management planning and control tool. It can be considered as a road map for a particular program or project in which all of the major elements (events)

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6.2.2.2 Dependency Determination

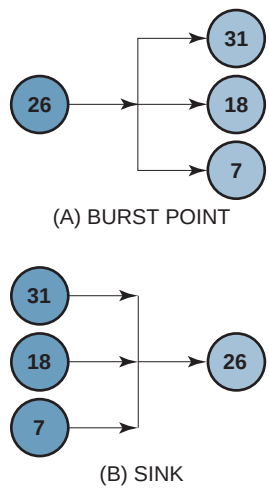

FIGURE 12–2. PERT sources (burst points) and sinks.

PMBOK® Guide, 4th Edition
6.2 Activity Sequencing

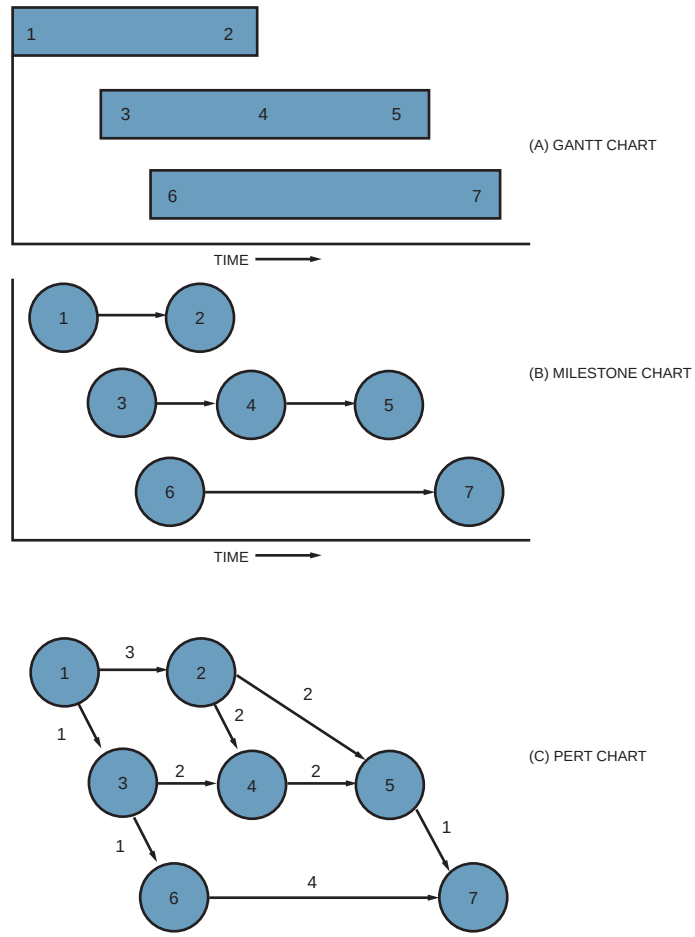

FIGURE 12–3. Conversion from bar chart to PERT chart.

have been completely identified, together with their corresponding interrelations.[4] PERT charts are often constructed from back to front because, for many projects, the end date is fixed and the contractor has front-end flexibility.

One of the purposes of constructing the PERT chart is to determine how much time is needed to complete the project. PERT, therefore, uses time as a common denominator to analyze those elements that directly influence the success of the project, namely, time, cost, and performance. The construction of the network requires two inputs. First, do events represent the start or the completion of an activity? Event completions are generally preferred. The next step is to define the sequence of events, as shown in Table 12–1,

4. These events in the PERT charts should be broken down to at least the same reporting levels as defined in the work breakdown structure.

TABLE 12–1. SEQUENCE OF EVENTS

Activity	Title	Immediate Predecessors	Activity Time, Weeks
1–2	A	—	1
2–3	B	A	5
2–4	C	A	2
3–5	D	B	2
3–7	E	B	2
4–5	F	C	2
4–8	G	C	3
5–6	H	D,F	2
6–7	I	H	3
7–8	J	E,I	3
8–9	K	G,J	2

which relates each event to its immediate predecessor. Large projects can easily be converted into PERT networks once the following questions are answered:

- What job immediately precedes this job?
- What job immediately follows this job?
- What jobs can be run concurrently?

Figure 12–4 shows a typical PERT network. The bold line in Figure 12–4 represents the critical path, which is established by the longest time span through the total system of events. The critical path is composed of events 1–2–3–5–6–7–8–9. The critical path is vital for successful control of the project because it tells management two things:

- Because there is no slack time in any of the events on this path, any slippage will cause a corresponding slippage in the end date of the program unless this slippage can be recovered during any of the downstream events (on the critical path).
- Because the events on this path are the most critical for the success of the project, management must take a hard look at these events in order to improve the total program.

Using PERT we can now identify the earliest possible dates on which we can expect an event to occur, or an activity to start or end. There is nothing overly mysterious about this type of calculation, but without a network analysis the information might be hard to obtain.

PERT charts can be managed from either the events or the activities. For levels 1–3 of the Work Breakdown Structure (WBS), the project manager's prime concerns are the milestones, and therefore, the events are of prime importance. For levels 4–6 of the WBS, the project manager's concerns are the activities.

The principles that we have discussed thus far also apply to CPM. The nomenclature is the same and both techniques are often referred to as arrow diagramming methods, or activity-on-arrow networks. The differences between PERT and CPM are:

- PERT uses three time estimates (optimistic, most likely, and pessimistic as shown in Section 12.7) to derive an expected time. CPM uses one time estimate that represents the normal time (i.e., better estimate accuracy with CPM).

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6.2 Activity Sequencing

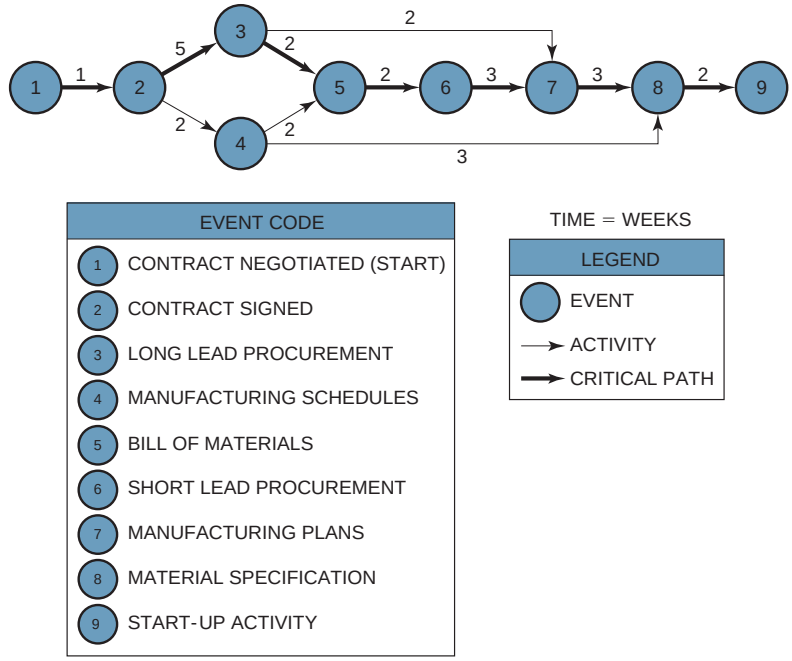

FIGURE 12–4. Simplified PERT network.

- PERT is probabilistic in nature, based on a beta distribution for each activity time and a normal distribution for expected time duration (see Section 12.7). This allows us to calculate the "risk" in completing a project. CPM is based on a single time estimate and is deterministic in nature.
- Both PERT and CPM permit the use of dummy activities in order to develop the logic.
- PERT is used for R&D projects where the risks in calculating time durations have a high variability. CPM is used for construction projects that are resource dependent and based on accurate time estimates.
- PERT is used on those projects, such as R&D, where percent complete is almost impossible to determine except at completed milestones. CPM is used for those projects, such as construction, where percent complete can be determined with reasonable accuracy and customer billing can be accomplished based on percent complete.

12.2 GRAPHICAL EVALUATION AND REVIEW TECHNIQUE (GERT)

PMBOK® Guide, 4th Edition
6.5.2 Schedule Network Analysis

Graphical evaluation and review techniques are similar to PERT but have the distinct advantages of allowing for looping, branching, and multiple project end results. With PERT one cannot easily show that if a test fails,

we may have to repeat the test several times. With PERT, we cannot show that, based upon the results of a test, we can select one of several different branches to continue the project. These problems are easily overcome using GERT. [For additional information on the GERT technique, see Jack R. Meredith and Samuel J. Mantel, Jr., *Project Management*, 3rd ed. (New York: Wiley; 1995); pp. 364–367.]

12.3 DEPENDENCIES

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6.2 Activity Sequencing
6.2.2.2 Dependency Determination

There are three basic types of interrelationships or dependencies:

- *Mandatory dependencies (i.e., hard logic):* These are dependencies that cannot change, such as erecting the walls of a house before putting up the roof.
- *Discretionary dependencies (i.e., soft logic):* These are dependencies that may be at the discretion of the project manager or may simply change from project to project. As an example, one does not need to complete the entire bill of materials prior to beginning procurement.
- *External dependencies:* These are dependencies that may be beyond the control of the project manager such as having contractors sit on your critical path.

Sometimes, it is impossible to draw network dependencies without including dummy activities. Dummy activities are artificial activities, represented by a dotted line, and do not consume resources or require time. They are added into the network simply to complete the logic.

In Figure 12–5, activity C is preceded by activity B only. Now, let's assume that there exists an activity D that is preceded by both activities A and B. Without drawing a dummy activity (i.e., the dashed line), there is no way to show that activity D is preceded by both activities A and B. Using two dummy activities, one from activity A to activity D and another one from activity B to activity D, could also accomplish this representation. Software programs insert the minimum number of dummy activities, and the direction of the arrowhead is important. In Figure 12–5, the arrowhead must be pointed upward.

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6.2.2.1 Arrow Diagramming Method

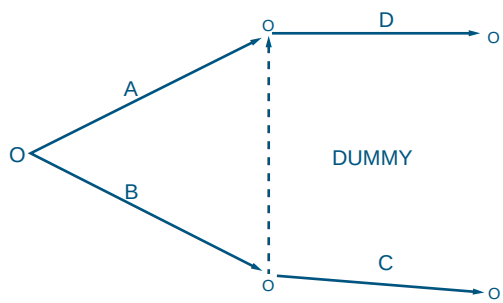

FIGURE 12–5. Dummy activity.

12.4 SLACK TIME

PMBOK® Guide, 4th Edition
6.5.2 Schedule Development
6.5.2.2 Critical Path Method

Since there exists only one path through the network that is the longest, the other paths must be either equal in length to or shorter than that path. Therefore, there must exist events and activities that can be completed before the time when they are actually needed. The time differential between the scheduled completion date and the required date to meet critical path is referred to as the slack time. In Figure 12–4, event 4 is not on the crucial path. To go from event 2 to event 5 on the critical path requires seven weeks taking the route 2–3–5. If route 2–4–5 is taken, only four weeks are required. Therefore, event 4, which requires two weeks for completion, should begin anywhere from zero to three weeks after event 2 is complete. During these three weeks, management might find another use for the resources of people, money, equipment, and facilities required to complete event 4.

The critical path is vital for resource scheduling and allocation because the project manager, with coordination from the functional manager, can reschedule those events not on the critical path for accomplishment during other time periods when maximum utilization of resources can be achieved, provided that the critical path time is not extended. This type of rescheduling through the use of slack times provides for a better balance of resources throughout the company, and may possibly reduce project costs by eliminating idle or waiting time.

Slack can be defined as the difference between the latest allowable date and the earliest expected date based on the nomenclature below:

T_E = the earliest time (date) on which an event can be expected to take place
T_L = the latest date on which an event can take place without extending the completion date of the project
Slack time = $T_L - T_E$

The calculation for slack time is performed for each event in the network, as shown in Figure 12–6, by identifying the earliest expected date and the latest starting date. For event 1, $T_L - T_E = 0$. Event 1 serves as the reference point for the network and could just as easily have been defined as a calendar date. As before, the critical path is represented as a bold line. The events on the critical path have no slack (i.e., $T_L = T_E$) and provide the boundaries for the noncritical path events.[5] Since event 2 is critical, $T_L = T_E = 3 + 7 = 10$ for event 5. Event 6 terminates the critical path with a completion time of fifteen weeks.

The earliest time for event 3, which is not on the critical path, would be two weeks ($T_E = 0 + 2 = 2$), assuming that it started as early as possible. The latest allowable date is obtained by subtracting the time required to complete the activity from events 3 to 5 from the latest starting date of event 5. Therefore, T_L (for event 3) $= 10 - 5 = 5$ weeks. Event 3 can now occur anywhere between weeks 2 and 5 without interfering with the scheduled completion date of the project. This same procedure can be applied to event 4, in which case $T_E = 6$ and $T_L = 9$.

5. There are special situations where the critical path may include some slack. These cases are not considered here.

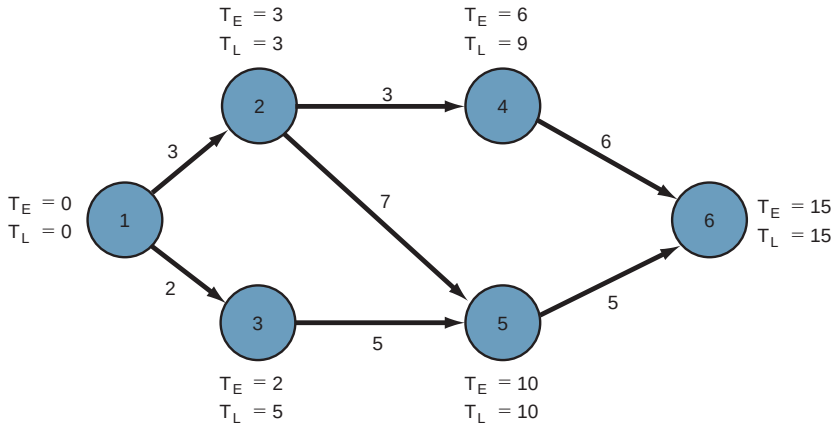

FIGURE 12–6. Network with slack time.

Figure 12–6 contains a simple PERT network, and therefore the calculation of slack time is not too difficult. For complex networks containing multiple paths, the earliest starting dates must be found by proceeding from start to finish through the network, while the latest allowable starting date must be calculated by working backward from finish to start.

The importance of knowing exactly where the slack exists cannot be overstated. Proper use of slack time permits better technical performance. Donald Marquis has observed that those companies making proper use of slack time were 30 percent more successful than the average in completing technical requirements.[6]

Because of these slack times, PERT networks are often not plotted with a time scale. Planning requirements, however, can require that PERT charts be reconstructed with time scales, in which case a decision must be made as to whether we wish early or late time requirements for slack variables. This is shown in Figure 12–7 for comparison with total program costs and manpower planning. Early time requirements for slack variables are utilized in this figure.

The earliest times and late times can be combined to determine the probability of successfully meeting the schedule. A sample of the required information is shown in Table 12–2. The earliest and latest times are considered as random variables. The original schedule refers to the schedule for event occurrences that were established at the beginning of the project. The last column in Table 12–2 gives the probability that the earliest time will not be greater than the original schedule time for this event. The exact method for determining this probability, as well as the variances, is described in Section 12.5.

In the example shown in Figure 12–6, the earliest and latest times were calculated for each event. Some people prefer to calculate the earliest and latest times for each activity instead. Also, the earliest and latest times were identified simply as the time or date when

6. Donald Marquis, "Ways of Organizing Projects," *Innovation*, 1969.

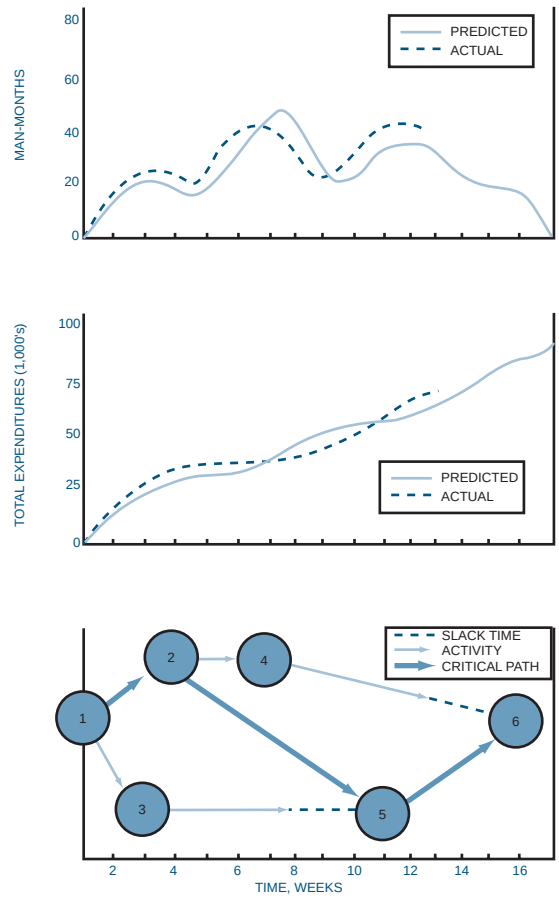

FIGURE 12–7. Comparison models for a time-phase PERT chart.

an event can be expected to take place. To make full use of the capabilities of PERT/CPM, we could identify four values:

- The earliest time when an activity can start (ES)
- The earliest time when an activity can finish (EF)
- The latest time when an activity can start (LS)
- The latest time when an activity can finish (LF)

Figure 12–8 shows the earliest and latest times identified on the activity.

To calculate the earliest starting times, we must make a forward pass through the network (i.e., left to right). The earliest starting time of a successor activity is the latest of the earliest finish dates of the predecessors. The earliest finishing time is the total of the earliest starting time and the activity duration.

TABLE 12–2. PERT CONTROL OUTPUT INFORMATION

Event Number	Earliest Time		Latest Time		Slack	Original Schedule	Probability of Meeting Schedule
	Expected	Variance	Expected	Variance			

PMBOK® Guide, 4th Edition
6.2.2 Activity Sequencing

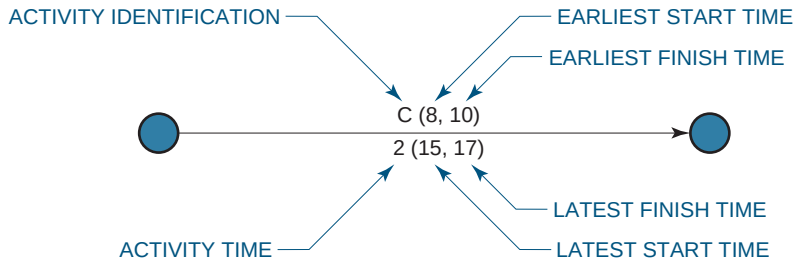

FIGURE 12–8. Slack identification.

To calculate the latest times, we must make a *backward* pass through the network by calculating the latest finish time. Since the activity time is known, the latest starting time can be calculated by subtracting the activity time from the latest finishing time. The latest finishing time for an activity entering a node is the earliest starting time of the activities exiting the node. Figure 12–9 shows the earliest and latest starting and finishing times for a typical network.

The identification of slack time can function as an early warning system for the project manager. As an example, if the total slack time available begins to decrease from one reporting period to the next, that could indicate that work is taking longer than anticipated or that more highly skilled labor is needed. A new critical path could be forming.

Looking at the earliest and latest start and finish times can identify slack. As an example, look at the two situations below:

[20, 26] / [24, 30]	[30, 36] / [25, 31]
Situation a	Situation b

PMBOK® Guide, 4th Edition
6.2.2 Activity Sequencing

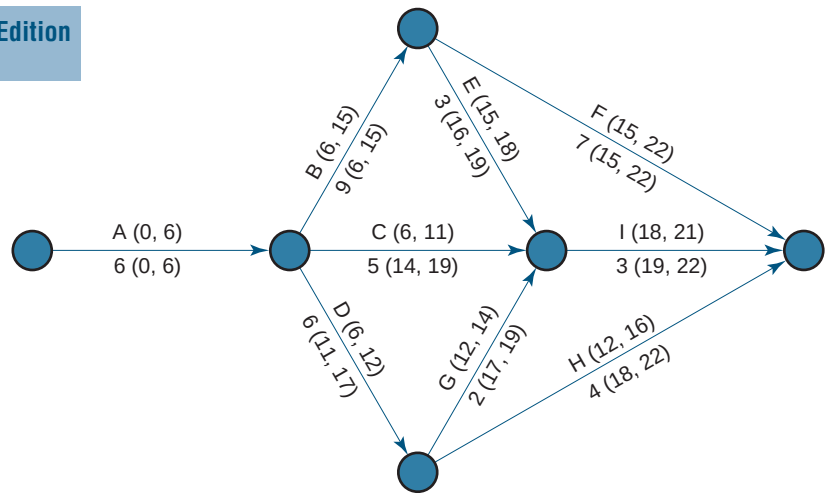

FIGURE 12–9. A typical PERT chart with slack times.

In Situation a, the slack is easily identified as four work units, where the work units can be expressed in hours, days, weeks, or even months. In Situation b, the slack is *negative* five units of work. This is referred to as negative slack or negative float.

What can cause the slack to be negative? Look at Figure 12–10. When performing a forward pass through a network, we work from left to right beginning at the customer's starting milestone (position 1). The backward pass, however, begins at the customer's end date milestone (position 2), *not* (as is often taught in the classroom) where the forward pass ends. If the forward pass ends at position 3, which is before the customer's end date, it is possible to have slack on the critical path. This slack is often called reserve time and may be added to other activities or filled with activities such as report writing so that the forward pass will extend to the customer's completion date.

Negative slack usually occurs when the forward pass extends beyond the customer's end date, as shown by position 4 in the figure. However, the backward pass is still measured from the customer's completion date, thus creating negative slack. This is most likely to result when:

- The original plan was highly optimistic, but unrealistic
- The customer's end date was unrealistic
- One or more activities slipped during project execution
- The assigned resources did not possess the correct skill levels
- The required resources would not be available until a later date

In any event, negative slack is an early warning indicator that corrective action is needed to maintain the customer's end date.

At this point, it is important to understand the physical meaning of slack. Slack measures how early or how late an event can start or finish. In Figure 12–6, the circles represented events and the slack was measured on the events. Most networks today, however,

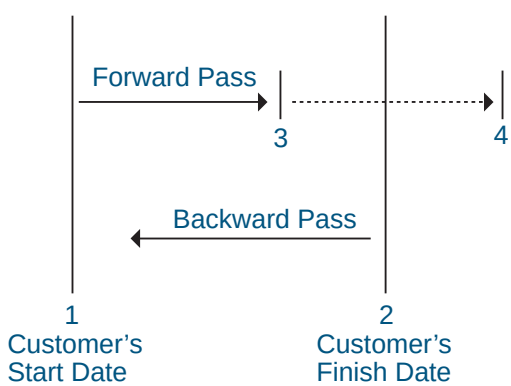

FIGURE 12–10. Slack time.

focus on the activity rather than the event, as shown in Figure 12–9. When slack is calculated on the activity, it is usually referred to as float rather than slack, but most project managers use the terms interchangeably. For activity C in Figure 12–9, the float is eight units. If the float in an activity is zero, then it is a critical path activity, such as seen in activity F. If the slack in an event is zero, then the event is a critical path event.

Another term is maximum float. The equation for maximum float is:

$$\text{Maximum float} = \text{latest finish} - \text{earliest start} - \text{duration}$$

For activity H in Figure 12–9, the maximum float is six units.

12.5 NETWORK REPLANNING

PMBOK® Guide, 4th Edition
6.5.2 Schedule Development
6.5.2.7 Schedule Compression

Once constructed, the PERT/CPM charts provide the framework from which detailed planning can be initiated and costs can be controlled and tracked. Many iterations, however, are normally made during the planning phase before the PERT/CPM chart is finished. Figure 12–11 shows this iteration process. The slack times form the basis from which additional iterations, or network replanning, can be performed. Network replanning is performed either at the conception of the program in order to reduce the length of the critical path, or during the program, should the unexpected occur. If all were to go according to schedule, then the original PERT/CPM chart would be unchanged for the duration of the project. But, how many programs or projects follow an exact schedule from start to finish?

Suppose that activities 1–2 and 1–3 in Figure 12–6 require manpower from the same functional unit. Upon inquiry by the project manager, the functional manager asserts that he can reduce activity 1–2 by one week if he shifts resources from activity 1–3 to activity 1–2. Should this happen, however, activity 1–3 will increase in length by one week. Reconstructing the PERT/CPM network as shown in Figure 12–12, the length of the critical path is reduced by one week, and the corresponding slack events are likewise changed.

There are two network replanning techniques based almost entirely upon resources: resource leveling and resource allocation.

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6.5.2.4 Resource Leveling

- Resource leveling is an attempt to eliminate the manpower peaks and valleys by smoothing out the period-to-period resource requirements. The ideal situation is to do this without changing the end date. However, in reality, the end date moves out and additional costs are incurred.
- Resource allocation (also called resource-limited planning) is an attempt to find the shortest possible critical path based upon the available or fixed resources. The problem with this approach is that the employees may not be qualified technically to perform on more than one activity in a network.

Unfortunately, not all PERT/CPM networks permit such easy rescheduling of resources. Project managers should make every attempt to reallocate resources to reduce the critical path, provided that the slack was not intentionally planned as a safety valve.

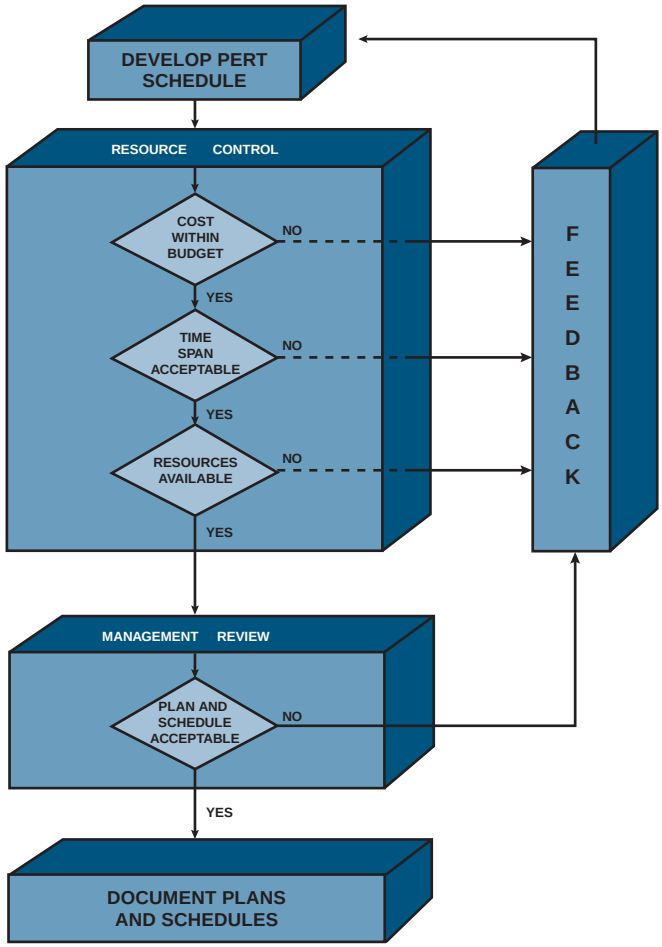

FIGURE 12–11. Iteration process for PERT schedule development.

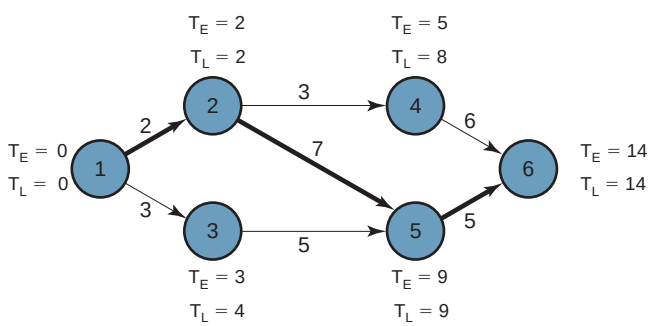

FIGURE 12–12. Network replanning of Figure 12–6.

Transferring resources from slack paths to more critical paths is only one method for reducing expected project time. Several other methods are available:

- Elimination of some parts of the project
- Addition of more resources (i.e., crashing)
- Substitution of less time-consuming components or activities
- Parallelization of activities
- Shortening critical path activities
- Shortening early activities
- Shortening longest activities
- Shortening easiest activities
- Shortening activities that are least costly to speed up
- Shortening activities for which you have more resources
- Increasing the number of work hours per day

Under the ideal situation, the project start and end dates are fixed, and performance within this time scale must be completed within the guidelines described by the statement of work. Should the scope of effort have to be reduced in order to meet other requirements, the contractor incurs a serious risk that the project may be canceled, or performance expectations may no longer be possible.

Adding resources is not always possible. If the activities requiring these added resources also call for certain expertise, then the contractor may not have qualified or experienced employees, and may avoid the risk. The contractor might still reject this idea, even if time and money were available for training new employees, because on project termination he might not have any other projects for these additional people. However, if the project is the construction of a new facility, then the labor-union pool may be able to provide additional experienced manpower.

Parallelization of activities can be regarded as accepting a risk by assuming that a certain event can begin in parallel with a second event that would normally be in sequence with it. This is shown in Figure 12–13. One of the biggest headaches at the beginning of any project is the purchasing of tooling and raw materials. As shown in Figure 12–13, four weeks can be saved by sending out purchase orders after contract negotiations are completed, but before the one-month waiting period necessary to sign the contract. Here the contractor incurs a risk. Should the effort be canceled or the statement of work change prior to the signing of the contract, the customer incurs the cost of the termination expenses from the vendors. This risk is normally overcome by the issuance of a long-lead procurement letter immediately following contract negotiations.

There are two other types of risk that are common. In the first situation, engineering has not yet finished the prototype, and manufacturing must order the tooling in order to keep the end date fixed. In this case, engineering may finally design the prototype to fit the tooling. In the second situation, the subcontractor finds it difficult to perform according to the original blueprints. In order to save time, the customer may allow the contractor to work without blueprints, and the blueprints are then changed to represent the as-built end-item.

Because of the complexities of large programs, network replanning becomes an almost impossible task when analyzed on total program activities. It is often better to have each department or division develop its own PERT/CPM networks, on approval by the

PMBOK® Guide, 4th Edition
2.1.1 Characteristics of the Project Life Cycle

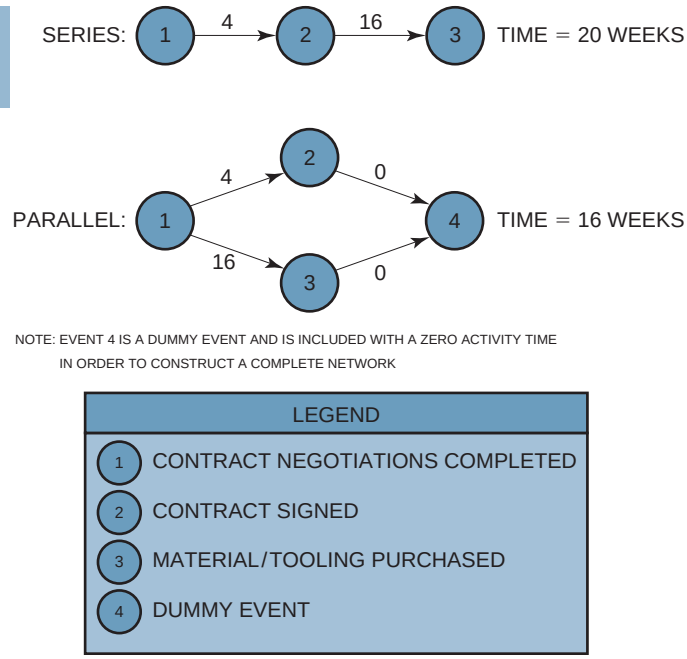

FIGURE 12–13. Parallelization of PERT activities.

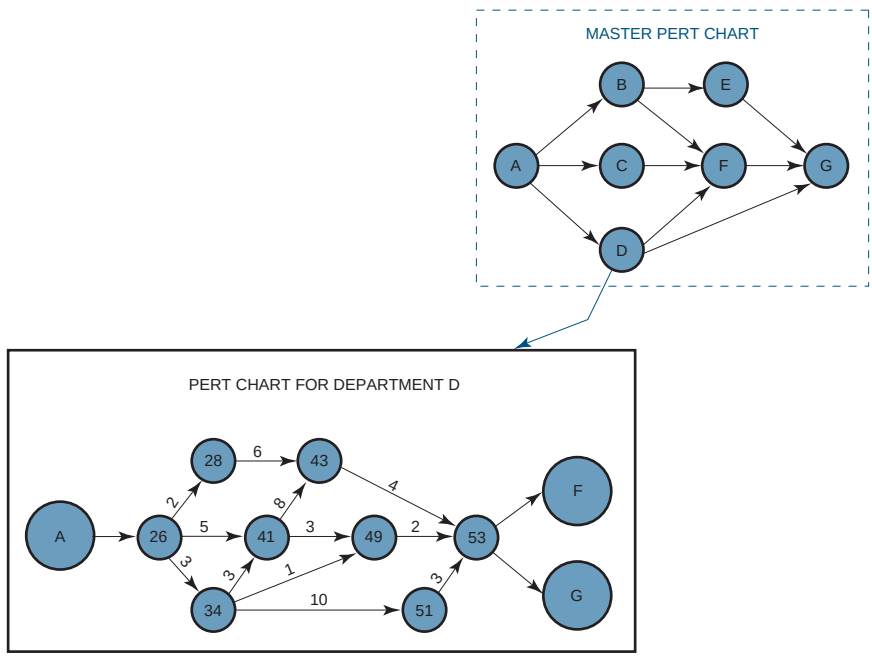

FIGURE 12–14. Master PERT chart breakdown by department.

project office, and based on the work breakdown structure. The individual PERT charts are then integrated into one master chart to identify total program critical paths, as shown in Figure 12–14. The reader should not infer from Figure 12–14 that department D does not interact with other departments or that department D is the only participant for this element of the project.

Segmented PERT charts can also be used when a number of contractors work on the same program. Each contractor (or subcontractor) develops his own PERT chart. It then becomes the responsibility of the prime contractor to integrate all of the subcontractors' PERT charts to ensure that total program requirements can be met.

12.6 ESTIMATING ACTIVITY TIME

PMBOK® Guide, 4th Edition
6.4 Activity Duration Estimating

Determining the elapsed time between events requires that responsible functional managers evaluate the situation and submit their best estimates. The calculations for critical paths and slack times in the previous sections were based on these best estimates.

In this ideal situation, the functional manager would have at his disposal a large volume of historical data from which to make his estimates. Obviously, the more historical data available, the more reliable the estimate. Many programs, however, include events and activities that are nonrepetitive. In this case, the functional managers must submit their estimates using three possible completion assumptions:

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6.4.2.4 Three-Point Estimates

- *Optimistic completion time.* This time assumes that everything will go according to plan and with minimal difficulties. This should occur approximately 1 percent of the time.
- *Pessimistic completion time.* This time assumes that everything will not go according to plan and maximum difficulties will develop. This should also occur approximately 1 percent of the time.
- *Most likely completion time.* This is the time that, in the mind of the functional manager, would most often occur should this effort be reported over and over again.[7]

Before these three times can be combined into a single expression for expected time, two assumptions must be made. The first assumption is that the standard deviation, σ, is one-sixth of the time requirement range. This assumption stems from probability theory, where the end points of a curve are three standard deviations from the mean. The second assumption requires that the probability distribution of time required for an activity be expressible as a beta distribution.[8]

7. It is assumed that the functional manager performs all of the estimating. The reader should be aware that there are exceptions where the program or project office would do their own estimating.

8. See F. S. Hillier and G. J. Lieberman, *Introduction to Operations Research* (San Francisco: Holden-Day, 1967), p. 229.

PMBOK® Guide, 4th Edition
6.4.2.4 Three-Point Estimates

The expected time between events can be found from the expression:

$$t_e = \frac{a + 4m + b}{6}$$

where t_e = expected time, a = most optimistic time, b = most pessimistic time, and m = most likely time.

As an example, if $a = 3$, $b = 7$, and $m = 5$ weeks, then the expected time, t_e, would be 5 weeks. This value for t_e would then be used as the activity time between two events in the construction of a PERT chart. This method for obtaining best estimates contains a large degree of uncertainty. If we change the variable times to $a = 2$, $b = 12$, and $m = 4$ weeks, then t_e will still be 5 weeks. The latter case, however, has a much higher degree of uncertainty because of the wider spread between the optimistic and pessimistic times. Care must be taken in the evaluation of risks in the expected times.

12.7 ESTIMATING TOTAL PROJECT TIME

PMBOK® Guide, 4th Edition
6.4 Activity Duration Estimates

In order to calculate the probability of completing the project on time, the standard deviations of each activity must be known. This can be found from the expression:

$$\sigma_{t_e} = \frac{b - a}{6}$$

where σ_{t_e} is the standard deviation of the expected time, t_e. Another useful expression is the variance, υ, which is the square of the standard deviation. The variance is primarily useful for comparison to the expected values. However, the standard deviation can be used just as easily, except that we must identify whether it is a one, two, or three sigma limit deviation. Figure 12–15 shows the critical path of Figure 12–6, together with the corresponding values from which the expected times were calculated, as well as the standard

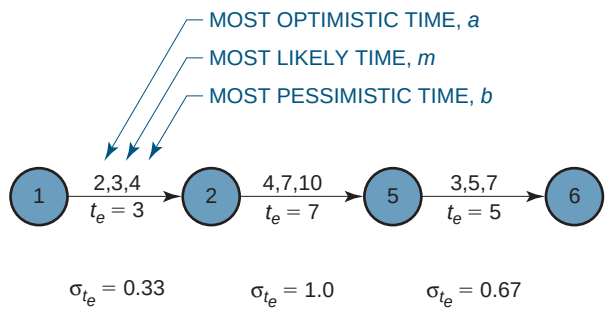


FIGURE 12–15. Expected time analysis for critical path events in Figure 12–6.

deviations. The total path standard deviation is calculated by the square root of the sum of the squares of the activity standard deviations using the following expression:

$$\begin{aligned}\sigma_{\text{total}} &= \sqrt{\sigma_{1\text{–}2}^2 + \sigma_{2\text{–}5}^2 + \sigma_{5\text{–}6}^2} \\ &= \sqrt{(0.33)^2 + (1.0)^2 + (0.67)^2} \\ &= 1.25\end{aligned}$$

The purpose of calculating σ is that it allows us to establish a confidence interval for each activity and the critical path. From statistics, using a normal distribution, we know that there is a 68 percent chance of completing the project within one standard deviation, a 95 percent chance within two standard deviations, and a 99.73 percent chance within three standard deviations.

This type of analysis can be used to measure the risks in the estimates, the risks in completing each activity, and the risks in completing the entire project. In other words, the standard deviation, σ, serves as a measurement of the risk. This analysis, however, assumes that normal distribution applies, which is not always the case.

As an example of measuring risk, consider a network that has only three activities on the critical path as shown below (all times in weeks):

Activity	Optimistic Time	Most Likely Time	Pessimistic Time	T_{ex}	σ	σ^2
A	3	4	5	4	2/6	4/36
B	4	4.5	8	5	4/6	16/36
C	4	6	8	6	2/6	16/36
				15		1.0

From the above table, the length of the critical path is 15 weeks. Since the variance (i.e., σ^2) is 1.0, then σ_{path}, which is the square root of the variance, must be 1 week.

We can now calculate the probability of completing the project within certain time limits:

- The probability of getting the job done within 16 weeks is
- 50% + (½)×(68%), or 84%.
- Within 17 weeks, we have 50% + (½)×(95%), or 97.5%.
- Within 14 weeks, we have 50% − (½)×(68%), or 16%.
- Within 13 weeks, we have 50% − (½)×(95%), or 2.5%.

12.8 TOTAL PERT/CPM PLANNING

Before we continue, it is necessary to discuss the methodology for preparing PERT schedules. PERT scheduling is a six-step process. Steps one and two begin with the project manager

laying out a list of activities to be performed and then placing these activities in order of precedence, thus identifying the interrelationships. These charts drawn by the project manager are called either logic charts, arrow diagrams, work flow, or simply networks. The arrow diagrams will look like Figure 12–6 with two exceptions: The activity time is not identified, and neither is the critical path.

Step three is reviewing the arrow diagrams with the line managers (i.e., the true experts) in order to obtain their assurance that neither too many nor too few activities are identified, and that the interrelationships are correct.

In step four the functional manager converts the arrow diagram to a PERT chart by identifying the time duration for each activity. It should be noted here that the time estimates that the line managers provide are based on the *assumption of unlimited resources* because the calendar dates have not yet been defined.

Step five is the first iteration on the critical path. It is here that the project manager looks at the critical calendar dates in the definition of the project's requirements. If the critical path does not satisfy the calendar requirements, then the project manager must try to shorten the critical path using methods explained in Section 12.3 or by asking the line managers to take the "fat" out of their estimates.

Step six is often the most overlooked step. Here the project manager places calendar dates on each event in the PERT chart, thus converting from planning under unlimited resources to planning with *limited resources.* Even though the line manager has given you a time estimate, there is no guarantee that the correct resources will be available when needed. That is why this step is crucial. If the line manager cannot commit to the calendar dates, then replanning will be necessary. Most companies that survive on competitive bidding lay out proposal schedules based on unlimited resources. After contract award, the schedules are analyzed again because the company now has limited resources. After all, how can a company bid on three contracts simultaneously and put a detailed schedule into each proposal if it is not sure how many contracts, if any, it will win? For this reason customers require that formal project plans and schedules be provided thirty to ninety days after contract award.

Finally, PERT replanning should be an ongoing function during project execution. The best project managers continually try to assess what can go wrong and perform perturbation analysis on the schedule. (This should be obvious because the constraints and objectives of the project can change during execution.) Primary objectives on a schedule are:

- Best time
- Least cost
- Least risk

Secondary objectives include:

- Studying alternatives
- Optimum schedules
- Effective use of resources

- Communications
- Refinement of the estimating process
- Ease of project control
- Ease of time or cost revisions

Obviously, these objectives are limited by such constraints as:

- Calendar completion
- Cash or cash flow restrictions
- Limited resources
- Management approvals

12.9 CRASH TIMES

PMBOK® Guide, 4th Edition
6.5.2.7 Schedule Compression

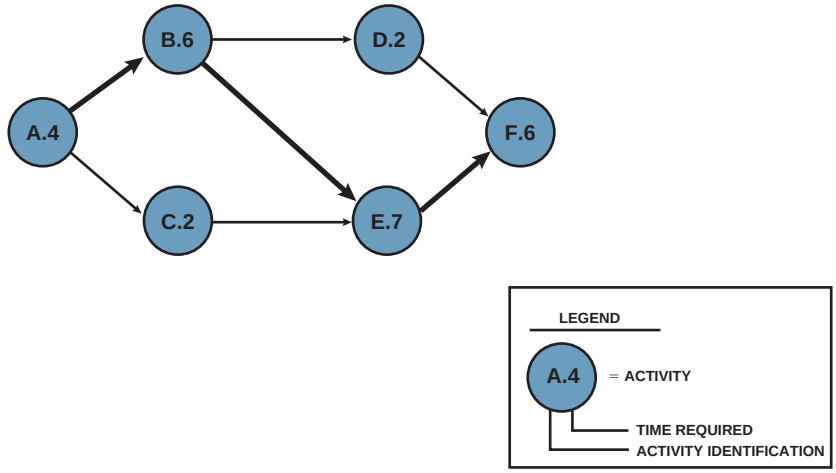
In the preceding sections, no distinction was made between PERT and CPM. The basic difference between PERT and CPM lies in the ability to calculate percent complete. PERT is used in R&D or just development activities, where a percent-complete determination is almost impossible. Therefore, PERT is event oriented rather than activity oriented. In PERT, funding is normally provided for each milestone (i.e., event) achieved because incremental funding along the activity line has to be based on percent complete. CPM, on the other hand, is activity oriented because, in activities such as construction, percent complete along the activity line can be determined. CPM can be used as an arrow diagram network without PERT. The difference between the two methods lies in the environments in which they evolved and how they are applied. According to Archibald and Villoria[9]:

> The environmental factors which had an important role in determining the elements of the CPM techniques were:
> (a) Well-defined projects
> (b) One dominant organization
> (c) Relatively small uncertainties
> (d) One geographical location for a project

The CPM (activity-type network) has been widely used in the process industries, in construction, and in single-project industrial activities. Common problems include no place to store early arrivals of raw materials and project delays for late arrivals.

Using strictly the CPM approach, project managers can consider the cost of speeding up, or crashing, certain phases of a project. In order to accomplish this, it is necessary to

9. R. D. Archibald and R. L. Villoria, *Network-Based Management Systems (PERT/CPM)* (New York: Wiley, 1967), p. 14.



ACTIVITY	TIME REQUIRED, WEEKS		COST $		CRASHING COST PER WEEK, $
	NORMAL	CRASH	NORMAL	CRASH	
A	4	2	10,000	14,000	2,000
B	6	5	30,000	42,500	12,500
C	2	1	8,000	9,500	1,500
D	2	1	12,000	18,000	6,000
E	7	5	40,000	52,000	6,000
F	6	3	20,000	29,000	3,000

FIGURE 12–16. CPM network.

calculate a crashing cost per unit time as well as the normal expected time for each activity. CPM charts, which are closely related to PERT charts, allow visual representation of the effects of crashing. There are these requirements:

- For a CPM chart, the emphasis is on activities, not events. Therefore, the PERT chart should be redrawn with each circle representing an activity rather than an event.
- In CPM, both time and cost of each activity are considered.[10]
- Only those activities on the critical path are considered, starting with the activities for which the crashing cost per unit time is the lowest.

Figure 12–16 shows a CPM network with the corresponding crash time for all activities on and off the critical path. The activities are represented by circles and include an activity identification number and the estimated time. The costs expressed in the figure are usually direct costs only.

10. Although PERT considers mainly time, modifications through PERT/cost analysis can be made to consider the cost factors.

To determine crashing costs we begin with the lowest weekly crashing cost, activity A, at $2,000 per week. Although activity C has a lower crashing cost, it is not on the critical path. Only critical path activities are considered for crashing. Activity A will be the first to be crashed for a maximum of two weeks at $2,000 per week. The next activity to be considered would be F at $3,000 per week for a maximum of three weeks. These crashing costs are additional expenses above the normal estimates.

A word of caution concerning the selection and order of the activities that are to crash: There is a good possibility that as each activity is crashed, a new critical path will be developed. This new path may or may not include those elements that were bypassed because they were not on the original critical path.

Returning to Figure 12–16 (and assuming that no new critical paths are developed), activities A, F, E, and B would be crashed in that order. The crashing cost would then be an increase of $37,500 from the base of $120,000 to $157,500. The corresponding time would then be reduced from twenty-three weeks to fifteen weeks. This is shown in Figure 12–17 to illustrate how a trade-off between time and cost can be obtained. Also shown in Figure 12–17 is the increased cost of crashing elements not on the critical path. Crashing these elements would result in a cost increase of $7,500 without reducing the total project time. There is also the possibility that this figure will represent unrealistic conditions because sufficient resources are not or cannot be made available for the crashing period.

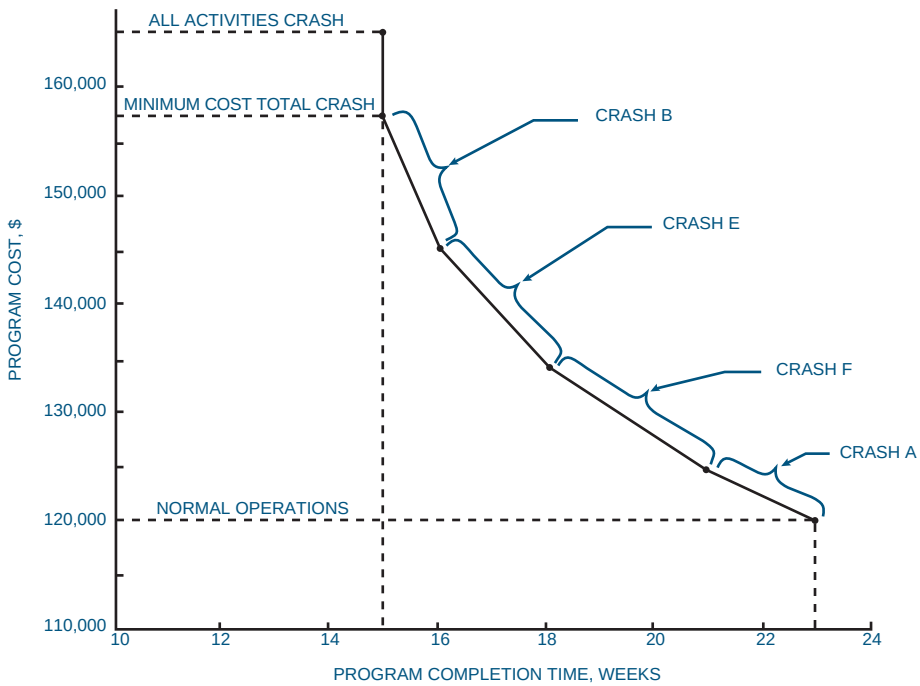


FIGURE 12–17. CPM crashing costs.

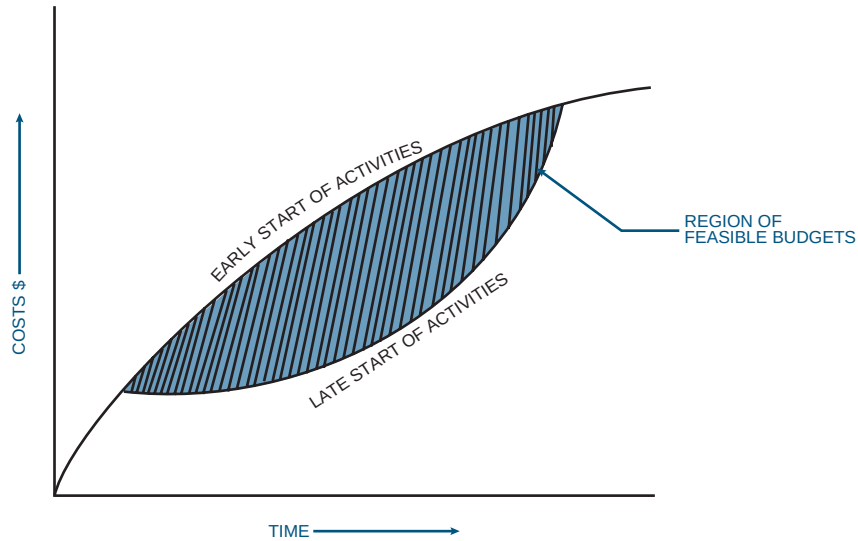


FIGURE 12–18. Region of feasible budgets.

The purpose behind balancing time and cost is to avoid wasting resources. If the direct and indirect costs can be accurately obtained, then a region of feasible budgets can be found, bounded by the early-start (crash) and late-start (or normal) activities. This is shown in Figure 12–18.

Since the direct and indirect costs are not necessarily expressible as linear functions, time–cost trade-off relationships are made by searching for the lowest possible total cost (i.e., direct and indirect) that likewise satisfies the region of feasible budgets. This method is shown in Figure 12–19.

Like PERT, CPM also contains the concept of slack time, the maximum amount of time that a job may be delayed beyond its early start without delaying the project completion time. Figure 12–20 shows a typical representation of slack time using a CPM chart. In addition, the figure shows how target activity costs can be identified. Figure 12–20 can be modified to include normal and crash times as well as normal and crash costs. In this case, the cost box in the figure would contain two numbers: The first number would be the normal cost, and the second would be the crash cost. These numbers might also appear as running totals.

12.10 PERT/CPM PROBLEM AREAS

PERT/CPM models are not without their disadvantages and problems. Even the largest organizations with years of experience in using PERT and CPM have the same ongoing problems as newer or smaller companies.

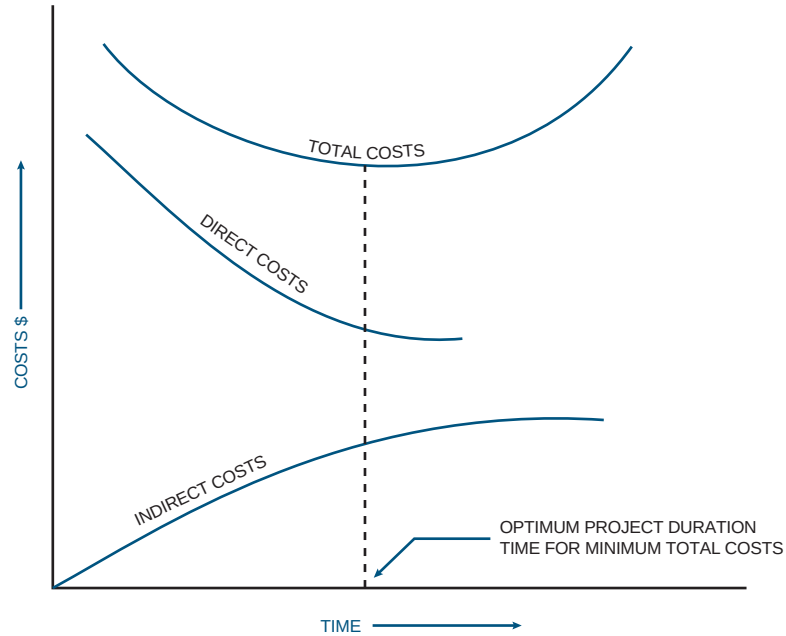


FIGURE 12–19. Determining project duration.

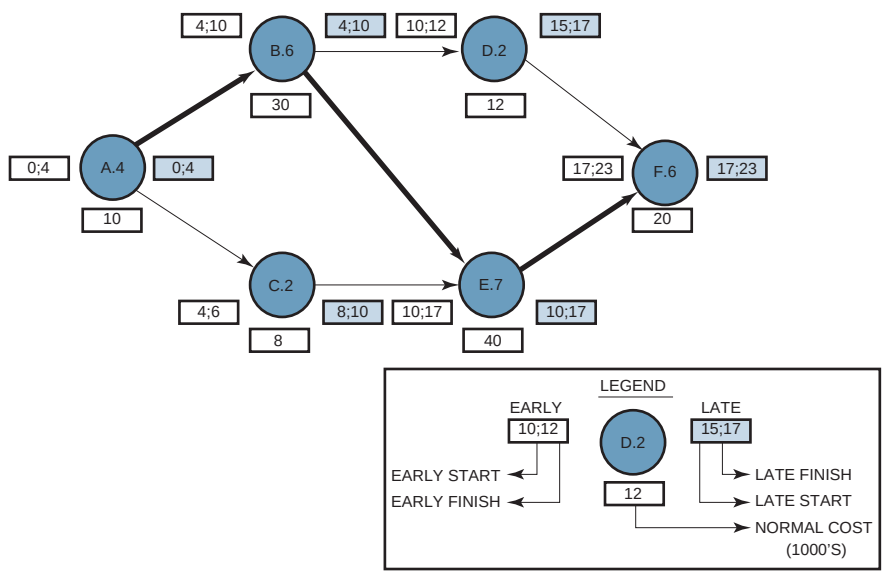


FIGURE 12–20. CPM network with slack.

Many companies have a difficult time incorporating PERT systems because PERT is end-item oriented. Many upper-level managers feel that the adoption of PERT/CPM removes a good part of their power and ability to make decisions. This is particularly evident in companies that have been forced to accept PERT/CPM as part of contractual requirements.

In PERT systems, there are planners and doers. In most organizations PERT planning is performed by the program office and functional management. Yet once the network is constructed, the planners and managers become observers and rely on the doers to accomplish the job within time and cost limitations. Management must convince the doers that they have an obligation to the successful completion of the established PERT/CPM plans.

Unless the project is repetitive, there is usually little historical information on which to base the cost estimates of most optimistic, most pessimistic, and most likely times. Problems can also involve poor predictions for overhead costs, other indirect costs, material and labor escalation factors, and crash costs. It is also possible that each major functional division of the organization has its own method for estimating costs. Engineering, for example, may use historical data, whereas manufacturing operations may prefer learning curves. PERT works best if all organizations have the same method for predicting costs and performance.

PERT networks are based on the assumption that all activities start as soon as possible. This assumes that qualified personnel and equipment are available. Regardless of how well we plan, there are almost always differences in performance times from what would normally be acceptable. For the selected model, time and cost should be well-considered estimates, not spur-of-the-moment decisions.

Cost control problems arise when the project cost and control system is not compatible with company policies. Project-oriented costs may be meshed with non-PERT-controlled jobs in order to develop the annual budget. This becomes a difficult chore for cost reporting, especially when each project may have its own method for analyzing and controlling costs.

Many people have come to expect too much of PERT-type networks. Figure 12–21 illustrates a PERT/CPM network broken down by work packages with identification of the

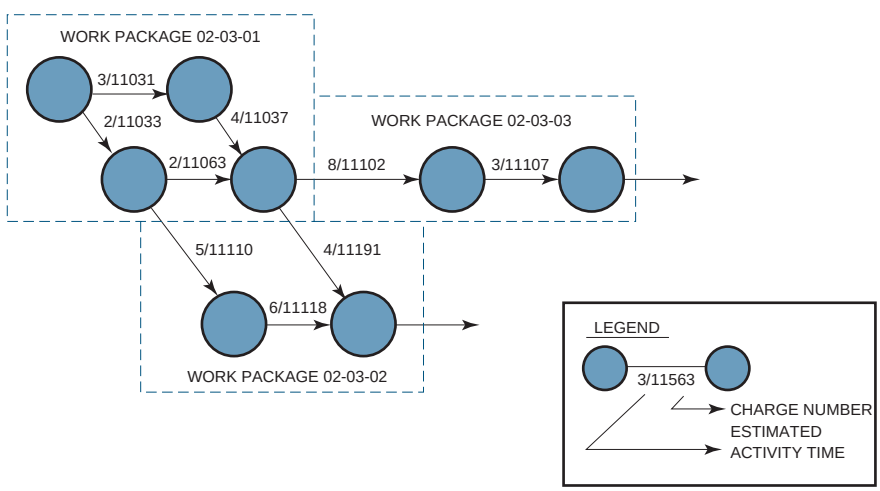


FIGURE 12–21. Using PERT for work package control.

charge numbers for each activity. Large projects may contain hundreds of charge numbers. Subdividing work packages (which are supposedly the lowest element) even further by identifying all subactivities has the advantage that direct charge numbers can be easily identified, but the time and cost for this form of detail may be prohibitive. PERT/CPM networks are tools for program control, and managers must be careful that the original game plan of using networks to identify prime and supporting objectives is still met. Additional detail may mask this all-important purpose. Remember, networks are constructed as a means for understanding program reports. Management should not be required to read reports in order to understand PERT/CPM networks.

12.11 ALTERNATIVE PERT/CPM MODELS

Because of the many advantages of PERT/time, numerous industries have found applications for this form of network. A partial list of these advantages includes capabilities for:

- Trade-off studies for resource control
- Providing contingency planning in the early stages of the project
- Visually tracking up-to-date performance
- Demonstrating integrated planning
- Providing visibility down through the lowest levels of the work breakdown structure
- Providing a regimented structure for control purposes to ensure compliance with the work breakdown structure and the statement of work
- Increasing functional members' ability to relate to the total program, thus providing participants with a sense of belonging

Even with these advantages, in many situations PERT/time has proved ineffective in controlling resources. In the beginning of this chapter we defined three parameters necessary for the control of resources: time, cost, and performance. With these factors in mind, companies began reconstructing PERT/time into PERT/cost and PERT/performance models.

PERT/cost is an extension of PERT/time and attempts to overcome the problems associated with the use of the most optimistic and most pessimistic time for estimating completion. PERT/cost can be regarded as a cost accounting network model based on the work breakdown structure and capable of being subdivided down to the lowest elements, or work packages. The advantages of PERT/cost are that it:

- Contains all the features of PERT/time
- Permits cost control at any WBS level

The primary reason for the development of PERT/cost was so that project managers could identify critical schedule slippages and cost overruns in time to correct them.

Many attempts have been made to develop effective PERT/schedule models. In almost all cases, the charts are constructed from left to right.[11] An example of such current attempts is the accomplishment/cost procedure (ACP). As described by Block[12]:

> ACP reports cost based on schedule accomplishment, rather than on the passage of time. To determine how an uncompleted task is progressing with respect to cost, ACP compares (a) cost/progress relationship budgeting with (b) the cost/progress relationship expended for the task. It utilizes data accumulated from periodic reports and from the same data base generates the following:
>
> - The relationship between cost and scheduled performance
> - The accounting relationships between cost and fiscal accounting requirements
> - The prediction of corporate cash flow needs

Unfortunately, the development of PERT/schedule techniques is still in its infancy. Although their applications have been identified, many companies feel locked in with their present method of control, whether it be PERT, CPM, or some other technique.

12.12 PRECEDENCE NETWORKS

PMBOK® Guide, 4th Edition
6.2.2.1 PDM

In recent years there has been an explosion in project management software packages. Small packages may sell for a few thousand dollars, whereas the price for larger packages may be tens of thousands of dollars. Computerized project management can provide answers to such questions as:

- How will the project be affected by limited resources?
- How will the project be affected by a change in the requirements?
- What is the cash flow for the project (and for each WBS element)?
- What is the impact of overtime?
- What additional resources are needed to meet the constraints of the project?
- How will a change in the priority of a certain WBS element affect the total project?

The more sophisticated packages can provide answers to schedule and cost based on:

- Adverse weather conditions
- Weekend activities
- Unleveled manpower requirements

11. See Gary E. Whitehouse, "Project Management Techniques," *Industrial Engineering,* March 1973, pp. 24–29, for a description of the technique.

12. Reprinted by permission of *Harvard Business Review.* From Ellery B. Block, "Accomplishment/Cost: Better Project Control," *Harvard Business Review,* May–June 1971, pp. 110–124. Copyright © 1971 by the Harvard Business School Publishing Corporation; all rights reserved.

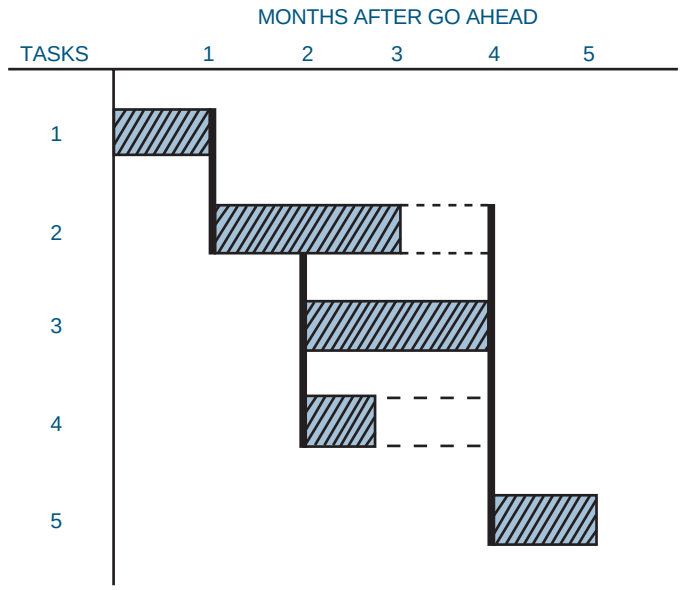


FIGURE 12–22. Precedence network.

- Variable crew size
- Splitting of activities
- Assignment of unused resources

Regardless of the sophistication of computer systems, printers and plotters prefer to draw straight lines rather than circles. Most software systems today use precedence networks, as shown in Figure 12–22, which attempt to show interrelationships on bar charts. In Figure 12–22, task 1 and task 2 are related because of the solid line between them. Task 3 and task 4 can begin when task 2 is half finished. (This cannot be shown easily on PERT without splitting activities.) The dotted lines indicate slack. The critical path can be identified by putting an asterisk (*) beside the critical elements, or by putting the critical connections in a different color or boldface.

The more sophisticated software packages display precedence networks in the format shown in Figure 12–23. In each of these figures, work is accomplished during the activity. This is sometimes referred to as the activity-on-node method. The arrow represents the relationship or constraint between activities.

Figure 12–23A illustrates a finish-to-start constraint. In this figure, activity 2 can start no earlier than the completion of activity 1. All PERT charts are finish-to-start constraints. Figure 12–23B illustrates a start-to-start constraint. Activity 2 cannot start prior to the start of activity 1. Figure 12-23C illustrates a finish-to-finish constraint. In this figure, activity 2 cannot finish until activity 1 finishes. Figure 12-23D illustrates a start-to-finish constraint.

PMBOK® Guide, 4th Edition
6.2.2.1 PDM

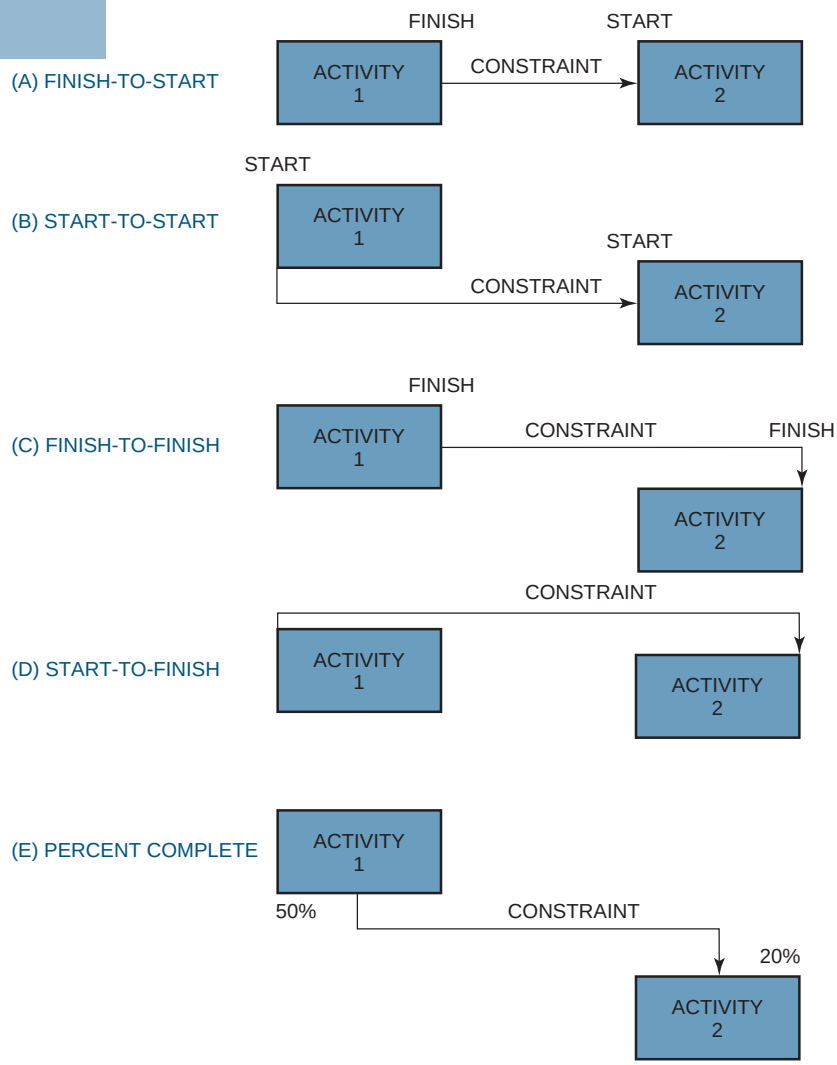


FIGURE 12–23. Typical precedence relationships.

An example might be that you must start studying for an exam some time prior to the completion of the exam. This is the least common type of precedence chart. Figure 12-23E illustrates a percent complete constraint. In this figure, the last 20 percent of activity 2 cannot be started until 50 percent of activity 1 has been completed.[13]

13. Meredith and Mantel categorize precedence relationships in three broad categories; Natural Precedences, Environmental Precedences, and Preferential Precedences. For additional information on these precedence relationships, see Jack R. Meredith and Samuel J. Mantel, Jr., *Project Management*, 3rd ed. (New York: Wiley;1995), pp.385–386.

PMBOK® Guide, 4th Edition
6.1.3.2 Activity Attributes

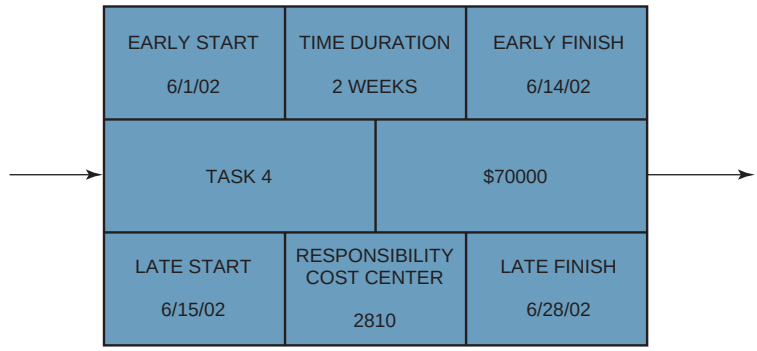


FIGURE 12–24. Computerized information flow.

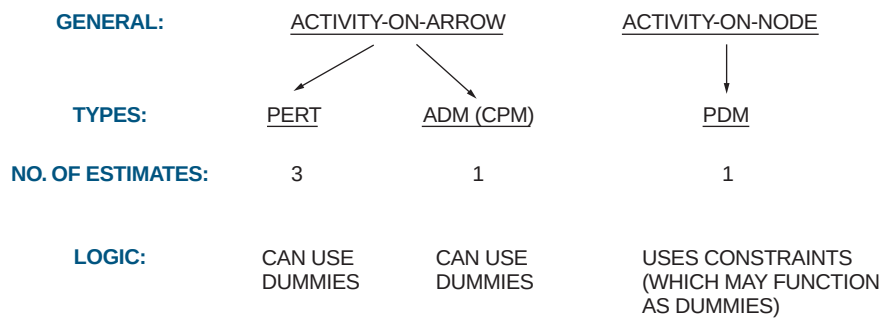


FIGURE 12–25. Comparison of networks.

Figure 12–24 shows the typical information that appears in each of the activity boxes shown in Figure 12–23. The box identified as "responsibility cost center" could also have been identified as the name, initials, or badge number of the person responsible for this activity.

Figure 12–25 shows the comparison of three of the network techniques.

12.13 LAG

PMBOK® Guide, 4th Edition
6.2.2.5 Leads and Lags
6.2.2.1 PDM

The time period between the early start or finish of one activity and the early start or finish of another activity in the sequential chain is called lag. Lag is most commonly used in conjunction with precedence networks. Figure 12–26 shows five different ways to identify lag on the constraints.

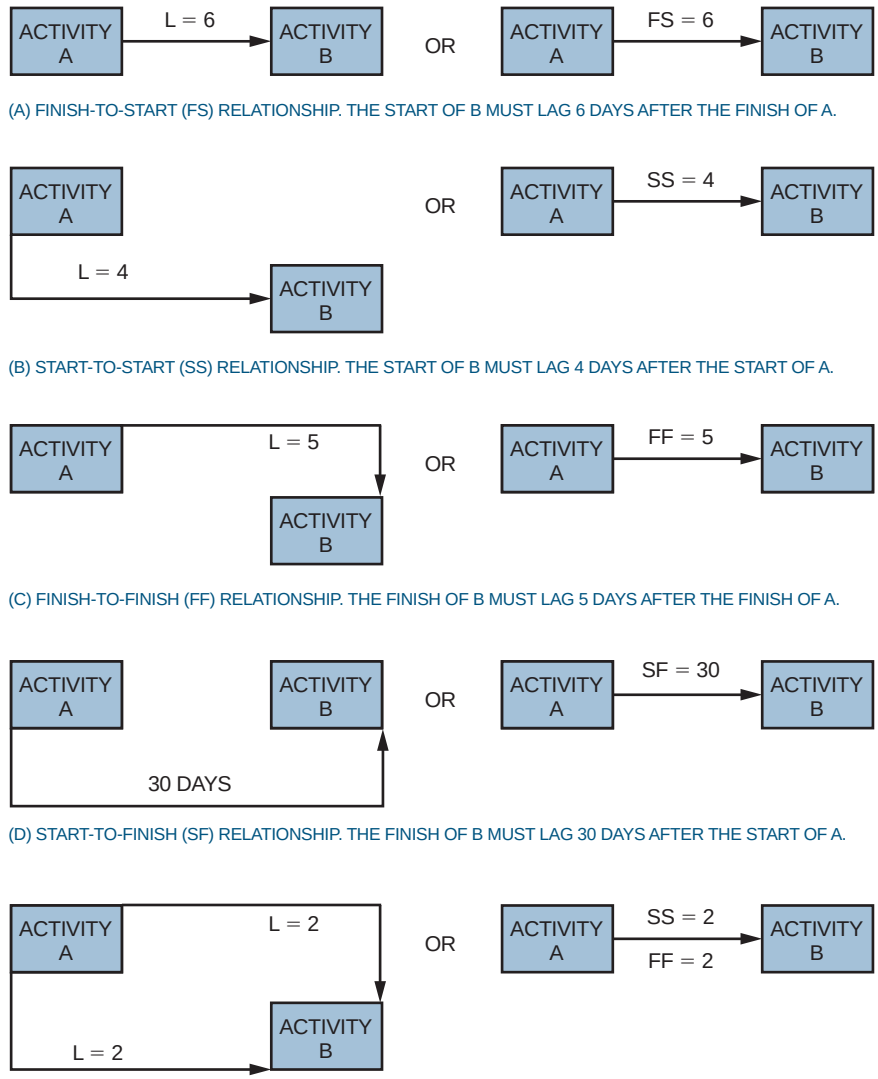


FIGURE 12–26. Precedence charts with lag.

Slack is measured within activities whereas lag is measured between activities. As an example, look at Figure 12–26A. Suppose that activity A ends at the end of the first week of March. Since it is a finish-to-start precedence chart, one would expect the start of activity B to be the beginning of the second week in March. But if activity B cannot start until the beginning of the third week of March, that would indicate a week of lag between activity A and activity B even though both activities can have slack within the activity. Simply

stated, slack is measured within the activities whereas lag is measured between the activities. The lag may be the result of resource constraints.

Any common term is lead. Again looking at Figure 12–26A, suppose that activity A finishes on March 15 but the precedence chart shows activity B starting on March 8, seven days prior to the completion of activity A. In this case, $L = -7$, a negative value, indicating that the start of activity B leads the completion of activity A by seven days. To illustrate how this can happen, consider the following example: The line manager responsible for activity B promised you that his resources would be available on March 16, the day after activity A was scheduled to end. The line manager then informs you that these resources will be available on March 8, and if you do not pick them up on your charge number at that time, they may be assigned elsewhere and not be available on the 16th. Most project managers would take the resources on the 8th and find some work for them to do even though logic says that the work cannot begin until after activity A has finished.

12.14 SCHEDULING PROBLEMS

Every scheduling technique has advantages and disadvantages. Some scheduling problems are the result of organizational indecisiveness, such as having a project sponsor that refuses to provide the project manager guidance on whether the schedule should be based upon a least time, least cost, or least risk scheduling objective. As a result, precious time is wasted in having to redo the schedules.

However, there are some scheduling problems that can impact all scheduling techniques. These include:

- Using unrealistic estimates for effort and duration
- Inability to handle employee workload imbalances
- Having to share critical resources across several projects
- Overcommitted resources
- Continuous readjustments to the WBS primarily from scope changes
- Unforeseen bottlenecks

12.15 THE MYTHS OF SCHEDULE COMPRESSION

Simply because schedule compression techniques may exist does not mean that they will work. There is a tendency for managers to be aggressively positive in their thinking at the onset of a project, believing that compression techniques can be applied effectively. As discussed by Grey[14]:

14. Stephen Grey, *Practical Risk Assessment for Project Management* (West Sussex, England: Wiley, 1995), pp. 108–109.

There is a common tendency, especially among people who have been convinced that they must "think positive," to be unwilling to accept that an activity might take longer than planned. To the question "What is the maximum time it could take?", they respond with "It will be finished in the planned time, it will not be allowed to take longer", or words to that effect. The words "it will not be allowed to take longer" or "it must not take any longer" are so consistent that they must reflect a common feature of the way businesses manage their staff.

While most people are willing to accept that costs could exceed expectations, and might even take a perverse delight in recounting past examples, the same is not true of deadlines. This is probably due to the fact that cost over runs are resolved in-house, while schedule issues are open and visible to the customer.

There might be ways in which a schedule can be held no matter what happens. Study tasks are almost always finished on time because the scope of work is allowed to vary according to what the study turned up. This is the exception rather than the rule though. In general, you can only be sure that a task will finish on time if:

- The scope of work is flexible, at least to some extent.
- It will be possible to calibrate the task from the early part of the work to tell if the planned work rate is adequate.
- You can raise the work rate and/or reduce the scope of work to bring the task back on target in the time left after you find it is heading for an overrun.

There are five common techniques for schedule compression, and each technique has significant limitations that may make this technique more of a myth than reality. This is shown in Table 12–3.

TABLE 12–3. MYTHS AND REALITIES OF SCHEDULE COMPRESSION

Compression Technique	Myth	Reality
Use of overtime	Work will progress at the same rate on overtime.	The rate of progress is less on overtime; more mistakes may occur; and prolonged overtime may lead to burnout.
Adding more resources (i.e., crashing)	The performance rate will increase due to the added resources.	It takes time to find the resources; it takes time to get them up to speed; the resources used for the training must come from the existing resources.
Reducing scope (i.e., needed. reducing functionality)	The customer always requests more work than actually needed.	The customer needs all of the tasks agreed to in the statement of work.
Outsourcing	Numerous qualified suppliers exist.	The quality of the suppliers' work can damage your reputation; the supplier may go out of business; and the supplier may have limited concern for your scheduled dates.
Doing series work in parallel	An activity can start before the previous activity has finished.	The risks increase and rework becomes expensive because it may involve multiple activities.

12.16 UNDERSTANDING PROJECT MANAGEMENT SOFTWARE

PMBOK® Guide, 4th Edition
6.3.2.8 Project Management Software

Efficient project management requires more than good planning, it requires that relevant information be obtained, analyzed, and reviewed in a timely manner. This can provide early warning of pending problems and impact assessments on other activities, which can lead to alternate plans and management actions. Today, project managers have a large array of software available to help in the difficult task of tracking and controlling projects. While it is clear that even the most sophisticated software package is not a substitute for competent project leadership—and by itself does not identify or correct any task-related problems—it can be a terrific aid to the project manager in tracking the many interrelated variables and tasks that come into play with a project. Specific examples of these capabilities are:

- Project data summary: expenditure, timing, and activity
- Project management and business graphics capabilities
- Data management and reporting capabilities
- Critical path analysis
- Customized and standard reporting formats
- Multiproject tracking
- Subnetworking
- Impact analysis (what if . . .)
- Early-warning systems
- On-line analysis of recovering alternatives
- Graphical presentation of cost, time, and activity data
- Resource planning and analysis
- Cost analysis, variance analysis
- Multiple calendars
- Resource leveling

Further, many of the more sophisticated software packages are now available for personal computers and use mainly precedence networks. This offers large and small companies many advantages ranging from true user interaction, to ready access and availability, to simpler and more user-friendly interfaces, to considerably lower software cost.

12.17 SOFTWARE FEATURES OFFERED

Project management software capabilities and features vary a great deal. However, the variation is more in the depth and sophistication of the features, such as storage, display, analysis, interoperability, and user friendliness, rather than in the type of features offered, which are very similar for most software programs. Most project management software packages offer the following features:

1. *Planning, tracking, and monitoring.* These features provide for planning and tracking the projects' tasks, resources, and costs. The data format for describing the

project to the computer is usually based on standard network typologies such as the Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), or Precedence Diagram Method (PDM). Task elements, with their estimated start and finish times, their assigned resources, and actual cost data, can be entered and updated as the project progresses. The software provides an analysis of the data and documents the technical and financial status of the project against its schedule and original plan. Usually, the software also provides impact assessments of plan deviations and resource and schedule projections. Many systems also provide resource leveling, a feature that averages out available resources to determine task duration and generates a leveled schedule for comparison.

2. *Reports.* Project reporting is usually achieved via a menu-driven report writer system that allows the user to request several standard reports in a standard format. The user can also modify these reports or create new ones. Depending on the sophistication of the system and its peripheral hardware, these reports are supported by a full range of Gantt charts, network diagrams, tabular summaries, and business graphics. Reporting capabilities include:

PMBOK® Guide, 4th Edition
7.3.2 Cost Control Tools and Techniques

- Budgeted cost for work scheduled (BCWS) or planned value of work (PV)
- Budgeted cost for work performed (BCWP) or earned value of work (EV)
- Actual versus planned expenditure
- Earned value analysis
- Cost and schedule performance indices
- Cash-flow
- Critical path analysis
- Change order
- Standard government reports (DoD, DoE, NASA), formatted for the performance monitoring system (PMS)

In addition, many software packages feature a user-oriented, free-format report writer for styled project reporting.

3. *Project calendar.* This feature allows the user to establish work weeks based on actual workdays. Hence, the user can specify nonwork periods such as weekends, holidays, and vacations. The project calendar can be printed out in detail or in a summary format and is automatically the basis for all computer-assisted resource scheduling.
4. *What-if analysis.* Some software is designed to make what-if analyses easy. A separate, duplicate project database is established and the desired changes are entered. Then the software performs a comparative analysis and displays the new against the old project plan in tabular or graphical form for fast and easy management review and analysis.
5. *Multiproject analysis.* Some of the more sophisticated software packages feature a single, comprehensive database that facilitates cross-project analysis and reporting. Cost and schedule modules share common files that allow integration among projects and minimize problems of data inconsistencies and redundancies.

12.18 SOFTWARE CLASSIFICATION

For purposes of easy classification, project management software products have been divided into three categories based on the type of functions and features they provide.[15]

Level I software. Designed for single-project planning, these software packages are simple, easy to use, and their outputs are easy to understand. They do provide, however, only a limited analysis of the data. They do not provide automatic rescheduling based on specific changes. Therefore, deviations from the original project plan require complete replanning of the project and a complete new data input to the computer.

Level II software. Designed for single project management, these software packages aid project leaders in the planning, tracking, and reporting of projects. They provide a comprehensive analysis of the project, progress reports, and plan revisions, based on actual performance. This type of software is designed for managing projects beyond the planning stage, and for providing semiautomatic project control.

Level III software. These packages feature multiproject planning, monitoring, and control by utilizing a common database and sophisticated cross-project monitoring and reporting software.

Most software packages at levels II and III have the following extensive capabilities for project monitoring and control:

1. *System capacity.* The number of activities and/or number of subnetworks that may be used.
2. *Network schemes.* The network schemes are activity diagram (AD) and/or precedence relationship (PRE).
3. *Calendar dates.* An internal calendar is available to schedule the project's activities. The variations and options of the different calendar algorithms are numerous.
4. *Gantt or bar charts.* A graphic display of the output on a time scale is available if desired.
5. *Flexible report generator.* The user can specify within defined guidelines the format of the output.
6. *Updating.* The program will accept revised time estimates and completion dates and recompute the revised schedule.
7. *Cost control.* The program accepts budgeted cost figures for each activity and then the actual cost incurred, and summarizes the budgeted and actual figures on each updating run. The primary objective is to help management produce a realistic cost plan before the project is started and to assist in the control of the project expenditures as the work progresses.
8. *Scheduled dates.* A date is specified for the completion of any of the activities for purposes of planning and control. The calculations are performed with these dates as constraints.
9. *Sorting.* The program lists the activities in a sequence specified by the user.

15. Some standards were initially set by *PC Magazine*, "Project Management with the PC," Vol. 3, No. 24, December 11, 1984.

10. *Resource allocation.* The program attempts to allocate resources optimally using one of many heuristic algorithms.
11. *Plotter availability.* A plotter is available to plot the network diagram.
12. *Machine requirements.* This is the minimum hardware memory requirement for the program (in units of bytes).
13. *Cost.* Indicates whether the program is sold and/or leased and the purchase price and/or lease price (where available).

12.19 IMPLEMENTATION PROBLEMS

Generally speaking, mainframe software packages are more difficult to implement than smaller packages, because everyone is requested to use the same package, perhaps even the same way. The following are common difficulties during implementation:

- *Upper-level management may not like the reality of the output.* The output usually shows top management that more time and resources are needed than originally anticipated. This can also be a positive note for the project manager, who is forced to deal with severe resource constraints.
- *Upper-level management may not use the packages for planning, budgeting, and decision-making.* Upper-level personnel generally prefer the more traditional methods, or simply refuse to look at reality because of politics. As a result, the plans they submit to the board are based on an eye-pleasing approach for quick acceptance, rather than reality.
- *Day-to-day project planners may not use the packages for their own projects.* Project managers often rely on other planning methods and tools from previous assignments. They rely heavily on instinct and trial and error.
- *Upper-level management may not demonstrate support and commitment to training.* Ongoing customized training is mandatory for successful implementation, even though each project may vary.
- *Use of mainframe software requires strong internal communications lines for support.* Managers who share resources must talk to one another continually.
- *Clear, concise reports are lacking.* Large mainframe packages can generate volumes of data, even if the package has a report writer package.
- *Mainframe packages do not always provide for immediate turnabout of information.* This is often the result of not understanding how to utilize the new systems.
- *The business entity may not have any project management standards in place prior to implementation.* This relates to a lack of WBS numbering schemes, no life-cycle phases, and a poor understanding of task dependencies.
- *Implementation may highlight middle management's inexperience in project planning and organizational skills.* Fear of its use is a key factor in not obtaining proper support.
- *The business environment and organizational structure may not be appropriate to meet project management/planning needs.* If extensive sharing of resources exists, then the organizational structure should be a formal or informal matrix.

If the organization is deeply entrenched in a traditional structure, then organizational mismatch exists and the software system may not be accepted.

- *Sufficient/extensive resources (staff, equipment, etc.) are required.* Large mainframe packages consume a significant amount of resources in the implementation phase.
- *The business entity must determine the extent of, and appropriate use of, the systems within the organization.* Should it be used by all organizations? Should it be used only on high-priority projects?
- *The system may be viewed as a substitute for the extensive interpersonal skills required by the project manager.* Software systems do not replace the need for project managers with strong communications and negotiation skills.
- *Software implementation is less likely to succeed if the organization does not have sufficient training in project management principles.* This barrier is perhaps the underlying problem for all of the other barriers.

12.20 CRITICAL CHAIN[16]

PMBOK® Guide, 4th Edition
6.5.2.3 Schedule Development—Critical Chain Method

The selection and completion of enough projects to improve an organization is often a matter of survival for executives. Witness the statistic by outplacement firm Drake, Beam, Morin stating that 57 percent of the 367 large corporations surveyed have replaced their CEOs in the past three years.[17] Executives use projects as a primary means to meet their goals. Therefore, we can assume that many of these CEOs were unable to complete enough projects successfully in the measurement time period to keep their jobs.

In trying to meet their goals, executives often describe three major challenges in project management:

- Choosing the right projects from among a large pool
- Getting each project to completion more quickly
- Funneling more projects through the organization without adding resources

Critical Chain is a project management methodology designed to address the latter two goals. Critical Chain is based upon a general improvement methodology called the Theory of Constraints, which addresses the first executive goal—choosing the right projects. Choosing the right projects is part of strategic planning, which is discussed in depth in other books.[18]

As executives attempt to release new projects into the organization, they often hear complaints that people are overloaded. Inevitably, they face a conflict between moving

16. Section author Gerald I. Kendall, PMP, Principal, TOC International, www.tocinternational.com, email Gerryikendall@cs.com, 850-939-9006.

17. *USA Today*, April 8, 2002, p. B1, "Scandals, Setbacks Topple CEOs Formerly Golden Image".

18. See Gerald I. Kendall, *Viable Vision* (Boca Raton, FL: J. Ross Publishing, 2004).

resources to the new project and allowing resources to continue working on existing projects. People in the organization may also urge the executive to delay the start of the new project while the executive feels compelled to move ahead.

Most executives accept this conflict as a fact of life. They believe that their role is to push people as hard as they can to perform to high standards. As a result, the reaction of many executives to the resource conflict is to demand that existing projects be finished earlier so that their new projects can begin sooner. These demands leave project managers with their own huge conflict. In order to finish a project sooner, most project managers find that they are forced to either reduce scope or quality or add resources, which will exceed the budget. None of these alternatives is acceptable to executives.

The resulting behavior, which is now prevalent in many organizations, is the fodder for a new approach called Critical Chain Project Management. When project and resource managers fail to convince executives to delay the start of a new project, they often take three actions that lead to many other negative effects:

- Multitasking of resources
- Working toward cutting task estimates
- Managing people very closely to ensure that they meet their due dates

Since executives are a major part of the system of projects inside organizations, Critical Chain recognizes that executives are part of the problem. To solve the problem and have a major impact on project results, executives must therefore be part of the solution.

The Critical Chain solution to scheduling and managing projects was derived from a methodology called the Theory of Constraints. Dr. Eliyahu M. Goldratt is the individual most often credited with the creation and advancement of this methodology over the past twenty-five years. To derive the Critical Chain solution, Goldratt applied the five focusing steps, identified in his writings.[19] These steps are:

1. *Identify* the system's constraint.
2. Decide how to *exploit* the constraint.
3. *Subordinate* everything else to the above decision.
4. *Elevate* the system's constraint.
5. If, in a previous step, the system's constraint has been broken, *go back* to step 1.

Within any project, the Critical Chain is defined as the longest chain of dependent events where the dependency is either task or resource related. This definition assumes that the longest chain is the one that is most likely to impact negatively the overall duration of the project. The Critical Chain is not necessarily equivalent to the project duration since, sometimes, there are noncritical tasks that begin before the Critical Chain tasks begin.

The Critical Chain solution recognizes the Critical Chain as the leverage point for reducing the project's duration. The first focusing step, *identify,* recognizes that managers put practices into place that block the reduction of the Critical Chain. The *exploit* and *subordinate*

19. Eliyahu M. Goldratt, *Theory of Constraints* (Croton-on-Hudson, NY: North River Press, 1990).

steps implement changes to condense the Critical Chain (in other words, to shorten the amount of time it takes to complete a project).

Critical Chain implements major behavioral changes in project managers, resource managers, team members, and executives. The only way that so many people in an organization can accept such fundamental changes is through a deep understanding of the current behaviors, the new behaviors required, and the benefits. This is usually accomplished through education of executives, project managers, resource managers, and team members, followed by policy and measurement changes. These changes include:

- An end to the practice of measuring people in any way on the accuracy of their estimates
- An end to the practice of measuring people on meeting due dates for individual project tasks
- A replacement of the above two practices by "the relay runner work ethic," explained later in this chapter
- A system, agreed to by all executives and senior managers, of allowing new projects to start only when a "strategic resource" is available
- The recognition of the need to strategically protect projects from task time variations, by using properly placed buffers. This imbeds the philosophy of W. Edwards Deming, the great quality advocate, regarding the handling of "common cause" and "special cause" variation and predictability.
- The significant reduction of the practice of multitasking by moving toward dedicated work on project tasks
- The implementation of multiproject software with the data actually being used by executives, resource managers, and project managers. Critical Chain reports present a common and accurate picture of the organization's projects and a systematic and logical way to manage variances.
- The implementation of buffer management as a key management and executive process for identifying project problems during execution

The successful implementation of Critical Chain has resulted in major improvements in organizations, examples of which are documented in the case studies in this Chaper. In order to understand the magnitude of the cultural change and the problems to be overcome, this Section explains the fundamentals of the Critical Chain approach, in both individual project environments and throughout an organization.

12.21 STUDYING TIPS FOR THE PMI® PROJECT MANAGEMENT CERTIFICATION EXAM

This section is applicable as a review of the principles to support the knowledge areas and domain groups in the PMBOK® Guide. This chapter addresses:

- Time management
- Planning
- Controlling

Understanding the following principles is beneficial if the reader is using this text to study for the PMP® Certification Exam:

- How to identify the three types of scheduling techniques and their respective advantages and disadvantages
- Difference between activity-on-arrow and activity-on-node networks
- Four types of precedence networks
- Basic network terminology such as activities, events, critical path, and slack (float)
- Difference between positive and negative slack
- Schedule compression techniques and crashing and fast-tracking (concurrent engineering)
- Importance of the work breakdown structure in network development
- The steps, and their order, for the development of a network
- Three types of dependencies
- How to perform a forward and backward pass
- Resources leveling
- Resource-limited planning
- Difference between effort and duration
- Which network technique uses optimistic, most likely, and pessimistic estimates
- Use of dummy activities
- Lag
- Difference between unlimited versus limited resource planning/scheduling

The following multiple-choice questions will be helpful in reviewing the principles of this chapter:

1. The shortest time necessary to complete all of the activities in a network is called the:
A. Activity duration length
B. Critical path
C. Maximum slack path
D. Compression path

2. Which of the following *cannot* be identified after performing a forward and backward pass?
A. Dummy activities
B. Slack time
C. Critical path activities
D. How much overtime is planned

3. Which of the following is *not* a commonly used technique for schedule compression?
A. Resource reduction
B. Reducing scope
C. Fast-tracking activities
D. Use of overtime

4. A network-based schedule has four paths, namely 7, 8, 9, and 10 weeks. If the 10-week path is compressed to 8 weeks, then:
A. We now have two critical paths.
B. The 9-week path is now the critical path.

C. Only the 7-week path has slack.
D. Not enough information is provided to make a determination.

5. The major disadvantage of using bar charts to manage a project is that bar charts:
A. Do not show dependencies between activities
B. Are ineffective for projects under one year in length
C. Are ineffective for projects under $1 million in size
D. Do not identify start and end dates of a schedule

6. The first step in the development of a schedule is a:
A. Listing of the activities
B. Determination of dependencies
C. Calculation of effort
D. Calculation of durations

7. Reducing the peaks and valleys in manpower assignments in order to obtain a relatively smooth manpower curve is called:
A. Manpower allocation
B. Manpower leveling
C. Resource allocation
D. Resource commitment planning

8. Activities with no time duration are called:
A. Reserve activities
B. Dummy activities
C. Zero slack activities
D. Supervision activities

9. Optimistic, pessimistic, and most likely activity times are associated with:
A. PERT
B. GERT
C. PDM
D. ADM

10. The most common "constraint" or relationship in a precedence network is:
A. Start-to-start
B. Start-to-finish
C. Finish-to-start
D. Finish-to-finish

11. A network-based technique that allows for branching and looping is:
A. PERT
B. GERT
C. PDM
D. ADM

12. If an activity on the critical path takes longer than anticipated, then:
A. Activities not on the critical path have additional slack.
B. Activities not on the critical path have less slack.
C. Additional critical path activities will appear.
D. None of the above.

13. Which of the following is not one of the three types of dependencies?
A. Mandatory
B. Discretionary

C. Internal
D. External

14. You have an activity where the early start is week 6, the early finish is week 10, the latest start is week 14, and the latest finish is week 18. The slack in this activity is:
A. 4 weeks
B. 6 weeks
C. 8 weeks
D. 18 weeks

ANSWERS

1. B
2. D
3. A
4. D
5. A
6. A
7. B
8. B
9. A
10. C
11. B
12. A
13. C
14. C

PROBLEMS

12–1 Should a PERT/CPM network become a means of understanding reports and schedules, or should it be vice versa?

12–2 Before PERT diagrams are prepared, should the person performing the work have a clear definition of the requirements and objectives, both prime and supporting? Is it an absolute necessity?

12–3 Who prepares the PERT diagrams? Who is responsible for their integration?

12–4 Should PERT networks follow the work breakdown structure?

12–5 How can a PERT network be used to increase functional ability to relate to the total program?

12–6 What problems are associated with applying PERT to small programs?

12–7 Should PERT network design be dependent on the number of elements in the work breakdown structure?

12–8 Can bar charts and PERT diagrams be used to smooth out departmental manpower requirements?

12–9 Should key milestones be established at points where trade-offs are most likely to occur?

12–10 Would you agree or disagree that the cost of accelerating a project rises exponentially, especially as the project nears completion?

12–11 What are the major difficulties with PERT, and how can they be overcome?

12–12 Is PERT/cost designed to identify critical schedule slippages and cost overruns early enough that corrective action can be taken?

12–13 Draw the network and identify the critical path. Also calculate the earliest–latest starting and finishing times for each activity:

Activity	Preceding Activity	Time (Weeks)
A	—	7
B	—	8
C	—	6
D	A	6
E	B	6
F	B	8
G	C	4
H	D, E	7
I	F, G, H	3

12–14 Draw the network and identify the critical path. Also calculate the earliest–latest starting and finishing times for each activity:

Activity	Preceding Activity	Time (Weeks)
A	—	4
B	—	6
C	A, B	7
D	B	8
E	B	5
F	C	5
G	D	7
H	D, E	8
I	F, G, H	4

12–15 Consider the following network for a small maintenance project (all times are in days; network proceeds from node 1 to node 7):

a. Draw an arrow diagram representing the project.
b. What is the critical path and associated time?

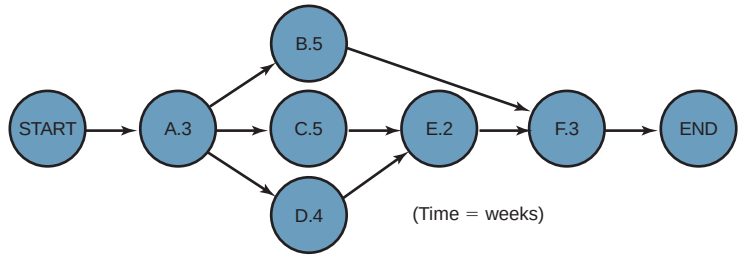
Job Activity	Network: Initial Node	Network: Final Node	Optimistic Time	Pessimistic Time	Most Likely
A	1	2	1	3	2
B	1	4	4	6	5
C	1	3	4	6	5
D	2	6	2	4	3
E	2	4	1	3	2
F	3	4	2	4	3
G	3	5	7	15	9
H	4	6	4	6	5
I	4	7	6	14	10
J	4	5	1	3	2
K	5	7	2	4	3
L	6	7	6	14	10

c. What is the total slack time in the network?
d. What is the expected time for 68, 95, and 99 percent completion limits?
e. If activity G had an estimated time of fifteen days, what impact would this have on your answer to part b?

12–16 Identify the critical path for the following network for a small MIS project (all times are in days; network proceeds from node 1 to node 10):

Job Activity	Network: Initial Node	Network: Final Node	Estimated Time
A	1	2	2
B	1	3	3
C	1	4	3
D	2	5	3
E	2	9	3
F	3	5	1
G	3	6	2
H	3	7	3
I	4	7	5
J	4	8	3
K	5	6	3
L	6	9	4
M	7	9	4
N	8	9	3
O	9	10	2

12–17 On May 1, Arnie Watson sent a memo to his boss, the director of project management, stating that the MX project would require thirteen weeks for completion according to the figure shown at the top of page 542.

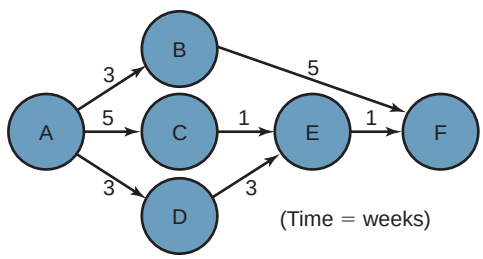


Arnie realized that the customer wanted the job completed in less time. After discussions with the functional managers, Arnie developed the table shown below:

	Normal		Crash		
Activity	**Time**	**Cost**	**Time**	**Cost**	**Additional (Crash) Cost/Week**
A	3	6,000	2	8,000	2,000
B	5	12,000	4	13,500	1,500
C	5	16,000	3	22,000	3,000
D	4	8,000	2	10,000	1,000
E	2	6,000	1	7,500	1,500
F	3	14,000	1	20,000	3,000
		$62,000			

a. According to the contract, there is a penalty payment of $5,000 per week for every week over six. What is the minimum amount of additional funding that Arnie should request?
b. Suppose your answer to part a gives you the same additional minimum cost for both an eight-week and a nine-week project. What factors would you consider before deciding whether to do it in eight or nine weeks?

12–18 On March 1, the project manager received three status reports indicating resource utilization to date. Shown below are the three reports as well as the PERT diagram.



PERCENT-COMPLETION REPORT

Activity	Date Started	% Completed	Time to Complete
AB	2/1	100%	—
AC	2/1	60%	2
AD	2/1	100%	—
DE*	not started	—	3
BF	2/14	40%	3

**Note:* Because of priorities, resources for activity DE will not be available until 3/14. Management estimates that this activity can be crashed from 3 weeks to 2 weeks at an additional cost of $3,000

PROJECT PLANNING BUDGET: WEEKS AFTER GO-AHEAD

Activity	1	2	3	4	5	6	7	8	Total $
AB	2,000	2,000	2,000	—	—	—	—	—	6,000
AC	3,000	4,000	4,000	4,000	5,000	—	—	—	20,000
AD	2,000	3,000	2,500	—	—	—	—	—	7,500
BF	—	—	—	2,000	3,000	4,000	3,000	3,000	15,000
CE	—	—	—	—	—	2,500	—	—	2,500
DE	—	—	—	3,500	3,500	3,500	—	—	10,500
EF	—	—	—	—	—	—	3,000	—	3,000
Total	7,000	9,000	8,500	9,500	11,500	10,000	6,000	3,000	64,500

COST SUMMARY

	Week Ending			Cumulative to Date		
Activity	Budget Cost	Actual	(Over) Under	Budget Cost	Actual	(Over) Under
AB	—	—	—	6,000	6,200	(200)
AC	4,000	4,500	(500)	15,000	12,500	2,500
AD	—	2,400	(2,400)	7,500	7,400	100
BF	2,000	2,800	(800)	2,000	4,500	(2,500)
DE	3,500	—	3,500	3,500	—	3,500
Total	9,500	9,700	(200)	34,000	30,600	3,400

a. As of the end of week 4, how much time is required to complete the project (i.e., time to complete)?
b. At the end of week 4, are you over/under budget, and by how much, for the work (either partial or full) that has been completed to date? (This is *not* a cost to complete.)
c. At what point in time should the decision be made to crash activities?
d. Either construct a single table by which cost and performance data are more easily seen, or modify the above tables accordingly.

To solve this problem, you must make an assumption about the relationship between percent complete and time/cost. In the project planning budget table, assume that percent complete is *linear* with time and *nonlinear* with cost (i.e., cost must be read from table).

12–19 Can PERT charts have more depth than the WBS?

12–20 Estimating activity time is not an easy task, especially if assumptions must be made. State whether each item identified below can be accounted for in the construction of a PERT/CPM network:

a. Consideration of weather conditions
b. Consideration of weekend activities
c. Unleveled manpower requirements
d. Checking of resource allocations
e. Variable crew size
f. Splitting (or interrupting) of activities
g. Assignment of unused resources
h. Accounting for project priorities

12–21 Scheduling departmental manpower for a project is a very difficult task, even if slack time is available. Many managers would prefer to supply manpower at a constant rate rather than continually shuffle people in and out of a project.

a. Using the information shown below, construct the PERT network, identify the critical path, and determine the slack time for each node.

Activity	*Weeks*	*Personnel Required (Full-time)*
A–B	5	3
A–C	3	3
B–D	2	4
B–E	3	5
C–E	3	5
D–F	3	5
E–F	6	3

b. The network you have just created is a departmental PERT chart. Construct a weekly manpower plot assuming that all activities begin as early as possible. (Note: Overtime cannot be used to shorten the activity time.)
c. The department manager wishes to assign eight people full-time for the duration of the project. However, if an employee is no longer needed on the project, he can be assigned elsewhere. Using the base of eight people, identify the standby (or idle) time and the overtime periods.
d. Determine the standby and overtime costs, assuming that each employee is paid $300 per week and overtime is paid at time and a half. During standby time the employee draws his full salary.
e. Repeat parts c and d and try to consider slack time in order to smooth out the manpower curve. (Hint: Some activities should begin as early as possible, while others begin as late as possible.) Identify the optimum manpower level so as to minimize the standby and overtime costs. Assume all employees must work full-time.

f. Would your answer to parts d and e change if the employees must remain for the full duration of the project, even if they are no longer required?

12–22 How does a manager decide whether the work breakdown structure should be based on a "tree" diagram or the PERT diagram?

12–23 Using Table 12–4, draw the CPM chart for the project. In this case, make all identifications on the arrows (activities) rather than the events. Show that the critical path is twenty-one weeks.

Using Table 12–5, draw the precedence chart for the project, showing interrelationships. Try to use a different color or shade for the critical path.

Calculate the *minimum* cash flow needed for the first four weeks of the project, assuming the following distribution.

Activity	*Total Cost for Each Activity*
A–H	16,960
I–P	5,160
Q–V	40,960
W	67,200
X	22,940

Furthermore, assume that *all* costs are linear with time, and that the activity X cost must be spent in the first two weeks. Prove that the minimum cash flow is $92,000.

TABLE 12–4. DATA FOR PROJECT CPM CHART

Activity	Preceding Activity	Normal Time (Weeks)
A	—	4
B	A	6
C	B,U,V,N	3
D	C	2
E	C	2
F	C	7
G	C	7
H	D,E	4
I	—	2
J	I,R	1
K	J	1
L	K	2
M	L	1
N	M	1
O	N	2
P	O	1
Q	—	4
R	Q	1
S	—	1
T	—	1
U	S	2
V	T	2
W*	—	*
X	—	2

*Stands for total length of project. This is management support.

TABLE 12–5. PROJECT PRECEDENCE CHART*

	Weeks																				
Activity	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
A																					
B																					
C																					
D																					
E																					
F																					
G																					
H																					
I																					
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Q																					
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S																					
T																					
U																					
V																					
W																					
X																					

*Draw the appropriate bar charts into the figure, assuming that each activity starts as early as possible (identify slack). Try to show the interrelationships as in a precedence network.

12–24 For the network shown in Figure P12–24 with all times indicating weeks, answer the following questions:

a. What is the impact on the end date of the project if activity B slips by two weeks?
b. What is the impact on the end date of the project if activity E slips by one week?
c. What is the impact on the end date of the project if activity D slips by two weeks?
d. If the customer offered you a bonus for completing the project in sixteen weeks or less, which activities would you focus on first as part of compression ("crashing") analyses?

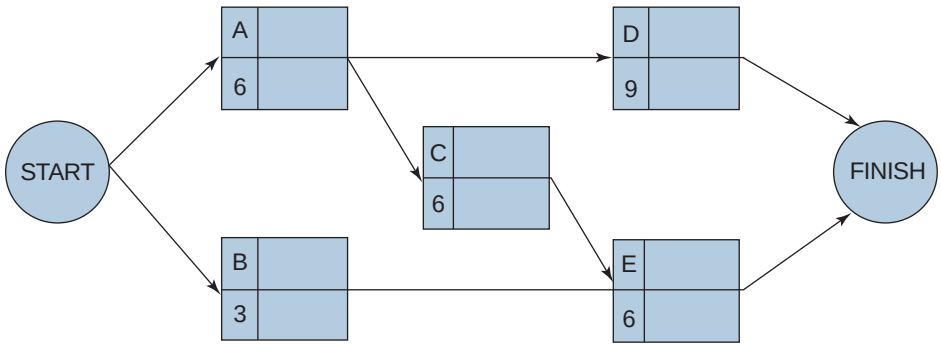

Figure P12–24

12–25 For the network shown in Figure P12–25 with all times indicating weeks, answer the following questions:

a. What is the impact on the end date of the project if activity F slips by seven weeks?

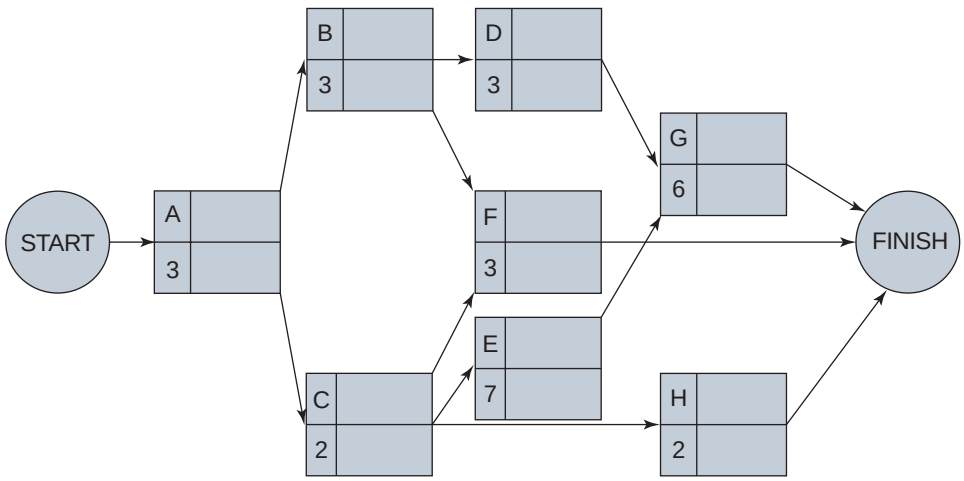

Figure P12–25

b. What is the impact on the end date of the project if activity E slips by one week?
c. What is the impact on activity H if activity C were to slip by two weeks?
d. What is the impact on the end date of the project if activity B slips by two weeks?

12–26 For the network shown in Figure P12–26 with all times indicating weeks, answer the following questions:

a. What is the impact on the end date of the project if activity I slips by three weeks?
b. By how many weeks can activity D slip before the end date gets extended?
c. If activity A slips by one week, how will the slack in activity G be impacted?
d. If activity H can somehow be compressed from seven weeks to two weeks, perhaps by adding a significant number of resources, what will be the impact, if any, on the end date of the project?

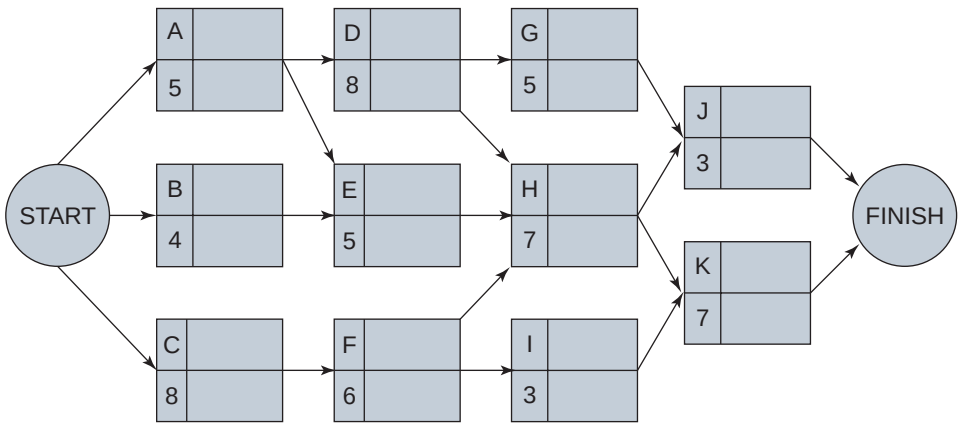

Figure P12–26

12–27 A project manager discovers that his team has neglected to complete the network diagram for the project. The network diagram is shown in Figure P12–27. However, the project manager has some information available, specifically that each activity, labeled A–G, has a different duration between one and seven weeks. Also, the slack time for each of the activities is known as shown in Figure P12–27 in ascending order.

Duration (weeks): 1, 2, 3, 4, 5, 6, 7
Slack time (weeks): 0, 0, 0, 2, 4, 4, 7

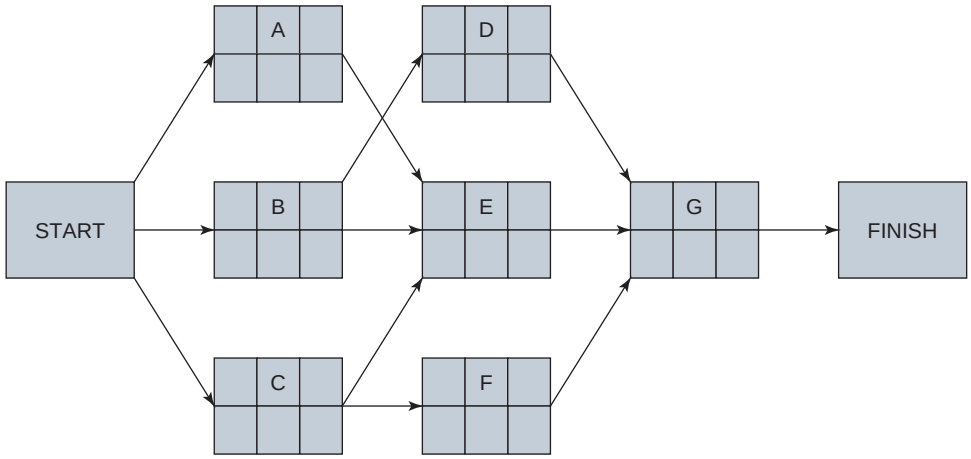

Figure P12–27

Using the clues provided below, determine the duration of each activity as well as the early start, early finish, latest start and latest finish times for each activity.

Clues

1. Activity E is on the critical path.
2. The early start (ES) time for activity F is five weeks.
3. The duration of activity B is seven weeks.
4. Activity D has four weeks of slack, but activity F has a greatest amount of slack.
5. The early finish (EF) time for activity G is seventeen weeks.
6. The latest finish (LF) time for activity E is thirteen weeks.

Activity	Duration	Early Start	Early Finish	Latest Start	Latest Finish
A	_____	_____	_____	_____	_____
B	_____	_____	_____	_____	_____
C	_____	_____	_____	_____	_____
D	_____	_____	_____	_____	_____
E	_____	_____	_____	_____	_____
F	_____	_____	_____	_____	_____
G	_____	_____	_____	_____	_____

12–28 A project manager discovers that his team has neglected to complete the network diagram for the project. The network diagram is shown in Figure P12–28. However, the project manager

has some information available, specifically that each activity, labeled A–G, has a different duration between one and seven weeks. Also, the slack time for each of the activities is known as shown below.

Duration (weeks): 1, 2, 3, 4, 5, 6, 7

Slack time (weeks): 0, 0, 0, 1, 1, 3, 7

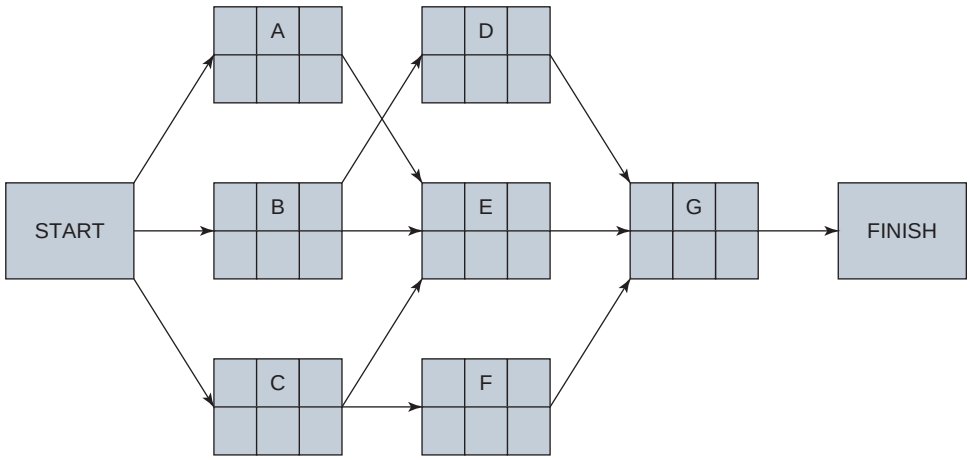

Figure P12–28

Using the clues provided below, determine the duration of each activity as well as the early start, early finish, latest start, and latest finish times for each activity.

Clues

1. Activity E is the longest duration activity and is on the critical path, which is the unlucky number 13; also, there is only one critical path.
2. The early finish (EF) time for activity F is eleven weeks.
3. The latest start (LS) time for activity D is nine weeks.
4. If activity A slips by one week, it will be on a critical path.

Activity	Duration	Early Start	Early Finish	Latest Start	Latest Finish
A	_____	_____	_____	_____	_____
B	_____	_____	_____	_____	_____
C	_____	_____	_____	_____	_____
D	_____	_____	_____	_____	_____
E	_____	_____	_____	_____	_____
F	_____	_____	_____	_____	_____
G	_____	_____	_____	_____	_____

12–29 A project manager discovers that his team has neglected to complete the network diagram for the project. The network diagram is shown in Figure P12–29. However, the project manager has some information available, specifically that each activity, labeled A–G, has a different duration between one and seven weeks. Also, the slack time for each of the activities is known as shown below:

Duration (weeks): 1, 2, 3, 4, 5, 6, 7

Slack time (weeks): 0, 0, 0, 3, 6, 8, 8

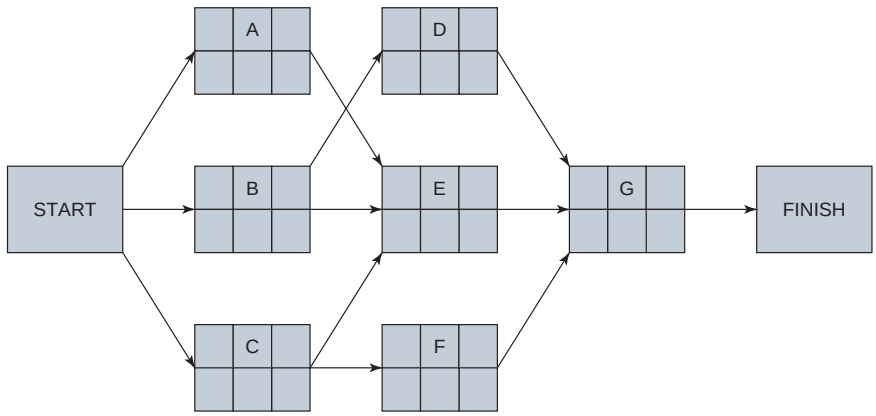

Figure P12–29

Using the clues provided below, determine the duration of each activity as well as the early start, early finish, latest start, and latest finish times for each activity.

Clues

1. There exists only one critical path, and it is the largest possible number given the possible durations shown.
2. Activity E has the smallest amount of slack that is greater than zero.
3. The early finish (EF) time for activity A is four weeks, and this does not equal the latest finish (LF) time. (Note: There is no negative slack in the network.)
4. The slack in activity C is eight weeks.
5. The duration of activity F is greater than the duration of activity C by at least two weeks.

Activity	Duration	Early Start	Early Finish	Latest Start	Latest Finish
A	_____	_____	_____	_____	_____
B	_____	_____	_____	_____	_____
C	_____	_____	_____	_____	_____
D	_____	_____	_____	_____	_____
E	_____	_____	_____	_____	_____
F	_____	_____	_____	_____	_____
G	_____	_____	_____	_____	_____

CASE STUDY

CROSBY MANUFACTURING CORPORATION

"I've called this meeting to resolve a major problem with our management cost and control system (MCCS)," remarked Wilfred Livingston, president. "We're having one hell of a time trying to meet competition with our antiquated MCCS reporting procedures. Last year we were considered nonresponsive to three large government contracts because we could not adhere to the customer's financial reporting requirements. The government has recently shown a renewed interest in Crosby Manufacturing Corporation. If we can computerize our project financial reporting procedure, we'll be in great shape to meet the competition head-on. The customer might even waive the financial reporting requirements if we show our immediate intent to convert."

Crosby Manufacturing was a $250-million-a-year electronics component manufacturing firm in 2005, at which time Wilfred "Willy" Livingston became president. His first major act was to reorganize the 700 employees into a modified matrix structure. This reorganization was the first step in Livingston's long-range plan to obtain large government contracts. The matrix provided the customer focal point policy that government agencies prefer. After three years, the matrix seemed to be working. Now they could begin the second phase, an improved MCCS policy.

On October 20, 2007, Livingston called a meeting with department managers from project management, cost accounting, MIS, data processing, and planning.

Livingston: "We have to replace our present computer with a more advanced model so as to update our MCCS reporting procedures. In order for us to grow, we'll have to develop capabilities for keeping two or even three different sets of books for our customers. Our present computer does not have this capability. We're talking about a sizable cash outlay, not necessarily to impress our customers, but to increase our business base and grow. We need weekly, or even daily, cost data so as to better control our projects."

MIS Manager: "I guess the first step in the design, development, and implementation process would be the feasibility study. I have prepared a list of the major topics which are normally included in a feasibility study of this sort" (see Exhibit 12–1).

Exhibit 12–1. Feasibility study

- Objectives of the study
- Costs
- Benefits
- Manual or computer-based solution?
- Objectives of the system
- Input requirements
- Output requirements
- Processing requirements
- Preliminary system description
- Evaluation of bids from vendors
- Financial analysis
- Conclusions

Exhibit 12–2. Typical schedule (in months)

Activity	Normal Time to Complete	Crash Time to Complete
Management go-ahead	0	0
Release of preliminary system specs	6	2
Receipt of bids on specs	2	1
Order hardware and systems software	2	1
Flowcharts completed	2	2
Applications programs completed	3	6
Receipt of hardware and systems software	3	3
Testing and debugging done	2	2
Documentation, if required	2	2
Changeover completed	22	15*

*This assumes that some of the activities can be run in parallel, instead of series.

Livingston: "What kind of costs are you considering in the feasibility study?"

MIS Manager: "The major cost items include input–output demands; processing; storage capacity; rental, purchase or lease of a system; nonrecurring expenditures; recurring expenditures; cost of supplies; facility requirements; and training requirements. We'll have to get a lot of this information from the EDP department."

EDP Manager: "You must remember that, for a short period of time, we'll end up with two computer systems in operation at the same time. This cannot be helped. However, I have prepared a typical (abbreviated) schedule of my own (see Exhibit 12–2). You'll notice from the right-hand column that I'm somewhat optimistic as to how long it should take us."

Livingston: "Have we prepared a checklist on how to evaluate a vendor?"

EDP Manager: "Besides the 'benchmark' test, I have prepared a list of topics that we must include in evaluation of any vendor (see Exhibit 12–3). We should plan to call on or visit other installations that have purchased the same equipment and see the system in action. Unfortunately, we may have to commit real early and begin developing software packages.

Exhibit 12–3. Vendor support evaluation factors

- Availability of hardware and software packages
- Hardware performance, delivery, and past track record
- Vendor proximity and service-and-support record
- Emergency backup procedure
- Availability of applications programs and their compatibility with our other systems
- Capacity for expansion
- Documentation
- Availability of consultants for systems programming and general training
- Who burdens training cost?
- Risk of obsolescence
- Ease of use

As a matter of fact, using the principle of concurrency, we should begin developing our software packages right now."

Livingston: "Because of the importance of this project, I'm going to violate our normal structure and appoint Tim Emary from our planning group as project leader. He's not as knowledgeable as you people are in regard to computers, but he does know how to lay out a schedule and get the job done. I'm sure your people will give him all the necessary support he needs. Remember, I'll be behind this project all the way. We're going to convene again one week from today, at which time I expect to see a detailed schedule with all major milestones, team meetings, design review meetings, etc., shown and identified. I'd like the project to be complete in eighteen months, if possible. If there are risks in the schedule, identify them. Any questions?"