Program Management: A Comprehensive Overview of the Discipline

Mitchell L. Springer

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Although many might argue that program management is magic or luck, Mitchell L. Springer describes it in terms of an integrated discipline, a discipline composed of both an art and a science portion. The art form is addressed through the numerous qualitative aspects of managing people, working in teams, understanding what motivates people, and gaining an understanding of ourselves as managers and our employees. The quantitative side is composed of a process with multiple activities. Each activity possesses attendant products. The integration of the multiple activities with their attendant products provides a powerful framework for successfully planning a program.

Program Management: A Comprehensive Overview of the Discipline does what no other book has done to date. It has integrated and pictorially depicted each of the many activities and their products which compose a well-defined sequence for creating a successful program plan from which to execute your program. The author has drawn from years of experience in managing studying and evaluating programs.

Program management is something we all do almost every day of our lives. It is not reserved for multi-million dollar programs with strategic governmental or defense implications. The process presented by the author can be applied to any project, whether it be building a garage or planting a garden. The examples presented provide a clear and concise picture of the complete set of activities, how the responsible parties interact, and which products are the desired outcome for each activity.

Dr. Mitchell L. Springer, PMP, currently serves as the manager of human resources for the Radios and Terminals Operation at Raytheon in Fort Wayne, Indiana. He possesses over twenty years of theoretical and practical experience in four disciplines: software engineering, systems engineering, program management, and adult and executive development. He has authored numerous articles and books and lectured on software development methodologies, management practices, and program management. Dr. Springer received his B.S. in computer science from Purdue University and holds an MBA and doctorate in adult and community education with a cognate in executive development from Ball State University. He is certified as both a Project Management Professional (PMP) and a Senior Professional in Human Resources (SPHR).

Program Management: A Comprehensive Overview of the Discipline

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“In all of my interactions with Mitchell Springer, I have been impressed with his scrupulous mastery of the details and his ‘winning’ interpersonal charm. Hence, it comes as no surprise that he has translated his finest qualities into his new text on program management. Just a glance at the table of contents attests to the book’s comprehensive nature. The ‘mechanics’ of program management, as well as the all-important ‘people issues,’ receive equal treatment. If you’re looking for that one comprehensive source in this critical area of management, Dr. Springer has produced the definitive work that you seek.”

—Mike Sheahan, Krannert Executive Education Programs, Purdue University

Acknowledgment gratefully acknowledged that program management is magic or luck. Mitchell L. Springer describes it in terms of an integrated discipline, a discipline composed of both an art and a science portion. The art form is addressed through the numerous qualitative aspects of managing people, working in teams, understanding what motivates people, and gaining an understanding of ourselves as managers and our employees. The quantitative side is composed of a process with multiple activities. Each activity possesses attendant products. The integration of the multiple activities with their attendant products provides a powerful framework for successfully planning a program.

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Nearly seven years ago, I was asked to lead a group of individuals in the design, development, and implementation of a process that program managers could follow in performing their initial planning of defense-related programs. (In this context, I define a program as a set of interrelated activities designed to meet a specific plan or objective.) Since this effort was under the direction of a defense contractor, the programs were typically complex designs involving state-of-the-art hardware and software systems, ranging in value from 2 million to nearly 100 million dollars, and sometimes involving more than 300 people per program.

The team selected for this effort consisted of senior-level engineers and program managers from numerous business areas within our company. As the years passed, personnel joined and retired from the team, and the level of commitment we were able to obtain from the remaining team members varied. Some team members' efforts in this task were only part-time, but a core team remained committed full-time throughout the duration of the effort.

We began, unfortunately, as though we had a clean sheet of paper, with no regard for existing practices. Naively, perhaps, we anticipated that once the process was designed and developed we would abandon existing planning practices from day one and begin using the newly “management-blessed” planning process. We were not without direction. During this time our company had begun a massive effort to “process-ize” every major activity—and even some minor ones. We were not alone—companies all over the world were in the “reengineering” mind-set.

We followed stringent guidelines for creating processes. The guidelines were derived from the Total Quality movement based on the teachings of W. Edwards
Deming. The steps are fundamental, and are documented in Eugene Melan’s *Process Management*.

As time passed, the team changed in personnel and direction. It became increasingly obvious that our corporate culture, and hence our original premise, would not allow for an immediate changeover from existing planning practices to the newly developed process. Our approach, which we struggled with internally on numerous occasions, was unrealistic because it did not consider existing practices. A day-one changeover versus a more incremental approach was the topic of many heated discussions. In the end the more pragmatic, incremental approach won. What we ultimately implemented had very little resemblance to our originally designed and developed program management planning process.

Our completed program management planning process was successfully implemented on numerous programs and modified many times after feedback. During this implementation period, I evaluated the efficiency and effectiveness of this process. Among the numerous questions I addressed in my evaluation were:

1. How adequate will the cost, schedule, and technical performance measurement baseline be as a result of following the program management planning process?
2. What is the quality of the performance measurement baseline that results from following the program management planning process?
3. To what extent do the team participants perceive their efforts in creating a performance measurement baseline as justified?
4. Is the methodology employed in this study generalizable to other studies of planning processes?
5. Relative to integrated linear and integrated nonlinear models of planning processes, what does this study reveal?

The design, development, implementation, and subsequent evaluation of this program management planning process involved hundreds of hours of research and the thorough study of numerous published works in the areas of program/project management, process management, reengineering, management methodologies, and organizational designs. This exhaustive effort results in the unique level of detail and explicitly defined activities that I present in this book.
When most of us become program/project managers, we are given key training on the tools and techniques that enable us to monitor our cost, schedule, and technical performance baseline. In other words, we are taught about: (1) scheduling techniques—the differences between Gantt charts and network diagrams; (2) earned value—how to compare a program’s actual cost to credit earned for work performed and baseline cost; and (3) perhaps we may be indoctrinated into the organization’s departmental budgeting process. Most of these are quantitative measures that, while essential, are arguably not the entirety of what is required for successful program/project management.

To emphasize this point, I’d like to tell a story. Early in my career, I was working on a program as the software engineering manager. We were a subcontractor to a larger prime contractor in Orlando, Florida. At this particular point in our relationship with this prime contractor, the program manager, the contracts manager, the marketing manager, and I were flying down to see our prime for what is termed fact finding. Fact finding is the process a prime contractor goes through with a subcontractor to determine the appropriateness of the subcontractor’s cost basis for their bid.

After some number of hours and numerous discussions on the many line items that formed the basis of our bid, we stumbled onto a particular document that we felt would take five months of a single person’s time to complete. The prime, our customer, felt it should only take two months to complete. After what appeared to be a standstill their contracts manager stood up and said, “We don’t think you are negotiating in good faith, we would like you to leave.” As my col-
leagues began to pack I sat dumbfounded, simply looking around. On seeing this, my contracts manager said, “Let’s go. Pack your briefcase, we’re leaving.” Now the hallway out of this facility was quite long. In fact, it was probably about two city blocks to the exit. The silence was deadening. Nobody spoke a single word. Once outside I asked our contracts manager what we were going to do; you see, I had never been asked to leave a negotiation session before. He simply replied that we would go back to our hotel and see what developed that evening.

After a nice meal (you always eat well when traveling with marketing people), we went back to the hotel only to receive a phone call from our prime, who asked that we return the next day to continue our discussions.

As requested, the next day we returned, again being escorted down the long hallway toward our meeting room. It was amazing how everyone was so jolly. People were laughing and joking like nothing had happened. There was great food and drinks for us, and all seemed well. We began to discuss line items that made up our cost proposal. Again, as in the previous day, we came to that one line item on which we disagreed.

What happened next seems funny now, but back then I was floored. Our contracts manager, not theirs, stood up and said, “We don’t think you are negotiating in good faith, we are leaving.” I was dumbfounded a second time. I couldn’t believe it. I sat motionless and watched. Again, my contracts manager looked over at me and said, “Let’s go, pack your briefcase.”

As we were escorted down the long hallway, my contracts manager looked over at me and recognized my puzzlement. He said, “Don’t worry, I’ve been thrown out of better places than this before.” My feeling was that I had never been asked to leave a negotiation, and I had never walked out of a negotiation, and above all else, I had never had both of them occur in the same trip!

On returning home, our business area manager was brought up to speed on the turn of events. He made one telephone call to his peer at our prime’s organization. I heard them talk. Our manager said, “What do you think, Bob? I heard our boys had some minor difficulty working together. What do you say we split the difference?” The other manager must have said OK because the next thing I knew our manager was hanging the telephone up and saying “It’s all OK, guys, you can get back to work now.” Excuse me! What just happened? I thought, you mean we flew four people to Orlando, Florida, spent time in hotels, ate meals and then met with, at times, six of their people for two days, only to have our V.P. spend three minutes on the telephone with their V.P. and all is well?

As I reflected on this, I wondered, Where in my quantitative training did I miss the part about contracts, contract negotiations, politics and dealing with people? The answer—I didn’t! It wasn’t covered in my scheduling class, or my cost
class, or even my training on reading end-of-the-month budget summaries. It wasn’t covered, period!

This is what separates this text from its predecessor. This is a look at the breadth of aspects that make up program/project management as a whole, not simply the quantitative aspects of planning.

Since the publication of Program Planning: A Real Life Quantitative Approach, I have had the very fortunate opportunity to work with hundreds of class participants from numerous disciplines. What I have learned is sort of what I have been advertising for many years, which is, program/project management is not simply for $100 million dollar programs, it is in fact something we all do every day of our lives. We simply don’t apply the rigor of following a formal process or generating a formal set of attendant products.

When Program Planning: A Real Life Quantitative Approach was written, many of the class participants commented on its attention to detail. They appreciated its completeness and really liked the graphic approach taken to detailing the numerous process flows. What we discovered, however, was that each of the many activities and their products were not rocket science at all, but simple common sense. To a large degree I have always felt this way. In fact, routinely when I address a group of seasoned program managers, I comment on how each of them is a very successful program manager, and how each has attained prestige through his or her successes. All I want to do is to propose a process with multiple activities and attendant products that might help to bring some consistency and coherency to the manner in which we plan and execute programs (ideally across programs, business areas, and sites of our company). This book describes such a process.
I offer a special thank you to my sons, Matthew and Christopher. Frequently, we think of our relationship with our children as opportunities for us as adults to teach basic principles and practices of moral and ethical behavior. We teach our children what is socially right from wrong, acceptable from unacceptable or appropriate from inappropriate given the circumstances. We all too often think of this teaching-learning relationship as being one-sided, from parent to child. While this relationship does exist, and as parents we do provide the greatest opportunity for our children to learn these basics of life, there is yet another teaching-learning relationship which has not gone unnoticed or unappreciated, that being what I have learned from the both of you.

I value both of you for all of your uniqueness and differences. I thank you for all the things you have taught me. And I love you unconditionally because of who you are.

I would also like to thank Susan for her efforts in helping me to prepare the figures for the text. She possesses significant breadth and depth in computer and application software experience. Aside from her efforts on this book, her intelligence, insight, rational thought and encouragement during trying times were not only welcomed, but essential in bringing stability and calmness during the storm. From Susan, I learn and therefore grow. Which, from my experience, creates respect, trust and admiration. As Tigger would say, as deep thinkers go, she is one of the deepest thinkerest!
Introduction

Like any discipline, program/project management stems from a need—in this case, a need to define formally a series of activities that typically are performed in a less formal and, perhaps, more disjointed fashion. This need for a formal definition of the program/project management process originated largely as a result of change. New technologies, the opening up of world markets and labor pools, and, most importantly, the pronounced and well-documented transition we as a nation are experiencing in moving from an industrial society to an information/knowledge society, are significant transformations.

In their book *Competing in the Third Wave*, Jeremy and Tony Hope quote Peter Drucker as saying:

> Every few hundred years in Western history there occurs a sharp transformation . . . within a few short decades, society rearranges itself—its world view; its basic values; its social and political structure; its arts; its key institutions. Fifty years later there is a new world. And the people born then cannot even imagine the world in which their grandparents lived and into which their own parents were born. (Hope, 1)

In further describing the transition from one era to another, Nuala Beck says in *Shifting Gears*:

> As the news headlines make plain, the shift from one [era] to another is always marked by turmoil and hard times in the declining economy. In the past shifting gears was always accompanied by severe depressions, at least partly because the rising new industries were unable to make enough of an impact right away to compensate for the rapid decline in the old economy. (Beck, 32)
Change and transformation are the stimulants. The responses are more efficient and effective ways of doing business. Competition provides a visible urgency. The discipline described in this book has evolved in response to demands from these multiple challenges.

A saying I’ve heard thrown around many times originated with Dorothy in The Wizard of Oz. On arriving in the Land of Oz, Dorothy proclaims to her dog, Toto, “I don’t think we’re in Kansas anymore.” She couldn’t have been more right. More and more today employees of organizations as well as organizations themselves are saying, “I don’t think we’re in Kansas anymore.” The changes that have been taking place over the last twenty-five to thirty years have at times been subtle, and at other times have occurred at lightning speed.

There have been a multitude of technological advances in this last decade alone. From my own personal perspective this is probably no more apparent than with the obsolescence of my “new” personal computer. About two and half years ago, I purchased a brand-new sixty-six megahertz computer with a five hundred megabyte hard drive. The price of this state-of-the-art machine was nearly $3,000. Today, the same machine—if anybody really wants it—can be purchased for less than $200. Most impressive, however, is the speed and memory of the current machines. Today’s machine is pushing ten times the processor speed and hard drive size of my now obsolete “new” machine. All this in less than three years! Working for a defense contractor, I see every day the challenge of designing state-of-the-art hardware and software. This technology might simply be wire-wrapped boards not yet in production, yet be antiquated one year from today.

I’ve used in my classes an American Broadcast Company documentary entitled Who’s Getting Rich, and Why You’re Not. This recent video deals with the growing number of white-collar employees in foreign countries, specifically those performing software engineering in Bangladesh. These professionals are making one-sixth the salaries that our U.S. software engineers are making and performing comparably in quantity and quality. Contrary to our beliefs that they are living in poverty on these wages, they are actually middle class in their own country. These Bangladeshi professionals are buying homes, automobiles, and all of the modern conveniences of our times. An example given is that a new tailor-made suit of the finest material can be purchased for about $30. The point is that not only is manufacturing being outsourced to second- and third-world nations, white-collar jobs are as well.

Our business world is changing. In the United States we are having to rethink how we deal with this new internationalization of markets and business competition. We have moved, over the years, through numerous management philosophies and organizational designs, all in an attempt to compete more effectively. I
have first-hand knowledge of change as it affects an organization through mergers and acquisitions. The company I currently work for has had four owners in six years. Each has brought its own management style and philosophy, as well as changes in organizational design. Within six years, I went from having a pension, to not having a pension but instead having a very good 401K, to having a less desirable 401K and a pension in which I was 100% vested for zero amount, to finally having both a very good 401K and a pension, which of course is 100% vested at zero amount. I sometimes wonder when retirement age rolls around if I’ll know where all of my pensions and 401Ks reside.

As to the cultural challenges we have had to face as a company, I’ve seen the many sides of stress, resistance, new social contracts, and realities of burgeoning debt resulting from the mergers. All of the current management terms associated with mergers and acquisitions are applicable: downsizing, rightsizing, outsourcing, normalizing, separated, unassigned, and proactively outplaced, to name only a few. I like the term AT&T has adopted—they’re said to be carrying out a “force management program” to reduce an imbalance of forces and skills (Micklethwait & Wooldridge, 9), and this fancy combination of terms makes reality sound institutionalized and less distasteful. The impact of these many reductions has been exhaustively documented in The Downsizing of America, where the authors (staff writers of the New York Times) say: “Whether they lost a job themselves or saw a relative or friend thrown out of work, nearly three-quarters of American adults say they have been touched to some degree by a layoff in the last fifteen years.”

During our second merger with our third owner one of our long-time employees came to me concerned over whether or not he should purchase a new lawn mower. The realities of our “force management program” were well in effect. During this time, as a company, we were trying to settle our employees through kinder and gentler policies such as casual dress. In terms of Abraham Maslow’s hierarchy of needs model (Robbins, 169), this employee was at the lower levels of the hierarchy (physiological and safety needs) while the organization was attempting to satisfy a higher-level social need: the need for affection, belonging, acceptance, and friendship. By recognizing this difference, our president was able to assure our employees of our long-term potential by identifying our longer-term strategic goals and objectives. This, coupled with a strategic plan, helped our employees to overcome their physiological and safety concerns and attain that higher level in the hierarchy where socialization becomes important. Now casual dress has more meaning.

So what does all of this have to do with program and project management? The answer, in one word: competitiveness. To continue to perform in a highly competitive market, we must create efficiencies that help us to be more effective and
competitive. This is not an option. If we are to remain as a substantial ongoing business concern, we are required to do this. For this reason, my book provides an ordered series of activities that brings consistency and formality to the process of program and project management. The process outlined in this book has been tested in action and evaluated as to its effectiveness.

In the past, when I’ve presented this process, I’ve spoken with senior-level managers with thirty years or more of experience who felt they really didn’t want to be told how to organize their work or plan their programs. The one comment I routinely made was that every day each of them would do a great deal of what we were about to discuss. Some of them performed the many activities and generated the many products in perhaps the same manner, or perhaps not at all. And they have been successful. But we need to be more aware of the process to bring some formality and consistency to the way we perform our program management across our many programs and business areas. Only from this awareness and from understanding the program/project management process can growth and development of the discipline arise.
The Evolution of Process Management

To better understand the historical significance of process management and to gain an appreciation for process management relative to other general program planning models, this section is organized into two primary categories: a historical orientation and a discussion of general program planning models. Succeeding sections then define process management explicitly, identify key components of the planning process of this study, and conclude with a discussion of the sources of documentation.

Historical Orientation

To better understand the context in which a process-oriented approach to management exists, it is beneficial to look historically at the relationships between the numerous management philosophies and organizational designs within the U.S. economic, social, and political scenarios. An interesting aspect of organizational design, management theory, and situational contexts is their inherent order and dependency. Generally, U.S. economic, social, and political factors formed the premise for management philosophies. Management philosophies, in turn, formed the underlying premise for organizational design. While this is certainly not an absolute sequential ordering, it would appear that the adage “necessity is the mother of invention” is applicable.

The present historical account examines aspects of management theory, organizational design, and U.S. situational factors from three perspectives:
1. The industrialization era. This period is characterized by the scientific management theories, mechanistic models of organizational design, and orientation toward production efficiency and effectiveness.

2. The human-relations period. This period moved away from the scientific methods of mass production to consider employee involvement. This period is characterized by process, quantitative, and behavioral approaches to management, an organic organizational design model, and once-small companies evolving into larger companies and larger companies evolving into conglomerates.

3. The international era. This period is decidedly different from all previous ones. It is not marked by continual expansion and prosperity, but rather by increased foreign competition, changes in buyer habits and perspectives, and generally dwindling U.S. manufacturing market shares. Indicative of this period are the contingency and matrix organizational design models, and the systems, contingency, and Total Quality Management (TQM) philosophies.

Over the years, experts have disagreed on exactly how many different approaches to management exist and what each approach entails. Generally speaking, the classical, behavioral, and management science approaches appear in most categorical accounts. Numerous authors, however, discuss the qualitative, contingency, systems, management system, TQM, high involvement, and triangular approaches as well. Within the contingency approaches an entirely different, yet related, area of leadership theories exists. While it is not the intent here to compare each of these approaches, our discussion will identify dominant management philosophies and organizational design models indicative of the periods and compare the environments that prompt changes from one management philosophy to the next.

At a macro level, figure 1.1 depicts the overall relationships between the U.S. economic, social, and political environments, management philosophies, and organizational design techniques.

**The Industrialization Era**

The Industrial Revolution in the United States appears to have been the catalyst for the earliest forms of organizational design and management philosophies. Three advances in technology launched the period: the steam engine (1790–1810), the railroads (1830–50), and the telegraph (1844). These technologies are thought to have been responsible for the proliferation of U.S. entrepreneurship by 1860. Along with these technologies came increasing demand for manufactured goods and industrial
Figure 1.1

Context Diagram

Overall Relationship

Historical Orientation
markets. During the last half of the nineteenth century, the U.S. economy entered an explosive transition from an agricultural nation to an industrial nation.

With the transition into an industrial society came demand for more efficient and effective production techniques. The goal of this period was to meet demand. Quality and price frequently gave way to availability. During this time, scientific management unfolded through the efforts of Frederic W. Taylor (1865–1915). Taylor was credited with the scientific management philosophy, which sought to increase productivity and make work easier by scientifically studying work methods and establishing standards. Scientific management, as developed by Taylor, was based upon four main principles (Rue & Byars 1989):

1. The development of a scientific method for designing jobs. This involved gathering, classifying, and tabulating data to arrive at the “one best way” to perform a task or series of tasks.
2. The scientific selection and progressive teaching of employees. This was not a generalist perspective, but instead a matching of the job or single task to a single worker. Taylor also emphasized the need to study worker strengths and weaknesses and to provide training to improve employee performance.
3. The bringing together of scientifically selected employees and scientifically developed methods for designing jobs. Taylor believed that new and scientific methods of job design should not merely be put before an employee; they should also be fully explained by management. He believed that employees would show little resistance to changes in methods if they understood the reasons for the change and they saw a chance for greater earnings for themselves.
4. A division of work resulting in an interdependence between management and the workers. If they were truly dependent on one another, Taylor felt, then cooperation would naturally follow.

The scientific study of work also emphasized specialization and division of labor. In time, the need for an organizational framework became more and more apparent. The concepts of line and staff were developed. In an effort to motivate workers, most scientific management programs developed wage incentives. Once standards were set, managers began to monitor actual performance and compare it with standards. Thus the management function of control was launched.

Summarizing scientific management as a managerial philosophy, Taylor saw equal benefits for both management and workers: management could achieve more work in a given amount of time, and workers could produce and earn more,
The Evolution of Process Management

with little or no additional effort (Rue and Byars 1989, 38). Taylor believed that economic rewards could motivate employees, provided that those rewards were linked to individual performance.

Other scientific management pioneers followed in Taylor’s footsteps. Morris Cooke applied scientific management principles to educational and municipal organizations. Henry Gantt created a scheduling technique for production control that utilized a bar chart, coined the “Gantt chart.” The Gantt chart is still widely used today. Frank and Lillian Gilbreth combined the study of motion and work methods with psychology. The Gilbreths’ work contributed significantly to research in the areas of fatigue, micromotion, and morale.

Yet, it was Henri Fayol who first issued a complete statement on a theory of general management. In Fayol’s primary work, he introduced 14 principles of management: (1) division of work, (2) formal positional authority, (3) discipline based on obedience and respect, (4) unity of command, (5) unity of direction, (6) subordination of the individual interests to the general interests, (7) dependence of wages on many factors, (8) centralization of authority, (9) scalar chain (line) of authority, (10) an ordered and ensured place for everything, (11) equity, (12) stability of tenured personnel, (13) initiative, and (14) the building of harmony and unity within the organization.

During the early twentieth century—a time of fairly rapid industrialization that encouraged public and private organizations to emphasize production and efficiency as criteria of effectiveness—mechanistic design evolved. Mechanistic design is informed by the hierarchically structured management philosophies of the time. Mechanistic organizational design promotes an effective organizational structure characterized by highly specialized jobs, homogeneous departments, narrow spans of control, and relatively centralized authority. Classical design theory presupposes a single best way to structure an organization to achieve these ends (Gibson 1988).

Max Weber, in describing applications of the mechanistic model, coined the term “bureaucracy.” Because authority involves the legitimate right to exact obedience from others, organizational design involves domination. Weber's search for the forms of domination that evolve in society led him to the study of bureaucratic structure (Gibson, Ivancevich, & Donnelly 1988, 497). Gibson and his coauthors say, “According to Weber, the bureaucratic structure is superior to any other form in precision, stability, stringency of its discipline and its reliability. It thus makes possible a high degree of calculability of results for the heads of the organization and for those acting in relation to it. The bureaucracy compares to other forms of organizations as does the machine to other nonmechanical modes of production” (1988, 498).

Weber’s description of bureaucratic organizational design has the following
characteristics: (1) all tasks are divided into highly specialized jobs; (2) each task is performed in accordance with a system of abstract rules to ensure uniformity and coordination of different tasks; (3) each member or office of the organization is responsible for job performance to one, and only one, manager; (4) each employee of the organization relates to other employees and clients in an impersonal, formal manner, maintaining a social distance with subordinates and clients; and (5) employment in the organization is based on technical qualifications and is protected against arbitrary dismissal.

The nature of Weber’s characteristics of an organizational bureaucracy is identical to Fayol’s management theory principles. Both describe an organization that functions mechanically to accomplish the organization’s goals in a highly efficient manner.

The Human-Relations Era

The Great Depression of 1929 saw unemployment in excess of 25 percent. Afterward, unions sought and gained major advantages for the working class. In this period, known as the golden age of unionism, legislatures and courts actively supported organized labor and the worker. Graff and Kroat (1968) described this event:

The collapse of the stock market was the initial stage of the long and bleak great depression. Unemployment which had been growing since the previous July, continued to increase at an alarming rate following the crash on Wall Street. Spending by consumers, which had been declining since July, continued to slacken. As businessmen stopped building new plants, the number of jobs available decreased. Income was not distributed well enough to keep people employed through an increase in spending by consumers. Farmers found prices lower than ever; millions of working people could neither buy factory goods nor find employment. Middle-class people everywhere could not meet the time payments on their cars, refrigerators or houses. The “prosperity decade” had ended with a sickening thud.

During these times of greater employee supply and lesser demand, employers easily solicited efforts from employees. As was the case when quality and price frequently gave way to availability in production decisions during the industrialization period, so too did employers sacrifice the human aspects of the employer-employee relationship during the lean years of the Depression.

Recognizing this problem, emphasis during this time shifted to attempts at understanding the needs of workers. The human-relations movement arose in the
early 1930s, and no activity better exemplifies this philosophy than the famous Hawthorne studies (1924–32) conducted by Harvard University psychologist Elton Mayo. The Hawthorne studies led to an increased interest in the human problems in the workplace and a refocusing on the human factor of production.

Again, as was the case with the efforts of Frederic Taylor, many followed in Mayo’s humanistic footsteps to better understand, describe, and document the intangible human relations of the time. One such person was Mary Parker Follett, who from 1920 to 1933 espoused a basic theory that the fundamental challenge for any organization was to build and maintain dynamic, yet harmonious, human relations within the organization. In 1938, Chester Barnard, another follower of Mayo, effectively integrated traditional management and the behavioral sciences. Barnard viewed the organization as a social structure and stressed the psychosocial aspects of organizations.

During the human-relations era, an alternative to mechanistic design theory developed and was sustained by the growing interest of behavioral scientists in the study of management and organization. This alternative theory, termed “organic design,” proposed that the more effective organization has relatively unspecialized jobs, heterogeneous departments, wide spans of control, and decentralized authority. Such organizational structures, Gibson, Ivancevich, and Donnelly argue, achieve not only high levels of production and efficiency but also satisfaction, adaptiveness, and development (1988, 526).

The two organizational models, mechanistic and organic, are probably best characterized by their orientations to organizational complexity and their degrees of centralization and formalization. The mechanistic organizational design tends toward highly complex organizations because of its emphasis on the specialization of labor. It is centralized because of its emphasis on authority and accountability, and it is formal because of its emphasis on function as the basis for departments. In contrast, the organic organizational design is relatively simple because of its de-emphasis on specialization and its emphasis on increasing job range. It is relatively decentralized because of its emphasis on delegation, authority, and increasing job depth, and it is relatively informal because of its emphasis on product and customer as its basis for departments. The mechanistic and organic organizational models prevailed until the late 1960s.

The International Movement

What do foreign trade zones, free ports, in-bond arrangements, and economic trade zones have in common? What do the European Community, the European Free Trade Association, the Andean Common Market, and the Afro-Malagasy
Economic Union have in common? Each of these phenomena represents an attempt to organize individual countries to take positive steps to reduce trade and tariff barriers among the participating countries.

As Norman Scarborough points out:

Agriculture, manufacturing and services account for the majority of jobs in our economy. [As pointed out above], early in American history the United States relied primarily on an agricultural economy. Then, at the turn of the twentieth century, our economic base moved towards manufacturing. Heavy industry, steel, automobiles, railroads and others became the foundation for our growing nation. But beginning around 1970 the U.S. economy had begun another shift, away from manufacturing and towards services. The U.S. Department of Labor predicts that, of the new jobs created by 1995, 90% will be in the service industry. Roughly seventy-seven million people are service industry related workers. Examples of service providers are banks, consulting firms, hotel chains, restaurants and airlines. One challenge for firms in declining industries is to find growth opportunities in the service industries. The shift towards services means that fewer manufacturing jobs are being created. While the number of service jobs are growing rapidly, they tend to be lower paying positions. Having difficulty competing on a global basis, many American firms are becoming “hollow corporations”—farming out the actual manufacturing of their goods to low-cost foreign producers. In addition to losing manufacturing jobs, this trend poses a danger to creating even higher standards of living. Improving productivity, the ratio of output of goods and services to the inputs . . . required to produce them, is essential to reaching higher living standards. The problem is that significant productivity gains are harder to achieve in a service economy. (1992, 27)

N. Jonas (1986) states that “the idea that a post-industrial America can become increasingly prosperous as a service-based economy appears to be a dangerous myth.” This perception of an increasingly lower standard of living, as we shift from an industrial economy to a service-based economy, is readily supported by many noted authors. C. Jackson Grayson and Carla O’Dell, in their book American Business: A Two Minute Warning, make a series of alarming revelations: “(1) U.S. competitiveness is seriously eroding, (2) the international competitive challenges are far greater than most realize, (3) the U.S. response to-date is inadequate to meet the challenges, and (4) not only can the United States lose its world economic leadership, but at the moment it is losing” (1988, 4). Nathan Rosenberg and L. E. Birdzell (1986) also address the wealth of a nation being primarily derived by the value
added to its output products, something generally accepted as being only possible in an industrial society.

It should be noted, however, that not everyone agrees that the United States is tending toward a lower standard of living as a result of our reductions in industrialization. John Naisbitt proposes that the United States is not in a decline, and that while it is true we are moving away from an industrial economy, we are moving toward an information economy, not a service economy. Naisbitt suggests that the myth of the United States’ decline and the attendant low-wage thesis were promoted by pro-labor attempts to unionize industrial workers in 1986 (1990, 26). Naisbitt goes on to suggest that while the middle class is indeed diminishing, it is moving upward, not downward, as many suggest. Further, the poor are not getting poorer; in fact there are fewer poor today than in 1959.

Whether or not the United States will suffer an increasingly lower standard of living, or whether the United States is capable of capitalizing on Naisbitt’s proposed information society is an interesting topic that is, however, not within the scope of this account. Our point is that never before have American businesses been so deeply involved in, and affected by, international trade. Philip Cateora states that “four long term trends are affecting U.S. businesses, small or large, domestic or international. The first trend is the internationalization of U.S. markets; second, interdependence of world economies; third, the emergence of international competitors all over the world; and fourth, the globalization of world markets” (1990, 2).

In this changing context, organizational design and management philosophies are attempting to combat these newly perceived international opportunistic threats. The predominate management philosophies are the systems, contingency, and Total Quality Management (TQM) approaches.

The systems approach (late 1960s to early 1970s) to management analyzes how the different elements of a corporation function and operate. This model is based on a simple concept: inputs get processed, which in turn result in outputs. The inputs are from the environment: human, physical, financial, and informational resources. The organization’s technology processes these inputs, resulting in products/services, behaviors, and profits/losses. The systems approach provides five useful contributions (Van Fleet & Peterson 1994):

1. Interaction with the environment is a concept based on the open systems concept.
2. Subsystem interdependency is the realization that systems exist within larger (or outer) systems. A change in the inner system most likely will result in a change to the outer system.
3. Synergy suggests that two people or units can achieve more working together than separately.

4. Entropy, the steady degradation of a system, happens when an organization is a closed system.

5. Equifinality is the idea that two or more paths may lead to the same place.

James Higgins describes the early evolution of the contingency approach: “Fayol and other early theorists searched for general principles of management that might be applied to all situations. However, while many of these principles worked in most situations, none could be applied to all situations. In the 1970s, it became evident that a manager’s actions should be contingent on the various key elements of a given situation. This led to the development of the contingency approach” (1994, 62).

The contingency theory of management is closely tied to numerous works on leadership styles. Fred E. Fiedler, an early leadership theorist, in 1967 was the first to undertake major research on the contingency approach to management. Until this time, leadership styles had been characterized as either production oriented or people oriented. Fiedler found that managers and leaders should exhibit varying degrees of concern for both production and people, depending on three things: the quality of the leader-member relations, the degree to which a task is defined, and the degree of the managers’/leaders’ power.

The contingency approach to management argues that the appropriate managerial actions in a situation depend on, or are contingent on, certain major elements of that situation. Proponents believe the best way to manage depends on the specific circumstances. Leslie Rue and Lloyd Byars state that “contingency theorists have often gone much further than simply to say ‘it all depends.’ Many contingency theorists outline in detail the style or approach that works best under certain conditions and circumstances” (1989, 50).

Contingency theory in its purest form attempts to define all factors in a given situation and prescribe appropriate behaviors. As one might guess, however, there are numerous potential factors in any given situation. Thus the contingency theory of management has evolved into yet another management philosophy: situational management. Situational management involves reviewing the key factors in a situation before determining what action to take.

Total Quality Management (TQM) encompasses the entire spectrum of quality initiatives used in business today. TQM origins date back to statistical quality control in the United States in the 1920s and 1930s. Its importance was realized only after the Japanese implemented its concepts after World War II under the leadership of a statistician at the Massachusetts Institute of Technology, W. Edwards Deming.

TQM relies on a strategic commitment to quality, employee involvement, ma-
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1. Leadership process includes perceived confidence and trust between superiors and subordinates. Subordinates feel free to discuss job problems with their superiors, who in turn solicit their ideas and opinions.
2. Motivational process taps a full range of motives through participatory practices. Attitudes are favorable toward the organization and its goals.
3. Information flows freely throughout the organization—upward, downward, and laterally. The information is accurate and undistorted.
4. Interaction process is open and extensive; both superiors and subordinates are able to affect organizational goals, processes, and activities.
5. Decision process occurs at all levels through group processing and is basically decentralized.
6. Goal-setting process encourages group involvement in setting high, yet realistic, goals.
7. Control process is dispersed throughout the organization and emphasizes self-control and problem solving.
8. Performance goals are high and are actively sought by superiors who recognize the necessity of making a full commitment to developing and training the human resources of the organization.

Contingency organizational design theories simply ask questions as to which of the two primary organizational designs, mechanistic or organic, is suited to a given situation. To answer these questions corporate officials specify the factors in a situation influencing the relative effectiveness of a particular design (Gibson, Ivancevich, & Donnelly 1988, 503).

Matrix organizational designs overlay product or project departments on existing functional organizations or departments. They attempt to minimize the weaknesses of both the mechanistic and organic designs. Matrix structures are found in organizations that require responses to rapid change in two or more environments, such as technology and markets; face uncertainties that generate high information-processing requirements; and must deal with financial and human resource constraints (Gibson, Ivancevich, & Donnelly 1988, 518–19).

There are many advantages to the matrix organization: efficient use of resources, flexibility in conditions of change and uncertainty, technical expertise, freeing top management for long-range planning, improving motivation and commitment, and providing opportunities for personal development (ibid., 520). Matrix organizational design includes task forces, product teams, product managers, and product management departments.

James Gibson, John Ivancevich, and James Donnelly state, “Organizational design remains an important issue in the management of organizational behavior and effectiveness. . . . organizational design will become even more important. . . . strategies that have been effective in the past will prove ineffective in the face of new international competition, technological change, and shifting patterns of industrial development. As organizations experiment with new management theories they will be forced to experiment with new organizational design” (1988, 525).

Process management, as a management philosophy, has evolved most notably in this era of internationalization. Process management crosses over both management philosophy and organizational design concepts, as discussed in the next section.

**Process Management Defined**

Process management, as characterized by R. Choyce (1992) and J. Gioia (1992), provides management with:
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1. A way of thinking systematically about the behavior of people at work in an organizational setting.
2. A vocabulary of terms, concepts, theories, and methodologies that allow work experiences to be clearly analyzed, shared, and discussed.
3. Techniques for dealing with many of the problems that commonly occur in the work setting.

Process management is not a new concept, originating as part of the production-oriented statistical quality control movement in the late 1920s and early 1930s. What is relatively new, however, is the transition of process management methods from a manufacturing environment to a total company orientation.

Process management is a continuous effort that recognizes that the work done in an organization is accomplished through a series of processes, and charges the organization’s managers with ensuring that these processes are clearly defined, healthy, and competitive. It is a comprehensive approach whose goal is to increase the effectiveness, efficiency, control, and adaptability of a given organization.

Process management represents a break from some of the traditional concepts of organizational authority (Stinnett 1992). It requires a new way of looking at, and thinking about, long-established assumptions concerning hierarchies and organizational structure. For instance, in a conventional organization it would be most unusual for the vice president or director of one group to become directly involved in the activities taking place in another group. Because process management involves managing processes across divisional and organizational boundaries, as well as within these boundaries, it requires a flexible management strategy. It also requires close cooperation among managers in diverse functional and operational units to ensure that the process flow is not interrupted by conflicts over lines of authority (King 1992).

Process management relies on process definition, elimination of non-value-added activities, customer/supplier orientation, and a team approach (Hoban 1992; Price 1992). Process management utilizes continuous process improvement (CPI), which assumes that a measurement baseline has been established. Through CPI, the process is measured forever. CPI accounts for error elimination, innovation, and business changes. All activities of a process are questioned; nothing is sacred.

Process management offers organizations a means of applying to non-production-functional organizations the same quality improvement and defect reduction techniques used in manufacturing processes. Many engineering, service, and business processes offer an organization the greatest untapped potential for cost savings through quality and productivity improvement (Welsh 1992). Process management is the most meaningful way to apply the principle of quality throughout an enterprise (Zells 1992).
Chapter 1

General Program Planning Models

According to Theodore Kowalski, the program planner can select one of four basic combinations with regard to a program planning format: “(1) a nonintegrated linear model, (2) a nonintegrated nonlinear model, (3) an integrated nonlinear model, and (4) an integrated linear model” (1988, 99). Nonintegrated means that attention is being paid solely to the programs being developed without considering the organizational and environmental factors. Integrated models consider criteria from the environment, organization and individual learners. Kowalski refers to integrated models as “systems models” (92). Linear models provide a sequential path that outlines the steps to be completed in performing the program planning. Nonlinear models, however, are not to be construed as being unstructured; they attempt to provide greater flexibility in terms of time and resource allocation.

The important components of successful program planning can be discussed through the systems approach model (SAM), an integrated nonlinear model, articulated by Murk and Wells (1988). SAM consists of five components, which are dynamically interrelated, yet independent. For SAM to be successful, all five components must be used, although not in the traditional linear fashion (45).

SAM’s components for program planning are: needs assessment, instructional planning and development, administration and budget development, program implementation, and program evaluation. Edgar J. Boone substantiates these as predominant components in his evaluation of nine of the most prevalent program planning models in adult education (1985, 20).

In their discussion of needs assessment as a part of program planning for adult and continuing education programs, Murk and Wells state that “all planners involved should understand the needs, aspirations, and educational and financial limitations of the adult participants” (1988, 46). And “as a training coordinator or program planner, you should know the major purposes or rationale behind the development of your program.”

Instructional planning and development proceeds from an understanding of what is to be done, that is, the needs that have been determined. This phase of program planning is concerned with defining the event or program, identifying meaningful goals, objectives, and outcomes, selecting the appropriate activities, choosing effective instructors, coordinating program logistics, and developing and administering formative evaluation procedures.

Murk and Wells identify administration and budget development as the third component of program planning, which consists of formulating a cost-effective budget, securing a funding source, establishing administrative personnel, developing a competency in marketing techniques, and coordinating the environmental conditions that contribute to a more meaningful learning experience (1988, 46).
The implementation phase of program planning attempts to execute the program in accordance with the previously defined plan. During implementation, constant feedback is required, which enables real-time dynamic program modification. This real-time modification helps the program facilitator to more adequately satisfy the dynamically realized needs of the participants.

The final component to SAM is program evaluation. Program evaluation is premised on the same principles as those identified in “Evaluation Methodologies and Accountability” later in this chapter.

SAM allows components to be executed in the order that makes the most sense. Murk and Wells, in discussing this interrelatedness, identify a situation where the knowledge gained from a previous program is used as the starting point for a similar, more recent version. In this example, the program planner would first look at the program implementation of the already completed program. SAM, as depicted in this example, supports this nonlinear approach to program planning.

**Integrated Linear Models versus Integrated Nonlinear Models**

There are some non-intuitive theoretical concepts that begin to surface when discussing integrated linear planning models and integrated nonlinear planning models, such as the systems approach model. One must intuitively ask such questions as: How can a program planner perform program development unless it is known what the user wants? And how can one identify a program budget or choose effective instructors unless the program has been conceived or preliminarily developed?

These types of questions lead to the belief that there is an inherent sequentiality to integrated nonlinear models, which obfuscates the differences between linear and nonlinear models in general. Therefore, this section attempts to resolve that perceived confusion by offering a different perspective of the relationship between integrated linear planning models and integrated nonlinear planning models.

The remainder of this discussion is based on the premise that integrated nonlinear planning models are really macromodels and that integrated linear models are really micromodels. They are not separate models; rather, the integrated linear model is a subset of the higher-level, integrated nonlinear model.

This view is justified by the fact that program planning is composed of numerous subcomponents within the basic framework of the predominantly identified components necessary for successful program planning (see “Composition of a Planning Process,” below). It should be intuitive that at a microlevel, a needs assessment is required prior to the completion of program development, and that a budget for a program cannot be fully identified until such factors as program length, costs of instructors, and place of instruction are identified. In this sense, there is a sequentiality or linearity to program planning. And from this
perspective, a linear model provides a very specific stepwise progression to program planning.

In reality, however, not all activities of program planning progress at the same pace through a linear model. The essence of linearity resides in each subcomponent having a predecessor and successor activity, but at any particular point in time, different subcomponents may be at different stages in the linear model. This important characteristic provides us with the macroview of program planning and hence leads us to nonlinear models.

Nonlinear models allow for various activities to be at different stages in the program planning model. Note that this is true even though each activity must, at a microlevel, go through a very logical natural progression, as depicted in the linear models. The key to this micro/macro discussion is that final versions of activities (such as budgets and programs) cannot be determined until the required predecessor step is completed. For example, program budgets cannot be fully completed until all costs have been identified.

I propose that program planning is a cyclical process, but possesses an inherent sequentiality. The inherent sequentiality is at the microlevel and must be adhered to by each of the subactivities, while the cyclical outer process provides us with the macroview we call nonlinear program planning. The outer/macro process provides the framework which allows for the cycling to take place. The final version of end products, however, cannot be generated until the sequential activities have been completed. This does not prevent preliminary or draft versions of end products from being begun or completed; in fact, the macroview encourages the development of intermediate versions of planning products—hence the cyclical nature. Figure 1.2 depicts this relationship.

I have used the components of SAM, as discussed by Murk and Wells, to depict the macro and micro relationships of the planning models. The microview (linear) stipulates that the final versions of end products cannot be completed until the planning process has been cycled through at least once. The macroview (nonlinear) allows each component to proceed, recognizing that only preliminary data is available for the generation of component end products.

*Evaluation Methodologies and Accountability*

Kowalski identifies three types of evaluation methodologies: summative, formative, and ex post facto (1988, 151). An adult- or continuing education program can be evaluated using any of these evaluation methodologies, depending on the purpose(s) of the evaluation.

A summative evaluation is concerned with making judgments. Its intent is to
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determine, for instance, whether a program is accomplishing its goals. For example, one or more programs may claim to accomplish the same basic goals. In a summative evaluation, the judgment made is of which program comes closest to accomplishing these goals. The losing program, most likely, will be discontinued.

By contrast, a formative evaluation is not concerned with making culminating judgments, but rather with making improvements to the program under evaluation. This form of evaluation seeks to identify ways in which experience can serve to improve the selected program the next time it is offered (Kowalski, 152).

An ex post facto evaluation is a longitudinal study. Kowalski states, “the purpose is to compare the results of a given workshop with the reported results in another company” (Kowalski, 152). In other words, the company is attempting to achieve the same results already reported by another company. Because the results from the other company have already been reported, the comparison is made after the fact, ex post facto.

In short, “summative evaluation may or may not be comparative. It could be used to select one option from many, or it could be used simply to determine if a program did or did not meet its goals. Formative evaluation seeks to improve a program by identifying the degree to which objectives have been met and by using

Figure 1.2. Cyclical Nature of a Sequential Process

<table>
<thead>
<tr>
<th>Needs Assessment</th>
<th>Instructional Planning and Development</th>
<th>Administration and Budget Development</th>
<th>Implementation</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>At any point in time, each of the components could cause us to cycle back to a previous component.</td>
<td>Preliminary and/or draft versions of products could be generated, but finals must have all inputs.</td>
<td>Sequentially, these activities must be performed prior to final versions of end products being generated.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
this information to adjust goals, procedures and the like. It is noncomparative. Ex post facto evaluation is comparative. It compares the results of a given program with the previous results of the same program” (Kowalski, 152).

The accountability so important in program planning “is a relatively new concept to the professional practice of adult education. Accountability refers to the practice of reporting efficiency of planned program operation, primarily to the learners and leaders of the target public, the organization, funding sources, the profession, and, where appropriate, the governance body” (Boone 1985, 197). That is, as professionals performing evaluations, we have a responsibility to the stakeholders of the educational program to report accurately and promptly our unbiased findings. It is therefore critical that the stakeholders are involved in developing the process and instruments used in performing the evaluation. Up-front stakeholder buy-in is more likely to generate a receptive audience to evaluation findings.

According to Boone, “Three processual tasks related to the accountability dimension of the evaluation and accountability subprocess speak to the adult educator’s responsibility to (1) report evaluation results, (2) analyze the organization in terms of evaluation results, and (3) make recommendations, based on evaluation results, to the organization” (ibid., 198).

The program planning process presented in this book is an integrated linear model developed for a specific industry. The evaluation methodology is noncomparative and summative—that is, the intent is to determine whether the outcome of the program, as mutually determined by the stakeholders and the evaluator, has been satisfied, and if so, to what degree or level of quality. It is hoped that the evaluation results will be used to improve the planning process. From this perspective there is an element of formative evaluation.

**Composition of a Planning Process**

Successful execution of a program is largely based on the development of an accurate and well-documented program baseline from which cost, schedule, and performance deviations can be readily identified and corrected. Planning is only one of the four phases in an overall management process, which are planning, execution, analysis, and adjustment.

The basic model of the four primary phases of a management process are depicted in figure 1.3.

Simply stated, planning identifies what to do, who is to do it, when it is to be done, and what resources are to be expended. Planning forms the foundation for each of the succeeding phases and is the most important phase of the entire pro-
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Execution is simply the realization of the plan generated in the planning phase. Analysis determines the level of adherence to the plan, and adjustments must be made if there are deviations from the plan. This corrective action is determined by either the program manager or jointly by the program manager and the procuring agency.

Although it would appear from the process flow that the four program management process phases are sequential, they are not. Planning, of course, must precede execution, analysis, and adjustment. Execution, analysis, and adjustment, however, can, and will, be undertaken simultaneously. A single program may be in each of these phases at the same time, because different activities within the program progress at varying paces.

Program planning is composed of a number of activities associated with defining the program organization: work to be performed; technical, cost, and schedule requirements; and the identification of risks. This study will approach program planning by examining the following activities of the program management planning process: program organization planning, schedule planning, cost planning, and performance planning. Salient features of these activities can be summarized as follows:

1. Program organization planning includes the establishment of the planning and program organizations and definition of the work to be performed, known as the work breakdown structure. During the program organization planning phase, the planning work to be accomplished is assigned to the responsible individuals. These assignments are documented in a planning responsibility assignment matrix. Subsequently, when the actual program
work has been defined, another program responsibility assignment matrix is created.

2. Schedule planning provides the time frame for resource allocation and establishes a baseline for current status and forecasts of completion dates of scheduled work. The scheduling activity consists of a hierarchy of related levels of schedules, with each succeeding lower level more fully identifying and expanding the tasks necessary to meet the program requirements. The various schedules depict a continuous logical sequence of contract activities and milestones from the master schedule through the intermediate schedule to the detailed schedules.

3. Cost planning is primarily concerned with establishing a preliminary budget, with which work progress and actual incurred costs can be compared. Effective cost planning is crucial to the financial survival of the program, organization, and procuring agency. Cost planning entails refining the work breakdown structure and its attendant dictionaries. The dictionaries clearly differentiate the varying work elements defined in the work breakdown structure and describe what the work consists of and what the work might exclude.

4. Performance planning is the identification and subsequent documentation of the technical performance requirements. These requirements are stated and/or derived from the contract issued by the procuring agency. Successfully completing the program requires satisfying these requirements. Performance planning also includes the identification of risks. Risk identification includes prioritization according to the probability of occurrence and the extensiveness of the impact on the program. A significant risk is one that has a high probability of occurrence plus a consequential impact.
Although the handling of contracts, whether it be with the customer, prime contractor or subcontractor, is primarily reserved for the contracts functional organization, it is imperative that program and project managers have a basic understanding of the many types and implications of each.

In program management, the program manager will always have certain amounts of risk in the program. How these risks are financially dealt with is determined through the type of contract between the organization and its customer. Early in the bidding phase of the program the program manager will make many decisions regarding who will assume the cost implications of the potential risks.

**Contract Types**

In general, contracts are grouped under the heading of two broad categories:

1. Fixed price contracts
2. Cost reimbursement contracts

When determining which type of contract to select there are many factors involved. These factors are discussed in the next section. In general, however, and probably more than anything else, the question to ask is “Can you estimate the amount of effort it takes to complete the tasks?”

If the answer to the above question is “Yes,” then a fixed price contract is in
order. If the answer to the above question is “No,” then a cost reimbursement contract is probably more applicable.

Understanding the amount of effort to perform the task does not mean the work is less defined. It simply means it’s more difficult to estimate the level of effort. There is a subtle but significant differentiation in the above statement. Two different contractors may see the same detailed specification but have very different perceptions of what is involved in performing the work to accomplish the task. Their differences may be based on experience, understanding of the end-user’s operational requirements, or whatever.

Factors in Selecting a Type

There may be many factors involved when selecting a type of contract. Some of the more prevalent ones include:

1. Price competition
2. Type and complexity
3. Urgency of the requirement
4. Contractor’s accounting system

Price Competition

Normally, effective price competition results in realistic pricing. The number of competitors has a direct relationship on what price an organization can charge. The more competitors there are, the more realistic the price should be. This is true unless, of course, a contractor is attempting to buy into a contract. As an aside: why might an organization “buy” into a contract? There may be many reasons for this, but some of the more prevalent ones include the following:

- Pursuing a new business venture or product line
- Believing there is significant follow-on business
- Protecting an existing business service or product
- Simply having excess cash

The following is a firsthand example of an organization buying into a contract. During the consolidation of the defense industry in the late 80s and early 90s bigger organizations began to bid on government programs that were once bid on and owned entirely by smaller defense contractors. Sometimes the bigger organizations didn’t have the existing product line but firmly believed there was sufficient
business opportunity to support the organizations’ internal efforts to play catch-up. To this end the larger defense contractors would offer to share the cost of the proposed contract with the government agency. This was a win-win for both the contractor and the government. The government obviously made out by virtue of having to pay less than would normally otherwise be required and the contractor made out by obtaining a foothold into a new market niche.

One might ask, “Why couldn’t any of the other smaller contractors have also bought into the contract?” The answer is that the bigger organizations had deeper pockets. They had considerably greater cash reserves affording them a greater degree of latitude in their marketing pursuits. To this end the smaller organizations frequently became subcontractors to the larger prime contractors, who themselves were now answering directly to the government agency.

**Type and Complexity**

Remember that the more accurate an organization can be on estimating the level of effort of the task, the more the contractor can move towards a fixed price contract versus a cost reimbursable contract. Therefore, as the requirement recurs, or as quantity production begins, the cost risk should shift to the contractor, and a fixed price contract should be considered.

Further discussion is in order here. If you or I were to ask someone to build us a home, they most generally would quote us a fixed price. Say, for example, a two-story, four-bedroom, 2.5-bath home might sell for $150,000. If on the other hand we ask our friendly builder to build us a nonstandard home, perhaps a log cabin or dome, he/she might not want to quote us a fixed price contract. But if there is a significant demand for log cabins and our builder has now built a number of them, he/she would be more inclined to provide us a fixed price to build that home. The point being, the cost risk associated with performing a task repetitively should be transferred to the contractor, as the contractor now has a firm understanding of what is required to perform the task. A cost reimbursement type of contract, by earlier definition, is used predominantly when the contractor does not have a firm understanding of the level of effort to perform the task.

Addressing cost risk more specifically, a fixed price contract places a risk of cost overrun on the contractor, not the customer. When the builder says your home will cost $150,000 you can generally believe that that is the cost of your home. If there is a cost overrun, that overrun will come from the builder’s profits. If on the other hand the builder is working under a cost reimbursable type of contract, the risk of cost overruns falls directly on the customer. In this case, if the price of lumber goes up the customer will be billed the additional costs, not the contractor.
Urgency of the Requirement

If urgency is a primary factor the customer may choose to assume a greater proportion of the risk or it may offer incentives to ensure timely contract performance.

With urgency may come incomplete specifications or an ambiguous statement of work. A contractor might also expect to see frequent changes as the requirements of the customer begin to evolve in real time. Under these circumstances it may be prudent to lock into a cost reimbursement type of contract.

Contractor’s Accounting System

Cost reimbursement types of contracts require a somewhat elaborate and, more importantly, accurate internal cost collection system. Under a cost reimbursement contract format the customer is reimbursing the contractor for efforts expended. It is only fair, then, that the contractor be able to produce detailed records (which may only exist because of rigorous procedures). Under the fixed price contract format the customer does not care what the costs of the contractor may be. The agreement under this form of contract simply says that any cost overrun will be the responsibility of the contractor.

Many would argue, and justifiably so, that it shouldn’t matter which type of contract a contractor has, the accounting system should be equally rigorous. This would seem to be a good argument. But from the customer’s perspective, only a cost reimbursable contract requires the finer attention to detail and subsequent support records. The purpose of having a rigorous system, under a fixed price contract scenario, is that the contractor can keep more accurate records of expenditures and therefore produce a more accurate bid on future and similar work.

Firm Fixed Price Contracts

A firm fixed price contract provides for a price that is not subject to any adjustment on the basis of the contractor’s cost experience in performing the contract. Under this form of contract a price provided by the contractor to the customer is made up of two components, a cost and a profit. As an aside, price equals cost plus profit. A contractor can reduce the price without suggesting the agreed-upon work be modified. But for a contractor to reduce the cost implies either a modification to the defined work or a further assumption of risks on the part of the contractor. Given this type of contract, if the contractor experiences a cost overrun then the contractor has to pay for that overrun with profits.

In our house building example, if the builder determines that he/she has made an error in the required square footage on the ground level then that cost to extend
the ground level should be the responsibility of the contractor, not the future home owner. The contractor may find another way to make it up later, for example, through customer-requested modifications to the original floor plan.

A short story typifies this scenario. When I was building my first home I received a firm fixed price for the home. In this case the builder did, as just described, underestimate the ground floor square footage requirement as prescribed by the housing addition. He told me that he would simply incur the cost of this error and I was in fact getting a really good deal. Later, as building progressed, I realized I would like to have a ladder installed in my garage for the attic above it. The builder said that would be no problem and the price of this effort, plus material, would be $300.00. It seemed a little high but I agreed nonetheless. Another change I wanted to make was to add glass doors to the front of the fireplace. He again agreed to the change and quoted me a price of $300.00. Again I agreed and construction continued. I couldn't help but realize eventually that each of the other changes I had requested (patio sliding doors being replaced with French doors, recessed lights versus extended lights, and a windowless full steel garage service door instead of the windowed steel garage service door) had all cost $300.00 each. I found this either very coincidental or very intentional, perhaps to recover the ground floor estimate made earlier in the construction process. The point being, the builder was bent on recovering the earlier cost overrun. Even though he acted in good faith by eating the original overrun to the ground level, his longer-term intentions were to recover his profits and get financially healthy.

A firm fixed price type of contract provides the maximum incentives for the contractor to control costs and perform effectively.

There are many permutations of this type of contract. The more prevalent ones are identified below and described in subsequent paragraphs.

- Fixed price with economic price adjustment
- Fixed price incentive contracts
- Fixed price level of effort

**Fixed Price with Economic Price Adjustment**

Fixed price contracts with economic price adjustments, simply stated, provide for the upward and downward revision of the stated contract price based upon the occurrence of previously specified contingencies.

Examples of such contingencies include the following:

- Labor
- Material

An example of labor contingencies might include pending union negotiations. Under these conditions it may be known that union talks could produce
higher wages, therefore having an impact, either higher or lower, on the overall contract. Given this as a possibility it would make sense to revisit the contract after such negotiations have been completed.

The case for adjusting the price based on material cost fluctuations is equally applicable. A newly manufactured computer chip will be considerably more expensive on introduction into the market than six months or one year later. Or, in the home building example, sometimes a builder may say that he knows that the price of lumber is going to rise in price between the time you close on a price and the time the builder purchases the lumber for your home. In this case, the builder may suggest an outside overall price increase and further suggest that your share of that increase may be some amount of dollars.

Under this type of contract the parties would agree to the time and method of calculation in a provision to the contract at the time of agreement. Again, this type of contract may be used when there is serious doubt concerning the market or labor conditions that will exist during an extended period of contract performance.

**Fixed Price Incentive Contracts**

Fixed price incentive contracts are designed to provide an additional incentive to the contractor for meeting some predefined milestone(s). Milestones may include:

- Cost
- Schedule
- Technical performance

It is important that the performance incentives of this type of contract be balanced so the contractor does not sacrifice one element in favor of another. For example, if the contractor is given incentive for meeting a schedule requirement, but at the expense of product quality, then the overall objective of a high-quality product within a period of time is of little value. This problem is especially true when additional resources must be spent on meeting the objective.

Some time ago Volkswagen had a series of billboards in our town which stated “0 to 60, Yes!” I really got a kick out these billboards. They never said 0–60 in 5 seconds, they simply said, sure we can get there. It may take a while but it can happen. If Volkswagen were required to perform 0–60 mph in 5 seconds then they probably could not have met this requirement with some supercharged type of engine. But to accomplish this task they would have sacrificed cost, most probably schedule, and even some other technical requirements, such as weight or size of the vehicle. For this reason it is important that incentives be balanced and we recognize the potential pitfalls associated with tradeoffs.
**Contract Types**

*Fixed Price Level of Effort*

A fixed price level of effort type of contract is designed so that the contractor can provide a specified level of effort in general terms over a specific period of time.

This type of contract is most suitable for investigation or study programs in a specific research and development area. Payment is based on effort expended rather than results achieved. This type of contract is especially good when the contractor, with the customer’s help, is trying to define the requirements for a later fixed price type of contract.

For example, perhaps the customer wants to investigate the feasibility of flying people commercially into orbit, circling around the globe, and then returning them safely to earth. And, to further the excitement of this, a free trip to Disney World is thrown in. If the customer, the organization funding this potential effort, is serious, it would probably contract with some organization that understands what it takes to fly aircraft outside the earth’s atmosphere. The organization contracted with would probably want to do research to determine the feasibility of such an undertaking. This would make most sense, since running off and building the appropriate type of aircraft would cost billions of dollars, even if it knew what the appropriate type of aircraft was!

In this scenario the organization doing the investigation might suggest they research the problem for six months with three engineers, a manager, and a secretary. The total full-time commitment would be for five individuals for three months, or fifteen person-months, at a predetermined price. The end result of this effort might simply be a report specifying the feasibility of such an undertaking. Another follow-on study might be performed to determine a ballpark high-level design and cost. Yet more studies might be performed to determine general population interest or prices people would be willing to pay. It is almost unimaginable how many surveys, investigations, and studies could be performed with this type of undertaking.

*Cost Reimbursement Contracts*

Unlike fixed price contracts, where the contractor quotes a firm fixed price for the activities of the program or project, cost reimbursement type contracts allow for the contractor to recover actual costs incurred plus some predefined profit. This type of contract is suitable for use when uncertainties involved in the contract performance do not permit costs to be estimated with sufficient accuracy to use any type of fixed price contract.

The conditions of reimbursement are premised on the costs being allowable. In other words a contractor cannot install in his/her personal home marble floor-
ing and charge the customer unless, of course, the customer agrees that putting marble flooring in the contractor’s home is part of the overall contracted effort.

Again, as in the case with fixed price contracts, there are many permutations of cost reimbursable contracts. These are identified below and outlined in subsequent paragraphs.

- Cost sharing
- Cost plus incentive fee
- Cost plus award fee
- Cost plus fixed fee
- Cost plus a percentage of cost

**Cost Sharing**

In cost sharing the contractor simply agrees not to be reimbursed for some portion of the cost incurred. The actual percentage to be shared is determined at contract award and documented in the contract.

The best example of this type of contract was presented earlier. Given the situation where an organization (contractor) might want to enter into a market it had not been in before, cost sharing would be one mechanism for doing this. In this case the contractor would absorb its share of the costs out of profits from this or another program.

**Cost Plus Incentive Fee**

A cost plus incentive fee contract is a cost reimbursement contract that provides for an initially negotiated fee to be adjusted later by a formula based on the relationship of total allowable costs to total target costs.

The operative terms here are “allowable” costs and “target” costs. On contract award the contractor has agreed in writing to some target level of expenditure, most generally on a monthly basis, but possibly any interval. Then, at predetermined points in the program, those target costs are compared to actual costs incurred. The relationship of these two costs determines the incentive received by the contractor. When we talk about allowable costs we are generally grounded in government terminology and definitions.

For example, when working on a government program and having to travel there are limits to the amount a hotel can cost or you can spend on a meal. These limits seem strange to travelers who do not perform government contracts, but for those of us who have been indoctrinated into this culture it seems quite normal. One group of people who routinely exceed the government’s reimbursable rates is
marketeers. For this reason I really enjoy traveling with marketing people. The only times I have ever enjoyed five-star restaurants is when I've been with them. Under these reimbursable guidelines, however, the contractor is responsible for costs up and over those identified as reimbursable by the customer.

Cost Plus Award Fee

According to Cibinic and Nash, “The cost plus award fee contract was devised by NASA in the 1960s to introduce incentives for improved performance into major contracts for support services. Since that time it has become one of the major types of contracts used for service contracts including research and development. The cost plus award fee contract provides that the contractor’s fee will be determined largely by an award given periodically by a high-ranking official in the procuring agency. While the basic elements to be evaluated in arriving at this award and the evaluation mechanism itself are usually disclosed to the contractor prior to performance, this type of contract is known as a subjective incentive. Since the award official has a significant amount of discretion in establishing the precise amount of award. This subjectivity has led some contractors to question the use of this type of incentive. But, experiences gathered over the past three decades indicates that cost plus award fee contracts are quite efficient in situations where it is not possible to write a contract specification or work statement that contains a precise description of the work the contractor is expected to perform” (Cibinic & Nash 1998, 1148).

The major advantage of the cost plus award fee contract is improved communication between parties. In the course of making periodic awards the customer provides the contractor with a detailed evaluation of the program's cost, schedule, and technical performance, pointing out the program's deficiencies and weaknesses.

The major disadvantage of the cost plus award fee contract is the level of effort it takes to administer the contract reviews as well as the coordination required to make the awards.

It has become common practice to combine cost plus incentive fee and cost plus award fee contracts. In this scenario cost plus incentive fee is used to provide incentive for cost control while the cost plus award fee is used as incentive for the contractor to institute schedule and technical performance control (Cibinic & Nash 1998, 1170).

Cost Plus Fixed Fee

Cost plus fixed fee is a type of contract that provides payment to the contractor of a negotiated fee that is fixed at the inception of the contract. The fixed fee does not
vary with actual cost but may be adjusted as a result of changes to the work to be performed under the contract (Federal Acquisition Regulations [FAR] 16.306[a]).

Of particular interest here is that the contractor gets zero additional fee for within-scope cost growth, plus may earn a bad reputation. If this were not the case a contractor would simply have to “grow” the program to earn additional fee (profit).

**Cost Plus a Percentage of Cost Fee**

The cost plus a percentage of cost fee contract basically implies that the fee (profit) to be gained by the contractor is tied to the cost incurred by the contractor.

A contractor, then, not only has no incentive to control costs but in fact could simply increase costs (which are reimbursable under the cost plus contract) and make additional fees in doing so. For this very reason these types of contracts are illegal when dealing with the U.S. Government (Cibinic & Nash, 1065).

**Time and Materials Contracts**

Time and materials types of contracts are used predominantly when it is not possible at the time of placing the contract to estimate accurately the extent or duration of the work or to anticipate costs with any degree of confidence.

This type of contract allows for the acquisition of products or services on the basis of:

- Labor hours at predetermined rates
- Material costs

Time and material contracts are somewhat limited in their use. They do not provide the customer with any real control over the contractor's work efficiency nor do they encourage the contractor to control costs. This does not mean, however, that the contractor has an open pocketbook to expend resources without ramification. An initial “best estimate” or “expected value” is agreed to up front as part of defining the contract.

**Labor Hour Contracts**

Similar to time and material types of contracts, labor hour contracts are used predominantly when it is not possible at the time of placing the contract to estimate accurately the extent or duration of the work or to anticipate costs with any degree of confidence.
The only real difference between labor hour contracts and time and material types of contracts is that materials are not supplied.

Again, as in the time and material type contract, labor hour contracts are somewhat limited in their use. They do not provide the customer with any real control over the contractor’s work efficiency, nor do they encourage the contractor to control costs.

**Letter Contracts**

A letter contract is a temporary written preliminary contractual instrument that authorizes the contractor to begin immediately manufacturing products or performing services. It typically has limited dollar value and must be replaced as soon as possible by a definitive contract.

A letter contract basically allows a contractor to begin work now, while the details or finalization can be worked out.

**Exercises**

*Exercise #1*—Your customer has asked you to submit a bid to develop a new product. While you have built similar products you have never built one this complex. The customer has provided a detailed specification and a required finish date. What type of contract will you propose?

*Exercise #1 Answer*—A firm fixed price contract would be most appropriate in this case. The determining factor is whether you have enough information to accurately estimate what it will take to accomplish the task. With a detailed specification and prior experience you should be able to accurately estimate the cost. Knowing the cost, you can provide a price.

*Exercise #1 Follow-on Question*—What might be the impact on your bid if the customer refuses to accept the type of contract you propose?

*Exercise #1 Follow-on Answer*—The customer’s unwillingness to accept your contract type should have an impact on your price. A cost reimbursement contract should cost less because the risk has shifted from the contractor to the customer.

*Exercise #2*—Assume the scenario of exercise #1, but in this case the customer does not have a detailed specification to provide you. The customer does have, however, a one-page list of operational objectives. What type of contract will you propose?
**Exercise #2 Answer** — Propose a cost plus type of contract. You no longer have sufficient information to be able to accurately estimate the job. Determining the stated and derived requirements is essential. You may want to try a mix of contract types. For example, to determine the requirements you may want to try a cost plus time and material or fixed price level of effort. Then for the remainder of the job perhaps a firm fixed price contract would suffice.

**Exercise #3** — Your company produces electric drills. In a typical year you manufacture and produce 10,000 drills. A new chain of home improvement stores has asked you to submit a proposal to have your drills featured in its stores. What type of contract will you propose?

**Exercise #3 Answer** — Since you can accurately estimate the level of effort to produce this item, a firm fixed price type of contract would be appropriate.

**Exercise #4** — You have been asked to work as a consultant to a program estimated to last three years. You are currently consulting to several other projects and are concerned as to whether you have sufficient time to devote to this project. If the primary concern to both you and your customer is how many hours you can devote to this project, what type of contract would you propose?

**Exercise #4 Answer** — At first glance you might think this should be a labor hours or time and material contract, but remember you have concern about your available time. With this concern a firm fixed price level of effort contract would be most appropriate. The actual level of effort you price becomes the commodity you are selling. Since with this contract the level of effort is agreed to by both parties, there should be no questions regarding the amount of time you are devoting to this project. If time availability is not a problem, simply go with a labor hour or time and materials type of contract.
The bidding process is an interesting courtship between the customer and the potential contractors. Figure 3.1 depicts the overall bidding process.

The process begins, sometimes, long before the initial request for proposal (RFP) ever gets distributed by the customer. For purposes of this discussion, however, we will begin the process with the customer’s receipt of the RFP. The RFP is designed to solicit from a set of potential bidders (contractors) a uniformly created proposal to provide products or services to the customer. The RFP itself is the culmination of an exhaustive, and frequently lengthy planning, budgeting, and approval process on the part of the customer.

RFPs minimally contain the following information:

- Schedules for product or service deliveries
- Format for providing costs/price
- Technical specifications
- Statement of work (SOW)
- Data deliverables
- Any RFP referenced documents
- Special instructions
- Award evaluation factors
- Format in which to submit the contractor’s proposal

Complex RFPs, those indicative of the U.S. Government or state or city governments, can contain as many as thirteen major sections, describing all of the above and other, more detailed information, such as how to package the contractor’s product for delivery to the customer.

Notice that the customer in Figure 3.1 can be either an outside customer or an
inside customer. If the effort to be performed is an internal research and development program or something of the like, the customer may very well be senior management of the organization. If this is the case then the contractor is an organization within the same organization.

Once the RFP is received, the proposal generation activity is initiated. During this period there will likely be one or more peer team review of your proposal. On final review the proposal is ready for submittal to the customer. Once submitted the effort is not yet over. There is usually an opportunity to fine-tune your initial submittal before a customer decision is made as to which contractor will be awarded the program.

**Bid Organization**

A proposal is typically made up of three basic volumes as indicated below and depicted in Figure 3.2.

1. Management
2. Technical
3. Cost

Each volume, depending on the size of the proposal effort, may have its own manager responsible for the generation of that volume. The management volume should, without doubt, describe clearly the following:
The Bidding Process

- How your organization proposes to obtain and organize its resources to perform on the program.
- Who the major players are, with information on their education and experience as it relates to this type of program.
- How your program will interface with the customer throughout the life of the program.
- How your organization will provide the product and/or service with more efficiency and effectiveness than your competition.
- How you can accomplish the program’s objectives within cost and schedule constraints.
- How you have been involved with other programs of this nature, perhaps in terms of size, complexity, cost, or other pertinent ways.

Although the management volume conveys pertinent information about your organization, the technical volume may be most important in terms of your winning or not winning the contract. The technical volume generally is weighted most heavily by your customer. After all, if your product or service is not what the customer wants, then why buy it? The technical volume contains information such as:

- What exactly you are selling to your customer.
- Why your product or service is better than your competition’s.
- Specifically, how your organization will build or make this product or service.
- How your organization intends to satisfy the customer’s requirements.

Assuming your organization has sufficiently convinced the customer that it can perform the program as required (management volume) and that it can pro-
duce a superior product or service to its competition (technical volume), then the next most critical question is “what does it cost?”

The cost volume is where the cost and price for the product or service is detailed to the level required by the instruction in the RFP. Typically, the customer will require that all of the bidders prepare their costs in the same format, so that costs for work performed can be compared. The format for the bid is typically outlined as part of a customer provided work breakdown structure (WBS). The WBS is discussed in subsequent paragraphs. By requiring the contractors to bid their efforts in accordance with a predefined format for predefined work the customer can then compare apples to apples and oranges to oranges.

This is most obvious by way of an example. If you ask multiple builders to build a four-bedroom home with three baths, on a finished basement, etc., you will most likely get very different prices. This is especially true when moving up and down the quality line of builders. A builder might suggest that it is not fair to compare its price to others’ because it uses only the finest grade of lumber or that its studs are only twelve inches apart instead of eighteen. Therefore, when requesting a price from a builder, you typically receive a description of the specifications of the home, detailing each item, its construction features, and costs. This now allows more readily the home builder to compare, on an equal basis, one builder’s price to another’s.

The marketing manager is always an integral part of the entire proposal process. It was most probably the marketing manager that identified the opportunity to begin with. The marketing manager probably knows the customer better than most others and probably has some idea of how much the customer may be willing to spend for this particular product or service. He/she therefore should be an integral part of this proposal team.

Note that in some cases (for example, soliciting a bid to do some landscaping around the house) the three volumes may be simply one sheet of paper. The marketing manager, volume managers, and bid manager may all be the same person.

**Responsibility Assignment Matrix**

When we talk about a bid and proposal responsibility assignment matrix (RAM) we are generally trying to pictorially define responsibility, and the extent of responsibility for each activity of the bid process. Figure 3.3 depicts a fictitious bid and proposal RAM.

Notice that for each activity to be performed there is assigned primary, secondary, review, and approval responsibilities. In this example, the bid manager has
Figure 3.3. Bid and Proposal Responsibility Assignment Matrix

<table>
<thead>
<tr>
<th>Bid Proposal Responsibility Assignment Matrix</th>
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<tbody>
<tr>
<td><strong>Legend:</strong></td>
</tr>
<tr>
<td>S - Seller Responsibility</td>
</tr>
<tr>
<td>B - Buyer Responsibility</td>
</tr>
<tr>
<td>A - Applicable to All</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Task</th>
<th>Bid Proposal Submission and Post Submission</th>
<th>Proposal Evaluation</th>
<th>Proposal Award</th>
<th>Proposal Closeout</th>
</tr>
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<tbody>
<tr>
<td>S</td>
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Post Submission and Post Submission:
- Submission and Approval
- Proposal Evaluation

Proposal Evaluation:
- Final Proposal
- Final Bid

Proposal Award:
- Final Bid
- Final Proposal

Proposal Closeout:
- Final Bid
- Final Proposal

Applicable Function/Task:
- Bid Proposal Submission
- Proposal Evaluation
- Proposal Award
- Proposal Closeout

Legend:
- S - Seller Responsibility
- B - Buyer Responsibility
- A - Applicable to All
primary responsibility for those activities involved with generating the proposal while corporate management and division management have approval responsibility for those items where cost/price is involved. Each of these activities will be reviewed in subsequent paragraphs.

One point of interest is that the functional managers have primary responsibility for conducting preliminary cost reviews. Why would functional organizations have this responsibility and not the bid manager? The answer will be much more obvious later in the text when we address the role of functional management in a project organization. But suffice it to say that functional management is responsible for staffing the programs and bidding the costs for their respective work activities.

**Before the Request for Proposal**

Figure 3.4 depicts the series of activities that occur before the contractor receives the RFP.

Notice that there is a series of decisions and activities that take place before the RFP.

- Is this a business opportunity at this point in time?
- Who is going to be the bid manager?
- What is the anticipated scope of the pending RFP?
- What is the anticipated budget for the RFP effort?
- Who might participate in the proposal effort?

As can be seen from the flow chart on the next page, the marketing manager, business area director, and general manager are the primary players until the bid manager is assigned. Once assigned, the bid manager assumes responsibility for notifying the proposal participants, determining who will work on the proposal team, and all other activities associated with preparing the initial budgets.

When the bid manager and the marketing manager request bid authorization they are in essence asking permission to spend some number of dollars over a specified period of time to work on the proposal. Notice that the marketing manager, business area director, and general manager are the ones involved in approving such expenditures. Once they are approved the bid manager prepares and issues a bid request letter that provides authorization for the functional organizations to begin thinking about this program. In other words, the functional organizations know that this proposal effort appears to have management blessing, at least for some period of time at some predefined expenditure level.
Figure 3.4: Pre-RFP Process Flow

Legend:
- FO—Functional Organization
- WM—Bid Manager
- CM—Central Manager
- BBD—Business Area Director
- MM—Marketing Manager

Start:
- Request Bid Invitation

1. Plan and Budget
   - Review Plan and Budget
   - Propose Plan and Budget
   - Bid Manager

2. Determine Scope
   - Bid Manager
   - Pre-RFP

3. Appraise Bid
   - Bid Manager
   - Pre-RFP

4. Develop Proposal
   - Bid Manager
   - Pre-RFP

5. Issue Bid Request
   - Bid Manager
   - Pre-RFP

6. Solicit Proposals
   - Bid Team

TO RFP Process:
- Kick-off Meeting
- Pre-RFP
   - WM

End:
On Receipt of the Request for Proposal

Assuming there was a pre-RFP effort, many decisions, including the following, would already be established:

- Who the bid (proposal) manager will be
- What the funding limits will be
- What level of effort will be expended
- What the schedule for generating the proposal will be

If there was not a pre-RFP phase then these activities and decisions will have to take place after the receipt of the RFP. This is most unfortunate if this is the case because seldom is there sufficient time to be performing these activities and preparing the proposal, unless the proposal is for a routine product or service which is simpler to bid.

In fact, in the simplest of cases, as in the case of the individual landscaper, a thirty-minute visit to your home may be sufficient.

Figure 3.5 depicts the RFP process.

Notice that many of the decisions and activities are the same as in the pre-RFP process if the pre-RFP process is not followed. One new step, after the appointment of the bid manager, is the preliminary risk assessment performed by the bid manager and the marketing manager. Performing a risk assessment on a program is typically the responsibility of the systems engineering functional organization. Any organization, however, can perform a risk assessment. In fact, the program manager will routinely assess the risk/reward aspects of key decisions on the program during program execution. Risk assessment and risk management in general are discussed in detail in later chapters.

Also of interest is that the RFP comes in-house through the contract administrator. The contract administrator is the only individual who should be sending or receiving contractual document from the customer.

Proposal Generation Process

The proposal generation process is depicted in figure 3.6.

During the proposal generation process each of the volume leaders is responsible for his/her respective volume of the overall proposal. One mechanism for creating a volume is through a graphics-oriented approach known as storyboarding. Storyboarding is a process where the entirety of what is intended to be said is placed on multiple walls of a proposal room (sometimes referred to as a proposal...
Figure 3.5. RFP Process

- Procurement
  - Solicitation
    - Proposal Acceptance
      - Prequalification
    - Proposal Evaluation
      - Technical Evaluation
        - Release of Proposals
          - Bid/no Bid
            - Appeal of Decision
              - Inform Procuring
                - Compare with pre-RFP documents
              - Request Pre-RFP
                - Business Area
                  - Contract Admin.
war room) in the form of an outline. The outline of each volume is made up of major themes and sub-themes. The volume leaders attempt to fill in the story line as it appears in outline form on the walls. The proposal is best presented pictorially with supporting text. This form of pictorial representation seems to be more appealing than simply reading through page after page of detail.

**Review and Approval Process**

Figure 3.7 depicts the review and approval process.

Throughout the development of the proposal there will be many reviews of the three basic volumes. The technical and management volumes are reviewed by a separate set of review members than is the cost volume.

The quantity of reviews the technical and management volumes go through is dependent upon the amount of time available before the final submission. In figure 3.7 there are two reviews of these volumes. We typically refer to these reviews by names of colors, as in the figure, where we call them pink and red teams. There have been defined as many as four different team reviews:

1. Blue/Pink Team
2. Red Team
3. Gold Team
4. Black Team

The blue/pink team evaluations are early course correction reviews. The fundamental technical architecture and programmatic direction of the company’s proposal is evaluated. At this point format is not the issue as much as to identify deficiencies and make suggestions for correction. The red team review is intended to critique the proposal for compliance against the RFP instructions and evaluation criteria. The red team looks for consistency and continuity among volumes. The red team is also concerned with presentation themes, graphics utilized, and overall message clarity and crispness. The gold team is typically a final review of the proposal before submission to the customer. The members of the gold team are usually senior managers of the organization. Also, at this point, final aesthetics are assessed. Items such as the table of contents are scanned for correctness. The black team is not a proposal review team but a team designed to “sniff” out information about the organization’s key competitors. They perform confidential market analyses and report on the organization’s strengths and weaknesses (Frey 1999, 139).

Notice again who the participants are in the pink and red team reviews. The business manager and marketing manager are leading the strategic direction of the proposal while the functional managers are concerned with content and adherence to the RFP. The cost volume review process takes a slightly different path as it moves through the senior management chain. In both cases the bid manager and marketing manager take the lead. In the final cost review the business area director and general manager are present to offer their input before submission to the customer.
Submittal Process

Once the proposal is written, reviewed, and approved it is ready to be submitted. Preparation for submittal involves printing and binding the proposal, creating the required transmittal covers, packing the proposal in appropriate shipping containers, and delivering it to the customer. Figure 3.8 depicts the submittal process.

In some instances the deadline is so near that the organization is required to hand deliver the proposal to the customer. On a major proposal a number of years ago our proposal was twelve 5-inch binders thick. The customer had requested three copies, yielding thirty-six 5-inch binders to be delivered. We packaged the binders into relatively small carry-on size boxes and chartered a plane for delivery. I personally loaded the boxes onto the chartered plane, flew to Washington, D.C., unloaded the boxes into a chartered van, made the delivery, and then flew home, all in one long afternoon. Obviously the projected earnings from this program were rather large to be able to afford the price associated with this form of delivery.

Notice that a functional organization is responsible for procuring the shipping containers, printing, and packing the proposal. The printing functional organiza-
tion could very well be the printing department; the packing functional organization, the packing department; and the functional organization responsible for procuring the shipping containers, the shipping department. Functional organizations are those organizations representing major disciplines or functions in the organization. For example, in our home building example functional organizations may be plumbers, framers, electricians, masonry, et cetera.

**Post-Submittal Process**

Sometimes, after the proposal has been submitted, the customer may request some minor type of change or it may be determined internal to the organization that it would have been better to have suggested a different design. If it's the customer requesting a change, then the customer will most likely ask for a best and final offer (BAFO). The customer may ask for a BAFO anyway, even without requesting a change. This provides the contractor one final attempt to massage their bid before a final award decision is made. Figure 3.9 depicts the post-submittal process.

If the customer does not offer the opportunity for a BAFO then there is a dead period before the customer makes the award decision. If the organization's bid decision was premised on an internal design and/or development effort that may be part of an internal research and development effort, then the proposal activity may have simply been a small inconvenience to the contractor. In other words the contractor may see a bigger market for its product or service and may therefore continue with its efforts while awaiting an award decision.

**Post-Decision Process**

Once the contractor's contract administrator receives notice of the customer's award decision then either the contractor will prepare to begin work or request a debrief from the customer as to why the customer rejected the offer. Even if the contractor did win the award, attending a customer debrief is beneficial. Figure 3.10 depicts the post-decision process.

Debriefs by the customer provide valuable information for future proposal effort with this customer. The debrief frequently will provide information such as:

- How your organization scored in each of its volumes
- Strengths and weaknesses of your proposal
- How to deal more effectively with this customer in the future
Figure 3.10: Post-Decision Process

- Identify Defect
- Prepare Lessons Learned Report
- Close Bid Request
- Bid/Accounting
- Procure Lessons Learned Report
- Bid
- Bid
- Award Decision
- Win
- Lose
- No
- Yes
- Customer Accept
- Bid
- Bid
- Bid
At the conclusion of any proposal effort it is always prudent to create a lesson-learned document. This document will help your organization in future proposal efforts by identifying those things that you did right and those things that you would do differently next time.

The last item, if the proposal effort was unsuccessful, is to close the charge number being used by the proposal team members. The charge number was being used for cost collection purposes as long as there was proposal work to be done.

**Statement of Work (SOW)**

The statement of work (SOW) is a narrative description of the work to be done. It outlines the objectives of the program, a description of the work, a time frame to perform the work, and any funding constraints, and details the work in attached technical specifications. The SOW is part of the customer’s request for proposal to the potential contractors. A well-written SOW provides enough information to avoid any ambiguity during reading (Kerzner 1998, 536).

On the surface it may seem rather simple to accurately describe the work to be accomplished in the contract but on further review it is not always so easy. Examples of ambiguity in wording follow:

The SOW says to conduct a minimum of 12 tests to satisfy a given requirement. To be safe you bid 18 tests, a 50% margin. At the end of the 12 tests the customer says that the results are inconclusive, and asks you to run another 12 tests, at a cost of $500,000 over that bid in your proposal.

This is quite real. Having worked as a software engineer and having responsibility for many software-oriented bid efforts, we quickly learned to document in our proposals exactly what we were intending to do. In software engineering there are three types of software testing that can be performed: black-box, gray-box, and white-box. The difference between black-box and white-box is enormous in terms of costs to the program. Black-box testing simply requires that an output be observed given some predefined form of input. In other words, when I hit a key on my keyboard the letter typed will show up on my screen. White-box testing, however, requires that each and every path through the software must be tested as the keystroke flows through the software to ultimately create the letter appearing on the monitor. This form of testing is very intrusive and requires major software test programs and drivers to adequately prove correct. Obviously the black-box testing is considerably less intrusive and requires simple observation.

Another example follows:
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 $1.3 million to transport all of your test equipment to the Atlantic Ocean.

Or, how about:

You receive a contract in which the SOW says 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. The customer wanted boxcars that were aerated from below. Ambiguity over the word “aerated” is what caused this case to go to court.

It is important when writing an SOW to stay away from words like “nearly,” “generally,” or “approximately.” During the heat of my proposal-writing days I used to like words like “near real-time” and “authentically simulated.” In the world of real-time embedded software and hardware systems “real-time” is frequently used to describe non-delay type of stimulus-response mechanisms. In other words it happens not only now but right now. Not always having explicit direction in the SOW as to what real-time meant in the context of a particular program, I would try to be as accurate as I could by suggesting that in my opinion, the system was performing in nearly “real-time.” Unfortunately, not everybody shared my enthusiasm for the term. The RFP asked for “real-time” not “near real-time.”

Technical Specification

The technical specification is provided as part of the RFP and provides detailed direction allowing for proposal costing. It is an exhaustive elaboration of the SOW. There may be many technical specifications. Kerzner (p. 542) identifies 53 different technical specifications covering nine areas composed of disciplines such as electrical and civil engineering, and subject areas such as piping and vessels. The reality is that there are literally hundreds of technical specifications used by the U.S. Government when they issue an RFP and SOW. Depending on the program type there are applicable specifications for each discipline involved specific to that particular type of product or service being acquired.

A specification provides information having to do with product specifics. For example: the box should weigh eight pounds, be painted green, and be able to relay
incoming data to other like boxes in three seconds. If we were looking at building a home we would have as a part of our specification items such as:

- Solid six panel poplar doors
- 4 ¾-inch poplar baseboard
- Hand-stained woodwork with three coats of sealer
- Wood burning fireplace with 36-inch insert
- Two by four construction, 16 inches on center
- Roof rafters 2 × 12
- Concrete patio of 12 × 12 ft.

Notice the details of our above specification compared to the more general description of our home. The SOW might simply have said we wanted a four-bedroom, two-and-a-half-bath, two-story home on a slab. One document higher, the RFP might have said we wanted to build a home in the southwest part of town, in a secluded housing addition, on a cul-de-sac.

**Work Breakdown Structure (WBS)**

The work breakdown structure (WBS) is a graphical hierarchical depiction of how the work is organized. It forms the basis for costing, scheduling, and assigning work responsibility.

A dictionary for each element must accompany the WBS. The dictionary should stipulate not only what is to be done but also what will not be done. For example, in an above example I discuss software engineering black-box versus white-box testing. It is of real value to specify which type of testing is being planned and bid.

There are many ways to organize the work in a WBS.

- Functions/Disciplines—with this type of work structure major functions such as electrical, plumbing, masonry, framing, etc. are identified as key areas where we may wish to collect work together.
- Organizational structure—if different organizations can be uniquely identified and work is separable then this type of work breakdown structure is in order. For example: design engineering and manufacturing.
- Physical location—organized by site or location. For example: Midwest region, Western region, Southern region, etc.
- Major systems or subsystems—yet another way to organize work. Using this method an automobile manufacturer organizes work by electrical,
braking, transmission, engine, chassis, and the like. The idea is to identify major subsystems of the whole and organize the work along these lines.

An example of a work breakdown structure is depicted in figure 3.11. In the WBS there are three levels depicted. Level one is “A—Program.” Level two is at the horizontal level where “AA” through “AF” are located. Level three has three alpha characters as its unique WBS element number (“AAA,” “ACA,” etc.). There is no requirement to use strictly alpha identifiers. One can use numeric or even alphanumeric identifiers. For example:

A
A.1
A.1.a

The customer will generally provide a work breakdown structure to the third level then expect the contractor to extend the customer-provided work breakdown structure at a level sufficient to provide adequate execution visibility, usually five levels. Costs, however, are usually reported to the customer at level three.

From a formal perspective there are three different work breakdown structures dealing with a formal state or city municipality. The government, for example, might begin with a work breakdown structure (WBS). From this a smaller subset of the work might be carved out and identified as a major subsystem to be awarded to a contractor for bidding. This contractor work breakdown structure is referred to as a CWBS. Finally, the contractor is expected to extend the CWBS into what is referred to as an extended contractor work breakdown structure (ECWBS). Now all of this can be really quite confusing and not necessary for everyday discussion. Generally the terms WBS, CWBS, and ECWBS are all referred to as simply the WBS. Throughout the remainder of this text CWBS and WBS will be synonymous. Formal examples will have the precise title identified.

Later in this chapter, we’ll provide additional examples of work breakdown structures with a simpler perspective.

Classes of Estimates

An estimate of the cost of the work to be performed may be made based on a number of methodologies, four of which will be discussed here.

1. Rough order of magnitude (ROM)
2. Top-down
Figure 3.11. Example Work Breakdown Structure
3. Definitive
4. Learning curve

Let’s say you are flying home from a meeting with a potential new customer and you are trying to figure out what the proposed work effort for this customer might cost. So, on the back of your drink napkin, you begin to add up numbers for the various parts of the job. When you are done, you have what might be referred to as a rough order of magnitude (ROM).

An ROM is typified as:

- Being made without any detailed engineering data
- Having the potential for the greatest inaccuracy
- Generally based on the past experiences of the estimator

Using this scenario, once home the marketing manager has a discussion with the program manager of a similar job. After some thought the program manager sits down and creates an estimate of what he/she thinks the cost of the new program might be. This type of estimate is known as a top-down estimate. An example of when this type of estimate would be applicable is if the new program is perhaps 50% more difficult than the similar program to which it is being compared.

Characteristics of a top-down approach are listed below.

- An approximate estimate
- Made without engineering data
- More accurate than a rough order of magnitude estimate
- Based on previous, “similar to” projects

Continuing our example, if the program manager proceeds to initiate a proposal effort involving all of the applicable functional organizations and they generate their respective costs, this effort would then be referred to as a definitive estimate. Definitive estimates are bottom-up estimates from the appropriate functional organizations that include man-hours, material, and other resources.

Definitive estimates are indicative of the following:

- Grass roots, bottom-up estimates
- Well-defined engineering data
- Includes plans, specifications, vendor quotes, etc.
- Generally the most accurate

The last form of estimate to discuss in this section is the learning curve estimate. Learning curves represent increasingly greater amounts of knowledge over time and are indicative of overall lower costs as we learn how to do something better or more
efficiently. If, for example, we manufacture widgets (perhaps millions of them over many years) one would expect our first estimates of the cost to manufacture these widgets to be considerably less accurate than our more recent estimates. This, again, is due to our experience in manufacturing millions of widgets over many years.

Learning curves therefore possess the following characteristics:

- Are represented graphically as repetitive functions
- Depict reductions in time, resources, and money as a result of continuous learning
- Are most generally applied in a manufacturing environment
Prior to contract award there are a number of activities that a program should perform to create an integrated cost, schedule, and technical performance measurement plan. After contract award these activities will form a performance measurement baseline that accurately reflects the program’s finalized contract. Pre-award planning provides the program with a solid foundation from which execution can commence with minimal effort expended in updating the post-contract award baseline. Program planning, therefore, is composed of activities that, when implemented prior to and after the contract award, provide the program and its management team with an efficient mechanism for executing and managing the program with minimal delay.

Organizing for planning is composed of four basic activities:

1. Establishing the planning organization (figure 4.1): a hierarchical depiction of the program planning team’s personnel and management structure.
2. Creating a planning responsibility assignment matrix (figure 4.2): a depiction of the activities required to establish the performance measurement baseline and the specific program planning resources assigned to those activities.
3. Creating a baseline planning schedule (figure 4.3): a time-phased integrated networked schedule depicting the activities required to establish the program’s performance measurement baseline.
4. Creating a program management library (figure 4.5): a logical entity made up of electronic files as well as physical files associated with the program.

The planning organization identifies and organizes the required planning
resources for the program. The planning personnel consist of the individuals responsible for establishing the program's integrated cost, schedule, and technical performance measurement plan. These people may (and should) be responsible for the subsequent execution of the program in accordance with the program's baseline plan.

The program manager is initially responsible for defining the planning organization resource requirements. Once they are defined the program manager conveys these identified needs to the proper managers and business area directors, who in turn make tentative personnel assignments to the program manager for purposes of
### Figure 4.2: Example Planning Team Responsibility Assignment Matrix

<table>
<thead>
<tr>
<th>Activity</th>
<th>Planner</th>
<th>Funder</th>
<th>Consultant</th>
<th>Executor</th>
<th>Checks</th>
<th>Sign-off</th>
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</thead>
<tbody>
<tr>
<td>A</td>
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</tbody>
</table>

**Legend:**
- d: Daily
- S: Weekly
- V: Monthly

**Notes:**
- Daily and Weekly tasks are performed by the team members.
- Monthly tasks are reviewed and signed off by the planner.
- Checks and sign-off ensure accountability and compliance.

---

**Notes:**
- Ensure all tasks are completed and documented.
- Regular meetings are held to discuss progress.
- Feedback from stakeholders is appreciated.

---

**Points to Remember:**
- Clear communication is key.
- Adaptability to changes is essential.
- Quality control is maintained throughout.
<table>
<thead>
<tr>
<th>Description</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Planning Schedule</td>
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<tr>
<td>Complete plan execution matrix</td>
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<tr>
<td>Establish planning responsibility assignment matrix</td>
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<tr>
<td>Establish planning organization plan</td>
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<td>Develop work breakdown structure (WBS) &amp; dictionary</td>
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<td>Develop detailed schedules</td>
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<tr>
<td>Ensure resource detai</td>
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<tr>
<td>Extend WBS to work package level</td>
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<tr>
<td>Create resource plans into scheduling tool</td>
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<tr>
<td>Develop resource plans</td>
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<tr>
<td>Expend EVMD to complete scope</td>
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<tr>
<td>Develop resource management (EVMD) plan</td>
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<tr>
<td>Review EVMD template for scope</td>
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<tr>
<td>Develop resource plan</td>
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<td></td>
</tr>
<tr>
<td>Develop EVMD plan</td>
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<td></td>
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<tr>
<td>Complete EVMD execution and scope tool</td>
<td></td>
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<tr>
<td>Complete EVMD execution and scope tool</td>
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</tbody>
</table>
planning. These assignments should be made with the intent of making these individuals a part of the long-term program team, that is, beyond the initial planning.

After acceptance of, or negotiation concerning, alternative personnel, the program manager initiates two activities: the generation of the planning organization chart and team responsibility assignment matrix (with the program's management office), and the generation of the baseline planning schedule (with the program's planner).

These products, once generated, are approved by the program manager and subsequently distributed in accordance with a predefined program distribution list.

Figure 4.4 depicts the detailed process flow for creating the planning organization chart, responsibility assignment matrix, and the baseline planning schedule.

Establishing a program management library is intended to increase communication among personnel, enhance communication between the management team and the customer, and centralize documentation that supports decisions, progress, and change. The program management library is a vehicle for effective communication. It supports a uniform and orderly categorization of documentation, which subsequently provides for effective communications within the program and external sources.

The program management library is generally maintained in a centrally located file cabinet. It may contain physical master documents or pointers to electronic versions. To be effective the program management library must be maintained through processes similar to those described in standard configuration management literature. That is, all data to be placed in the library should be organized chronologically by subject, dated, and approved (if required), and should include a sign-out sheet for those wishing to temporarily remove documents.

More importantly, however, is the type of information to be placed in the library and its handling. There are a number of products that should be generated as a result of good program management practices. These products, the persons responsible for assuring library retention, the originators, and the person responsible for approval (if required) are depicted in figure 4.5.

There are questions to answer before placing an item in the program management library: Does the item require approval? If the item is to be distributed as well as placed in the library, to whom should it go, and who should be involved in distributing it? Figure 4.6 depicts these decisions.

This activity is more involved than simply creating a program management library. It also includes those factors associated with the handling, distribution, and placement of program information. If a piece of program information is considered to be formal, then the contract manager needs to be involved in its distribution and filing. If the item is a contract data item to be distributed to the customer,
Figure 4.4: Detailed Process Flow
### Figure 4.5.
Sample Data in a Program Management Library

<table>
<thead>
<tr>
<th>Item</th>
<th>Responsible for Retention</th>
<th>Originator</th>
<th>If Approval is Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>contract</td>
<td>CA</td>
<td>customer</td>
<td>PM/CA</td>
</tr>
<tr>
<td>contract modifications</td>
<td>CA</td>
<td>customer</td>
<td>PM/CA</td>
</tr>
<tr>
<td>contract data</td>
<td>DM</td>
<td>various</td>
<td>PM</td>
</tr>
<tr>
<td>contract correspondence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>incoming</td>
<td>CA</td>
<td>customer</td>
<td>PM</td>
</tr>
<tr>
<td>outgoing</td>
<td>CA</td>
<td>various</td>
<td>PM</td>
</tr>
<tr>
<td>meeting minutes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>internal</td>
<td>PM</td>
<td>various</td>
<td>PM</td>
</tr>
<tr>
<td>external</td>
<td>PM/CA</td>
<td>various</td>
<td>PM</td>
</tr>
<tr>
<td>action item list</td>
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<td>PM</td>
<td>PM</td>
</tr>
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<td>program events calendar</td>
<td>PM</td>
<td>PM</td>
<td>PM</td>
</tr>
<tr>
<td>significant events</td>
<td>PM</td>
<td>various</td>
<td>PM</td>
</tr>
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<td>program directives</td>
<td>PM</td>
<td>PM</td>
<td>PM</td>
</tr>
<tr>
<td>telecons</td>
<td>Various</td>
<td>various</td>
<td>PM</td>
</tr>
<tr>
<td>earned value management files</td>
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<td></td>
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<tr>
<td>dictionaries</td>
<td>administrator</td>
<td>various</td>
<td>PM</td>
</tr>
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<td>PM</td>
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<td>administrator</td>
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<td>PM</td>
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<tr>
<td>baseline change requests</td>
<td>administrator</td>
<td>CAMs</td>
<td>PM</td>
</tr>
</tbody>
</table>

### Figure 4.6.
Program Management Library Detailed Process Flow

CM: Contract Manager  O/R: Originator/Receiver
DM: Data Manager  PM: Program Manager
PML: Program Management Library  PMO: Program Management Office
For: Formal  Infor: Informal
then both contract administration and data management are involved. Preparing a document for delivery to the customer involves the proper reproducing, marking, and pricing and should be performed in accordance with the requirements specified by the organization’s data management and configuration management practices.

Establishing the program management library is a prerequisite to the handling, distribution, and placement of program data.
Defining the Work

Requirements management involves five steps: identification, analysis, allocation, a means for verification, and traceability. Generating a requirements database requires that stated and derived requirements be identified and categorized upon being placed into the database and that some basic information be associated with each requirement to enable subsequent traceability to lower-level design activities. One measure of effective program planning and successful execution is the thoroughness of the steps involved in identifying, categorizing, and allocating contractually stated and derived requirements. Figure 5.1 depicts the basic process flow for requirements management.

Requirements identification is the process of collecting stated and derived requirements from both internal and external sources. External documentation that provides a source for program-stated and -derived requirements includes the contract statement of work, contract specification, and contract provisions. Internal documentation that provides a source for program-derived requirements includes specific functional organization processes.

An explicitly stated requirement is one which states, for example, that “the programming language used in this program shall be the Ada programming language.” A derived requirement is one that the contractor has placed upon itself as a result of direction given by the stated requirement. An example of this type of requirement is when the contractor decides to use a Telesoft Ada programming language compiler instead of a VAX Ada programming language compiler. The intention to use the Telesoft Ada programming language compiler is self-imposed but, nevertheless, a
requirement. The customer stated only that the programming language had to be Ada, not that the Ada programming language compiler had to be Telesoft's.

Requirements analysis separates similar requirements into groups of higher-level requirements. This activity creates a hierarchical depiction of related requirements. For example, when building a house, major functional organizations might include electrical, plumbing, masonry, framing, landscaping, etc.

Requirements allocation is the assignment of a given requirement or family of requirements to a functional piece of the system for implementation. For example, the requirement to program the software in the Ada programming language might be given to the software group working on the program. The understanding is that the software group will be responsible for ensuring that this requirement is satisfied. Within the software group the requirement may be further allocated to a specific subset of individuals such as the software support group. All requirements for each functional organization therefore are associated with that organization.

During the proposal preparation phase is when the requirements are initially identified, analyzed, and allocated. Once functional organizations are assigned they are responsible for initial proposal costing, all phases of design (preliminary design, detailed design, integration, and test), and any/all activities associated with satisfying the requirements.
Staying with our current example, the software support group also identifies the type of testing required to demonstrate that the requirement has been satisfied. This verification method may fall into one of four categories: analysis, demonstration, inspection, or test.

Analysis as a verification method can perhaps best be thought of, for example, as performing a desk analysis of an algorithm to verify the algorithm’s correctness relative to mathematical theorems. Demonstration is a form of verification, which allows for a physical demonstration of the item to be tested. Take the example I used earlier of the Volkswagen that can go from 0 to 60—in an unspecified time. This amusing advertisement carried an interesting testing implication, i.e., simply sit in the vehicle and wait until it reaches 60 miles per hour and the verification by way of demonstration satisfies the requirement. Inspection implies a visual inspection of the entity for compliance. Test implies testing the entity against some predefined standard—in this case, reaching 60 miles an hour.

The last item dealing with requirements management is requirement traceability. Requirement traceability is the process by which a requirement is traced from its original statement in a contract or related document to the actual piece of the total system that is responsible for implementing a means to satisfy the requirement.

The requirements database, a collection of all stated and derived requirements, provides the program with a means of tracking all program requirements through each phase of the program’s life cycle. A preliminary requirements database is established during the bid and proposal phase.

Once the requirements have been identified, analyzed, and allocated, then it is time for a work breakdown structure. The work breakdown structure (WBS) is a graphical hierarchical depiction of how the work is organized. It forms the basis for costing, scheduling, and assigning work responsibility. Discussion of the work breakdown structure takes place when discussing the bidding process.

Work Breakdown Structure (WBS)

The WBS must be accompanied by a dictionary for each element of the WBS. The dictionary should stipulate not only what is to be done but what will not be done. For purposes of completeness an example of a WBS is depicted in figure 5.2.

The program management office has primary responsibility for processing this activity, supplemented by the functional organizations. The process consists of:

1. Expanding the contract-provided CWBS to form the extended CWBS. The initial expansion should be to one level below the reporting level. Incorporating the individual functional organizations’ work breakdown structures
Figure 5.2: Work Breakdown Structure
into the program's extended CWBS template generates this expansion. Individual elements of the CWBS do not need to be expanded equally.

2. Developing the dictionary, which unambiguously describes the work to be accomplished under each element of the extended CWBS.

3. If the extended CWBS and dictionary require changes the program manager’s review of the extended CWBS and dictionary are returned to the program management office. Otherwise the program manager signifies approval by signing the extended CWBS and dictionary.

Detailed requirements for generating the extended CWBS and dictionary are as follows:

1. For each contract there should be a single CWBS that defines all authorized work.

2. Since the CWBS forms part of the contract, it should be defined before the contract is signed. This will generally be accomplished during the proposal and/or negotiation phase of the procurement, since it requires concurrence between the customer and the contractor.

3. The program management office representatives on the proposal team are responsible for coordinating the CWBS with the customer. The program management office representatives should make every effort to avoid letting the CWBS divide the work into unnatural or unmanageable packages. Unless otherwise required by the customer the CWBS should be organized consistently with the product family tree.

4. The extended CWBS dictionary correlates with the basis of the work depicted in the intermediate schedules and detailed schedules.

5. The program management office, with support from the functional organizations, is responsible for determining the initial top-down costs of the work.

6. Each extended CWBS element is categorized under only one higher-level element.

7. The degree to which CWBS elements are extended is governed by:
   a. Contract reporting level
   b. The complexity and criticality of elements of work to meet contract requirements
   c. The cost of elements of work
   d. The visibility needed by management for control of the element of work.

8. The extended CWBS dictionary identifies quantities of all deliverables, relevant CLINs, and data items.

9. All work for each subcontractor should be separately identified within the
CWBS using one or more extended CWBS elements according to the nature of the work. Each subcontract should be represented as a cost account. A subcontract should consist of a purchase order that contains a statement of work. A subcontract is required if the supplied item or service is unique and a purchase order does not sufficiently define requirements.

10. The following requirements apply to subcontract cost accounts:
   a. The subcontractor’s statement of work should include the work described in the extended CWBS dictionary for the subcontract cost account work packages.
   b. The subcontractor’s cost reporting structure (level) should be the work packages identified within the subcontract cost account.
   c. The subcontractor work breakdown structure (SWBS) should be generated for the subcontract cost account and extends to at least the cost account work package level.
   d. Monitoring of the subcontract should be in one or more work packages in the subcontract cost account.
   e. Cost account managers who use a subcontractor’s product in their cost accounts are responsible for monitoring the technical aspects of that product.
   f. The subcontract cost account should have a minimum set of items as in table 1.

11. Cost account material is any hardware, software, or service that is planned and controlled by an identifying part number, model number, or detailed description. Cost accounts for material should also include:
   a. Material used for destructive tests or internal setup for pilot runs (over-buy)
   b. Shrink (anticipated loss, damage, etc., based on historical rates)
   c. Vendor setup charges
   d. Vendor burn-in tests
   e. Minimum buy costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Derived From</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>statement of work (SWBS, SDRL, subcontract schedule, etc.)</td>
<td>extended CWBS dictionaries, any cost account planning input documents</td>
<td>cost account manager</td>
</tr>
<tr>
<td>specifications</td>
<td>requirements database, any cost account planning input documents</td>
<td>cost account manager/system engineering</td>
</tr>
<tr>
<td>subcontract provisions</td>
<td>contract (flowdown), internal requirements</td>
<td>subcontract administration</td>
</tr>
</tbody>
</table>
f. Procurement and transportation (material burden)
g. Licenses and maintenance fees
h. Purchased material inspection, if applicable (based on historical rates).

12. Cost accounts for material should be a direct charge resource that includes:
   a. All assets purchased for a program from sources outside of the company
   b. Interdivisional purchases
   c. Internal transfers.

13. Material planning should:
   a. Have a cost account that contains BCWS for all material.
   b. Define nonrecurring material (for example, materials used by engineering during product development and built in the engineering lab, including the material for tools and special tests) and classify nonrecurring material as either high-value/critical material or low-value material.
   c. Define low run-rate material as material for systems, modules, tools, and special test equipment that are built in operations but not in a production environment (flow charts, paced lines, etc.).

14. Items in the requirements database at the CWBS level should correspond to the extended CWBS level in accordance with any existing extended CWBS templates of functional organizations. The extended CWBS elements that do not correspond to a requirement should be deleted from the extended CWBS.

15. Recurring and nonrecurring efforts should be divided into separate elements. Generally, recurring and nonrecurring efforts should be subsidiary elements under each element to which the distinction applies.

16. No work should be associated with summary-level elements.

17. If the element identifiers in the extended CWBS are incompatible with the identifiers that the company cost accounting system requires, the extended CWBS should provide a cross-reference between the extended CWBS element identifiers and the company cost accounting system identifiers.

18. The extended CWBS should be updated as required. After cost accounts have been fixed the extended CWBS should be extended to the work-package level.

19. The dictionary should define the scope of work of each extended CWBS element.

20. For each element of the extended CWBS there should be a description of the technical content, associated risks, and cost category (direct, recurring, nonrecurring, material, etc.) that includes the following information:
    a. The program name, extended CWBS identification code, title assigned to the element, job/task number (as applicable), contract line item number, revision date, and revision level.
    b. A definition of the extended CWBS element (associated work and/or
product that can be assigned completion dates) and the type of work performed in the extended CWBS element (such as design, development, and manufacturing), as well as its technical content and cost category.

c. A listing of the specific tasks, or types of tasks, to be included (e.g., component design, tooling, fabrication, structural subassembly).

d. A listing of the types of tasks to be excluded (e.g., final assembly).

e. Name of subcontractor, if applicable.

f. Product completion/acceptance criteria.

g. A work-package description consisting of the following:

i. Clear differentiation from all other work packages in the cost account.

ii. Definition of quantifiable tasks in terms of a physical product that can be assigned completion dates.

iii. Specification of the minimum set of documents, resources, or products from other work packages required to start work (start milestone).

iv. Definition of completion criteria based on accomplishing a specific task.

v. Identification of the earned value technique selected.

vi. For the percent complete earned value technique, the formula that provides a ratio of the objective factors to the budget at completion.

vii. For the apportioned effort earned value technique, definition and documentation of factors and methods used to apply apportioned effort and identification of the directly related specified work packages are cost accounts by extended CWBS identifier and title.

Work Breakdown Structure (WBS) Dictionary

Once the work is organized and properly depicted in graphical form as above, then for each WBS element (for example: "AA," "ACC," or "AF") a written description should be created. In the ideal sense, the dictionary description should include such items as:

- WBS alphanumeric identifier
- Title of the WBS element
- Revision date representing the most recent date changes were made to this description
- The WBS description
- References back to which stated or derived requirement, identified in the requirements database, caused this element to come into existence

An example of a very complex WBS element dictionary is depicted in figure 5.3.
The process flow for generating the work breakdown structure and its attendant dictionary is depicted in figure 5.4.

Recognize, as discussed in the bidding process, that the WBS is really nomenclature for the customer's identification and allocation of the work. The piece of the total system to be allocated to a contractor is typically referred to as the contractor work breakdown structure (CWBS) and the contractor’s extension of the CWBS is referred to as the extended CWBS or ECWBS. So, in the above, the more precise nomenclature is to call our WBS an extended CWBS.
Preliminary Responsibility Assignment Matrix (RAM)

Once the requirements are identified, analyzed, allocated, and organized into a work breakdown structure and dictionary element descriptions are written, then we can make an initial stab at depicting costs for each major chunk of work. Chunks of work, or more professionally, collections of related work, are called cost accounts. A cost account is a collection of related work that can be costed, scheduled, performed, and monitored to completion. To further identify efforts associated with these cost accounts an organization might assign a unique charge number for personnel working the cost account to charge their time.

Figure 5.5 depicts a rather elaborate preliminary responsibility assignment matrix.

In figure 5.5 there are details not yet discussed, such as contract target cost, contract budget base, cost of money, etc. These items will be discussed later in this chapter. For now, recognize that the allocated target budget is an estimate of what each listed WBS element will cost to design, develop, and deliver. For those items ready to begin work on, charge numbers have been opened and are identified. Notice that for each charge number there is a single cost account identified.

The detailed process flow for generating the preliminary responsibility assignment matrix (RAM) is depicted in figure 5.6.

Inputs to this activity are:

- Contract target price (external/internal)
- Cost proposal or cost estimate
- Extended CWBS and dictionary

The external contract target price is generated by a marketing process for the proposal phase and by the contract manager for an external contract. The internal contract target price is provided by the business area director. The internal contract target price is funded by internal research and development or bid and proposal in direct support of an external contract or other internally funded effort. The cost proposal or cost estimate is generated by accounting to the program management office. The cost estimate is an initial top-down estimate that allocates budget to CWBS elements prior to any bottom-up estimate.

The difference between the preliminary responsibility assignment matrix and the final baseline responsibility assignment matrix are those changes resulting from continuation of the planning process.

This activity is the responsibility of the program management office and functional organization managers, with support of accounting, and consists of several steps.
Figure 5.5. Preliminary Responsibility Assignment Matrix

<table>
<thead>
<tr>
<th>Responsibility</th>
<th>Activity 1</th>
<th>Activity 2</th>
<th>Activity 3</th>
<th>Activity 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Manager</td>
<td>VV</td>
<td>VV</td>
<td>VV</td>
<td>VV</td>
</tr>
<tr>
<td>Project Leader</td>
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<td>Project Accountant</td>
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<td>VV</td>
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<tr>
<td>Project Architect</td>
<td>VV</td>
<td>VV</td>
<td>VV</td>
<td>VV</td>
</tr>
</tbody>
</table>

Note: VV indicates a high level of responsibility.
There are three steps in the generation of the preliminary responsibility assignment matrix.

1. Cost accounts are assigned. Initially cost accounts are defined in the extended contract work breakdown structure at one level below the reporting level (normally at level 4).

2. The distributed target budget is allocated to each cost account to match the work identified in the extended CWBS dictionary using analysis of historical data.

3. A charge number structure based on cost accounts is established. Typically no charge number should be used for charges on more than one cost account.

**Budget Development**

Budget development begins with a contract target price provided to the customer. Price is made up of two elements: contract cost and profit. Once profit is removed, then what remains is the contract’s target cost. The contract’s target cost forms the budget base from which all work is performed.

The performance measurement baseline budget is the budget to execute the program, taking into consideration any additions from management reserve (held for in-scope, unanticipated changes). The performance measurement baseline then forms the budget to distribute to the cost account managers once general and administrative costs are removed. The cost and subsequent price had, as a part, these...
general and administrative costs added on, which must therefore be removed before redistributing the budget to the managers responsible for accomplishing the work.

Authorized unpriced work is effort for which definitized contract costs have not been agreed to but for which written authorization has been received by the contractor.

Undistributed budget is budget applicable to the contract effort which has not yet been identified to the WBS elements at the lowest level being reported to the customer (Fleming 1992, 94).

Figure 5.7 depicts the entire budget development process.

Heaven on Earth Wedding Planners

Let’s now take a real-life example and apply some of what we have discussed so far. Let’s assume there is a future bride talking with her future husband. She has provided the following request for proposal.

She says, “Snookums, I want to get married. I want a church wedding with my family, bridesmaids, rehearsal dinner, reception with music and dancing and all the trimmings.” He replies, “Sweetie, how about we elope?” “Nooo!” she replies. “I want a real wedding. You wouldn’t want me to feel cheated out of having a pearl and ivory wedding with all the memories, would you?” She adds, “and every time I think of how special our wedding was, I’ll have warm and snuggly feelings about you and how caring you are. That’s worth something, isn’t it?” she asks. “Of course it is, Pumpkin,” he replies. “I want my little pinky stinker winker bean to be happy. We’ll have as big a wedding as you like.” “Thank you, my little Pooh Bear, we’re going to be happy forever,” she concludes.

Our future husband, being fairly astute, decides to enlist the help of an organization known as Heaven on Earth (HOE) Wedding Planners. Following our process as we have defined it so far, HOE begins to identify our future bride’s stated requirements. These requirements are typically identified in request for proposals or statement of works as “shall” statements. As in, “... the contractor shall do...”

She says, “Snookums, I want to get married. I want a church wedding with my family, bridesmaids, rehearsal dinner, reception with music and dancing and all the trimmings.” He replies, “Sweetie, how about we elope?” “Noo!” She replies. “I want a real wedding. You wouldn’t want me to feel cheated out of having a pearl and ivory wedding with all the memories, would you?” She adds, “and every time I think of how special our wedding was, I’ll have warm and snuggly feelings about you and how caring you are. That’s worth something, isn’t it?”
she asks. “Of course it is, Pumpkin,” he replies. “I want my little pinky stinker winker bean to be happy. We'll have as big a wedding as you like.” “Thank you, my little Pooh Bear, we're going to be happy forever,” she concludes.

Our bolded portions of the above represent what HOE and our future husband consider to be mandatory, or explicitly stated, requirements. To list them we would have:

- Traditional church wedding
- Rehearsal dinner
- Reception
- Honeymoon
- Happily ever after

Further examining these stated requirements, HOE and our future husband determined that there were some other, derived requirements. These are:

- Lots of $$$—money is not necessarily an issue
- Local site—not 1,000 miles away
- Christian church of some type—perhaps Lutheran, Catholic, Methodist, etc.
- Photographer (maybe video so she can remember how caring I was)
- Nice hotel—for beginning of happy ever after part!

HOE then creates a work breakdown structure for the many activities to be performed. It is depicted in figure 5.8.

HOE further continues to define dictionary elements for each element of our WBS. A couple of those dictionary element descriptions are defined below.

Pre-Wedding: this element involves all discussions, activities, and events that lead up to the wedding itself. It does not include the wedding day or any of its activities or events.

Planning: this element includes those items listed below.

- The participation in a Myers Briggs Personality Assessment as administered by a certified professional.
- Meals where the last review of personality preferences are examined for compatibility. It is anticipated that there will be a maximum of 10 lunches/dinners of ~$20 each.
- The purchasing of cases of Coke or Pepsi for late-night continuing discussions of mutual goals and aspirations. It is estimated that no more than 20 cases of Coke/Pepsi will be purchased at $4 each (assumes use of coupons).
### Defining the Work

Additional discussion topics under this WBS element include, but are not limited to, the when, where, how, and why of the actual event. The outcome of this WBS element is a detailed requirements document which includes both stated and derived requirements to be reviewed and mutually agreed to by both the bride and groom.

HOE, with the above work breakdown structure and attendant dictionaries, creates a preliminary responsibility assignment matrix as depicted in figure 5.9.

In this preliminary RAM, HOE has uniquely identified by name who has what activities to perform as well as the initial budget estimate to perform those activities. One can see that $1,665.00 has been set back as management reserve for in-scope, yet unanticipated, changes to the overall program. This money still forms a part of the overall cost of the program and has been set aside.

With all requirements defined, work organized, costed, and tentatively as-

---

#### Figure 5.9.
HOE Responsibility Assignment Matrix

<table>
<thead>
<tr>
<th>COST ACCOUNT</th>
<th>1.0 — Heaven on Earth</th>
<th>1.1 — Pre-Wedding</th>
<th>1.2 — Wedding</th>
<th>1.3 — Reception</th>
<th>1.4 — Post-Wedding</th>
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<tbody>
<tr>
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<td>Management Reserve</td>
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<td>Undistributed Budget</td>
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<td>---</td>
<td>---</td>
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<td>Cost of Money</td>
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<td>---</td>
<td>---</td>
</tr>
<tr>
<td>General &amp; Administrative</td>
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<td>---</td>
<td>---</td>
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<tr>
<td>---</td>
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<td>6,500.00</td>
<td>1,835.00</td>
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<td>---</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1.1 — Planning</td>
<td>500.00</td>
</tr>
<tr>
<td>1.1.2 — Planning Execution</td>
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<td>1.1.2.1 — Secure Church</td>
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</tr>
<tr>
<td>1.1.2.2 — Secure Reception Hall</td>
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</tr>
<tr>
<td>1.1.2.3 — Secure Florist</td>
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</tr>
<tr>
<td>1.1.2.4 — Secure Photographer</td>
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</tr>
<tr>
<td>1.1.2.5 — Secure Videographer</td>
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</tr>
<tr>
<td>1.1.2.6 — Obtain Marriage License</td>
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</tr>
<tr>
<td>1.1.2.7 — Obtain Invitations</td>
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</tr>
<tr>
<td>1.1.2.8 — Post Announcement</td>
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</tr>
<tr>
<td>1.1.2.9 — Obtain Bridesmaid’s Dresses</td>
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</tr>
<tr>
<td>1.1.2.10 — Obtain Groomsmen’s Tuxes</td>
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</tr>
<tr>
<td>1.2 — Rehearsal Dinner</td>
<td>400.00</td>
</tr>
<tr>
<td>1.2.1 — Rehearsal Dinner</td>
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</tr>
<tr>
<td>1.2.2 — Wedding</td>
<td>200.00</td>
</tr>
<tr>
<td>1.3 — Required Activities</td>
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</tr>
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<td>1.3.1 — Reconciling Accounts</td>
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<td>1.4 — Post-Wedding</td>
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<td>1.4.1 — Honeymoon</td>
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<tr>
<td>1.4.2 — Send Out Thank You’s</td>
<td>35.00</td>
</tr>
</tbody>
</table>
signed, the only thing left of significance is to create a set of schedules (master, intermediate and detailed).

**Additional Work Breakdown Structure Examples**

To provide further insight into how work might be organized, figures 5.10 and 5.11 are work breakdown structures for hosting a Thanksgiving dinner and performing business process reengineering.

**Figure 5.10. Thanksgiving Dinner**

**Figure 5.11. Business Process Reengineering**

**WBS Exercise**

Let’s do an exercise. Assume you are a builder and are asked to build a residential home with two floors, four bedrooms, and 2.5 baths on a basement. You have
Figure 5.12. Work Breakdown Structure by Function

- Foundation
  - Concrete Footing
  - Footing
  - Concrete Plug
  - Footing Plug
  - Concrete Head
  - Footing Head

- Door Frames
  - Steel Door
  - Door Frame
  - Steel Frame
  - Door Frame with Frame

- Windows
  - Steel Window
  - Window Frame
  - Steel Frame
  - Window Frame with Frame

- Roofs
  - Steel Roof
  - Roof Frame
  - Steel Frame
  - Roof Frame with Frame

- Fencing
  - Steel Fencing
  - Fencing Frame
  - Steel Frame
  - Fencing Frame with Frame

- Wall
  - Steel Wall
  - Wall Frame
  - Steel Frame
  - Wall Frame with Frame

- Dampers
  - Steel Dampers
  - Damper Frame
  - Steel Frame
  - Damper Frame with Frame

- Landscaping
  - Concrete Landscape
  - Landscape Frame
  - Steel Frame
  - Landscape Frame with Frame
identified all of the requirements and now wish to depict the work to be performed in WBS format. How might the WBS look? Figure 5.12 depicts one manner in which the work might be graphically depicted.

Notice that the WBS in figure 5.12 has been organized by function. In other words, each major function/discipline involved in home building has been identified and work appropriately assigned.

But perhaps our builder thinks differently. Perhaps our builder prefers to organize the work by phases in which he/she will perform the work. This is altogether normal and perhaps most appropriate for this builder. A depiction of the same work organized by planning phase is presented below in figure 5.13.
To this point we have identified, stated, and derived requirements and created a requirements database. From our requirements we created an organization of the work: a work breakdown structure. Attendant to our work breakdown structure we created a dictionary with descriptions for each element.

While putting the finishing touches on the work breakdown structure, or shortly after, we must begin to lay out the work identified into a series of schedules: master, intermediate, and detailed. Once the work is defined and scheduled we can create a human resource plan. The human resource plan is a time-phased depiction of resources required to perform the work and accomplish the goals of the program.

Types of Schedules

There are many different types of tools available to help to program/project scheduling. These tools range in price from very inexpensive to very expensive. Prices can be as low as $10 to as much as $50,000 and more. The price varies, typically, in accordance with the level of functionality of the tool. Simpler tools may only do simple bar charts while the more complex tools will:

- Depict schedules in network diagrams using multiple formats (discussed later in this chapter).
- Allow for resources to be identified against schedule activities.
- Create human resource plans automatically from the data.
- Allow for costs to be associated with the scheduled activities.
- Support the creation of a cost and schedule baseline.
• Allow the cost and schedule baseline to be statused.
• Generate reports identifying cost and schedule deviations from the plan.

To say the least there are literally hundreds of tools with incalculable permutations of the above capabilities. One tool that I use in my classes is Microsoft Project 98 (or the most recent version). It supports all of the above mentioned capabilities to some degree or another.

When discussing scheduling techniques we usually refer to the pure techniques:

• Program Evaluation and Review Technique (PERT)
• Critical Path Method (CPM)
• Gantt Charts
• Milestone Charts.

Generally, however, no tool uses a pure technique. Instead, most tools use some permutation of one of the pure techniques. Fundamentally, when we discuss schedules, there are really only two primary schools of thought:

• Scheduling techniques that depict the interrelatedness of scheduled activities.
• Scheduling that do not show the interrelatedness of scheduled activities.

Over the succeeding paragraphs, we are going to examine the pure techniques in more detail, looking at the advantages and disadvantages of each.

**Gantt Charts**

Gantt charts were developed by Henry Laurence Gantt (1861–1919) during WWI. Fundamentally, they depict scheduled tasks with hollow bars over a horizontal time scale. The many activities are on the vertical axis and their corresponding hollow bars are filled in to reflect progress of the activity.

Figure 6.1 depicts the typical Gantt chart.

Gantt charts exhibit many advantages and disadvantages, as identified below:

**Advantages:**

• Easy to understand
• Inexpensive to prepare
• Ideal for repetitive work that can be measured quantitatively

**Disadvantages:**

• Potentially subjective
• Interrelationships among the schedule activities are not depicted
• No follow-on implications from schedule movements
Scheduling the Work

Gantt charts are very inexpensive to prepare and easy to read. In fact, a good spreadsheet tool typically allows for some form of drawing that enables one to create Gantt charts on spreadsheets. In this scenario an individual wouldn’t even have to buy a scheduling tool if Gantt charts were the only form of scheduling required. Doing repetitive work that can be counted accurately with some form of quantitative measure is a good use of Gantt charts. Every day, week, or month all that needs to be done to status an activity is to count the items produced, delivered, or completed, whichever measure is appropriate. Once counted, the scheduler simply needs to take appropriate credit by filling in the hollow bar.

As can be seen from the above example, however, if the activities being statused were not quantitative in nature, then the measure becomes quite subjective. For example, as a young software engineer in a discipline that was just beginning to come into existence I would routinely provide my status in non-quantitative measures. When asked how we doing in meeting our schedule dates for software being designed and developed we would simply say, “. . . everything seems to be pretty much on schedule. . .” What did this mean? In reality it might mean, and frequently did, that even though only 20% of the work remained it most probably represented 80% of the total effort. In our earlier years we didn’t realize this, of course, but as time went on it quickly became a fact based on historical data.

The biggest disadvantage of Gantt charts is that the activities are not depicted to represent their interrelatedness. In other words, how the activities are tied together is not represented in the Gantt chart. This being the case, if one activity were to slip

Figure 6.1.
Gantt Chart
in the schedule, we would not know what impact it might have on the other activities. If the program were small enough and the activities were relatively few, then we intuitively might know the answer.

Milestone Charts

Where Gantt charts are activity oriented, milestone charts are event oriented. Key program/project milestones are identified and placed on a schedule at the time at which they are due to occur. Then, at the predefined time (daily, weekly, or monthly), the milestones are statused as either being completed or not.

Milestone charts have their own symbology that describes the status of the many milestones. Figure 6.2 depicts symbols used in milestone charts and figure 6.3 depicts the use of those symbols.

From figure 6.3 notice that hardware development has experienced a schedule slip and a rescheduled completion date. Notice as well that the software develop-
Scheduling the Work

The many advantages and disadvantages are discussed below.

Advantages:

- Effective method of communication
- Symbology is standard and simple to use
- Presents actual progress against a baseline plan

Disadvantages:

- There may be surprises when there are too few milestones
- Doesn't show schedule activity interdependencies
- No follow-on implications from schedule activity movements

Looking at the symbology used in creating milestone charts it appears that there are only a handful of commonly used symbols. For individuals using this type of scheduling technique it doesn't take long for them to get used to this basic set of symbols. From the outside looking in, however, the symbols seem confusing.
and awkward to grasp. Milestone charts suffer from the same problem as did the Gantt charts. That is, neither of them shows the interrelatedness of the many schedule activities. Therefore, just as in the case with the use of Gantt charts, if one schedule activity slides out in time, the parties involved will have no idea of what the impact to the remaining schedule activities will be.

It is perfectly natural to combine the Gantt chart with the milestone chart. Figure 6.4 depicts this permutation of the pure forms of each.

**Network Schedules**

Network scheduling involves identifying the schedule activities in such a way that the activities are tied to each other. In this manner if one activity is moved in one direction or the other, then all related/dependent activities are moved accordingly.

When talking about network schedules, two dominant techniques are discussed:

- Program Evaluation and Review Technique (PERT)
- Critical Path Method (CPM).

PERT was developed in 1958 under sponsorship of the United States Navy.

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**Figure 6.4.**
Permutation of Gantt and Milestone Chart
Scheduling the Work

Special Project Office. It was developed as a special management tool for scheduling and controlling the Polaris Missile program. The Polaris Missile program involved 250 prime contractors and more than 9,000 subcontractors. PERT is credited with saving the program over two years in bringing the Polaris Missile submarine to combat readiness.

PERT basically works by computing the mode of the beta distribution using three estimates:

1. Most optimistic time
2. Most likely time
3. Most pessimistic time

PERT was intended to increase control in situations where time estimates are difficult to make with confidence.

PERT experienced a rapid rise, then an abrupt decline in usage around the 1970s. Two reasons were often cited for this:

1. PERT was overapplied.
2. PERT was combined with cost data or other nonscheduling aspects of program management and it became cumbersome to manipulate.

Over the last five years PERT has experienced a resurgence in use primarily due to software running PERT on personal computers.

CPM was developed in 1957 by J. E. Kelly of Remington-Rand and M. R. Walker of Dupont. CPM was developed to aid in scheduling maintenance shutdowns in chemical processing plants.

CPM is superior to PERT when time can be estimated closely and labor and material costs can be calculated accurately early in the program.

In CPM two time and cost estimates are given for each activity in the network. These estimates are:

1. Normal estimate—the cost of finishing the program in normal time.
2. Crash estimate—the time required to finish an activity if special effort is made to reduce program time to a minimum. It’s the cost to perform the effort on a crash basis in an attempt to minimize time to completion.

Network Approaches

Network approaches to scheduling generally fall into two basic categories:
Activity-on-arrow (AOA) is most closely associated with PERT but can be applied to CPM as well. This method is sometimes called activity-on-arc or arrow diagramming method.

Activity-on-node (AON) is most closely associated with CPM and is the basis for most computer scheduling applications. This method is sometimes called precedence diagramming method.

Activity-on-arrow is based on three rules.

1. Each activity is represented by one and only one arrow in the network.
2. No two activities can be represented by the same head and tail events.
3. To ensure correct representation the following questions must be answered as each activity is added to the network:
   a. Which activities must be completed immediately before this activity can start?
   b. Which activities must immediately follow this activity?
   c. Which activities must occur concurrently with this activity?

Figure 6.5 depicts rule number one. Each activity is represented by one and only one arrow in the network. Figure 6.6 depicts rule number two. No two activities can be identified by the same head and tail event.

Dummy activities are a way to show parallel activities without violating rule number two. In figure 6.7 suppose tasks "A" and "B" must precede "C," while only "B" precedes "E." Note the wrong way to depict this scheduling requirement on the left, while the right accurately depicts the requirements with the addition of the dummy activity “D1.”

Exercise #1—Suppose we had the following requirements. Draw the activity-on-arrow diagram so that the following precedence relationships are satisfied:
Scheduling the Work

Figure 6.6.
No Two Head and Tail Events

No two activities can be identified by the same head and tail event

Figure 6.7.
Parallelism with Dummy Activities

• “E” is preceded by “B” and “C”
• “F” is preceded by “A” and “B”

On the surface figure 6.8 would seem to satisfy these two requirements. What we discover in figure 6.8 is that “D1” was inserted to allow “B” to precede “E”; in doing so, however, “A” now also precedes “E.” Figure 6.9 is the correct solution.

Exercise #2—Suppose we were asked to draw the precedence diagram for the following conditions:

• “G” is preceded by “A”
• “E” is preceded by “A” and “B”
• “F” is preceded by “B” and “C”

Is figure 6.10 correct?

Figure 6.10 is not correct. Figure 6.10 implies “A” also precedes “E.” The correct solution is depicted in figure 6.11.

The activity-on-node scheduling method is characterized by the following:

1. AON is the basis for most computer scheduling applications.
2. Arrows are used to denote precedence relationships among activities.
3. No need for dummy activities.
4. All nodes, with the exception of the terminal node, must have at least one successor.
5. All nodes, except the first, must have at least one predecessor.
6. There should be only one initial and one terminal node.
7. No arrows should be left dangling. With the exception of rules number four and five above, every arrow must have a head and a tail.
8. An arrow specifies only precedence relations. Its length has no time duration significance relative to either of the activities it connects.
9. Cycles or closed loop paths through the network are not permitted. They imply that an activity is a successor of another activity that depends on it.

Activity-on-node and activity-on-arrow share the same formula for calculating early start and early finish times. Early start is the earliest the activity can start given the latest finish time of the activity's predecessor. Early finish is the earliest the activity can finish and is based on when it can start and how long the activity
Scheduling the Work

Figure 6.10 (right).
Exercise #2 Correct Solution?

Figure 6.11 (below).
Exercise #2 Correct Solution

is. Early start and early finish times are determined by calculating forward through the schedule’s activities.

Forward pass:

\[ ES(J) = \max [EF(I) \text{ where } I \text{ is an immediate predecessor of } J] \]

\[ EF(J) = ES(J) + L(J) \]

The schedule activity’s latest finish and latest start times are based on the successor’s latest start time. Formulas for calculating latest finish and latest start times are:
\[ \text{LF}(J) = \min\{\text{LS}(I) \text{ where } I \text{ is the successor of } J\} \]
\[ \text{LS}(J) = \text{LF}(J) - L(J) \]

Figure 6.12 depicts an example of early start, early finish, latest finish, and latest start times.

Total slack of an activity is calculated as the difference between its late start (or finish) and its early start (or finish). The free slack is the difference between the earliest among the early start times of its successors and its early finish time. That is, for each activity \( J \):

\[ \text{TS}(J) = \text{LS}(J) - \text{ES}(J) \]
\[ \text{FS}(J) = \min\{\text{ES}(I) \text{ where } I \text{ is the successor of } J\} - \text{EF}(J) \]

Activities with zero total slack fall on the critical path. Figure 6.13 provides an example with slack time calculated. Notice the critical path runs through nodes “A,” “C,” “F,” and “G.”

**Closing Thoughts on Developing a Network Diagram**

Although CPM and PERT are conceptually similar, symbols and charting techniques vary. PERT historically has utilized probability techniques while, in general, CPM has not. The following procedures apply to both CPM and PERT.
1. Identify all individual tasks comprising the program.
2. Determine the expected time to complete each activity.
3. Determine precedence and interrelationships among activities.
4. Develop a network diagram presenting these activities in proper sequence reflecting any dependency relationships.
   a. Activities indicated by lines
   b. Events or milestones by circles
   c. Dependencies or sequencing on separate paths by dotted lines
5. Complete and annotate the cumulative time required to reach each milestone along the paths. This will indicate the earliest time work can start on the next activity. The final time will indicate the total time required to complete a particular path.
6. Identify the critical path. This is the sequence of events taking the longest time to complete.
7. Starting at the program completion milestone on the farthest right, begin working backward and compute the latest time an activity can start without delaying the overall program. For example: if the total program takes 40 weeks and the last activity takes 5 weeks, then the final activity cannot begin later than week 35. The difference between the earliest start time and the latest time for each activity is the slack time or float. The critical path contains no slack time, i.e., free time.
The advantages and disadvantages of network diagrams are listed below.

Advantages:

- Network diagrams organize what otherwise would be confused.
- They are essential for complex systems, ship construction, missiles, etc.
- They allow managers to predict shortages and act on them early in the program.
- Once prepared, network diagrams are easy to update and rework.
- Network diagrams provide more control over activities and events.

Disadvantages:

- The activity times are only as good as the estimates provided.
- Sometimes the network diagrams are hard to follow when they possess too many lines and intersections.
- Sometimes the network diagrams become the focus of too much attention while other issues may be the root cause of the problems, e.g., management/labor relations.

Master Schedule

Schedules provide the time frame for resource allocation and establish a baseline for current status and forecasts of completion dates. A program contains a hierarchy of related levels of schedules beginning with the master program schedule, with each succeeding lower level more fully identifying and expanding the activities necessary to meet the program requirements. Management of these activities begins with the master program schedule, incorporates the intermediate schedule, and culminates in the detailed schedules. As a management tool the intermediate schedule and detailed schedules are typically depicted as an interdependency network, a network diagram that depicts the interrelationships among the numerous program activities.

A program’s master schedule is incrementally created, beginning with the identified activities and milestones specified in the contract.

Figure 6.14 depicts a typical master program schedule.

Figure 6.15 depicts the detailed process flow for generating the master program schedule and should be referred to when reading the following paragraphs.

Input to this activity is the requirements database, which contains stated and derived schedule requirements. Stated requirements are derived from the contract or request for proposal. Internally derived requirements are defined from within the processes of the functional organizations within the program. For example, the
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design engineering organization process specifies that a review is required (such as a preliminary design review). Even if there is no stated external requirement for such a review the preliminary design review should be included on the appropriate schedules as an event and it should occur unless the program manager and the functional manager agree to delete the requirement.

Processing for this activity is the responsibility of the program planner, who utilizes the requirements database.

1. The schedule includes:
   a. Contract deliveries
   b. Major customer review/decision points and major contractual schedule events
   c. Buyer-furnished equipment/material and delivery dates
   d. Buyer review/approval dates

Figure 6.14.
Example Master Program Schedule

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   a. Contract deliveries
   b. Major customer review/decision points and major contractual schedule events
   c. Buyer-furnished equipment/material and delivery dates
   d. Buyer review/approval dates

Figure 6.15.
Master Program Schedule Process Flow
e. Summaries of all program activities and key schedule events
f. Schedule reserve

2. The program manager reviews the master program schedule. If the master program schedule requires changes it will be returned to the program planner. Otherwise the program manager will demonstrate approval by signing the master program schedule.

The master program schedule is generated in accordance with the following considerations:

1. The master program schedule is depicted as an interdependency network, or Gantt chart.
2. Early, late, and baseline dates for each summary and event are identified.
3. The scheduling process is performed with approved tools. Approved tools will ensure the use of a consistent format throughout the company.
4. The schedules are generated utilizing top-down development. The master program schedule is generated and approved before the intermediate schedules. The intermediate schedules are generated and approved before the detailed schedules.
5. Traceability exists from each lower-level schedule element to a uniquely identifiable upper-level schedule element; that is, a lower-level schedule element completely supports the next-higher schedule element.
6. Since the master program schedule functions as a reporting tool to company management and to the customer it should occupy only one page. When adequate space for contract data requirements lists and contract line item numbers is precluded by the one-page format then the master program schedule may be augmented by supplemental schedules.
7. The master program schedule is released with schedule reserve indicated (if applicable). Schedule reserve consists of time retained for later use when unplanned activity occurs. Unplanned activities would negatively affect the schedule of in-scope work if schedule reserve has not been planned at the start of the program. The inclusion of a schedule reserve is at the discretion of the program manager and can eliminate the later need to submit a change request to the external customer or business area director. Lower-level schedules are generated to show completion of the activities no later than the dates of the accelerated schedule activities created when schedule reserve was taken.

As discussed earlier, while the master program schedule is being generated the
work breakdown structure provided by the customer may be extended to reflect the current understanding of the work and its organization. Accompanying the work breakdown structure are dictionaries that describe the work to be performed as depicted in the currently extended work breakdown structure.

Extending the work breakdown structure and creating dictionaries is the first step in planning the costs of the program. Cost planning is concerned with defining the relationship between the elements of work to be performed under the contract, allocating budget to the elements of work, defining who is responsible for performing the work, and selecting preliminary cost accounts.

The cost account is the management control point at which actual costs can be accumulated and compared to budgeted costs for work performed. It is also a control point for cost, scheduling, technical performance planning, work execution, and performance measurement. Cost account responsibility is assigned to a cost account manager.

**Intermediate Schedule**

The intermediate schedules are a hierarchically lower resolution of the work to be performed than initially depicted in the master program schedule. The intermediate schedules continue to separate the activities depicted in the master program schedule into lower-level subactivities. This further evolution of identified work culminates in the lowest level of schedules produced, detailed schedules.

Figure 6.16 depicts a typical intermediate schedule.
Figure 6.17 depicts the detailed process flow for generating the intermediate schedule and should be referred to when reading the following paragraphs.

Processing for this activity is the responsibility of the program planner and consists of the following:

1. Developing the summary-level activities on the master program schedule in greater detail.
2. Identifying the following features associated with these further developed summaries/subprojects:
   a. Key events
   b. Duration of summaries/subprojects
   c. Fixed start/completion dates
3. Changing the master program schedule when any date is changed as a result of intermediate schedule development.
4. The program manager’s review of the intermediate schedule; if the intermediate schedule requires changes, it is returned to the program planner, otherwise the program manager signifies approval by signing the intermediate schedule.

The intermediate schedule should:

1. Depict the intermediate schedule as an interdependency network
2. Identify early, late, and baseline dates for each summary, subproject, and event
3. Identify relationships (dependencies, successor/predecessor) among key events
4. Identify the float (slack time) of each summary and event
5. Identify the critical path(s)

**Detailed Schedules**

Detailed schedules are the bottom-most schedules in the schedule hierarchy. The purpose of developing lower-level schedules is to identify discrete manageable elements of work.

The detailed schedules expand each intermediate schedule summary/sub-project into multiple activities to the extent necessary, or desired, and add schedule events that satisfy the requirements of the intermediate schedule. The detailed schedules are working schedules that depict horizontal dependencies and are therefore used on a daily basis by the cost account managers to manage their work.

Figure 6.18 depicts a typical detailed schedule.

Figure 6.19 depicts the detailed process flow for creating preliminary detailed schedules and should be referenced when reading the following paragraphs.

Two things can happen as a result of creating the detailed schedules: the end dates in the interdependency network may no longer be acceptable, and the intermediate schedule may have been affected. All processing activities below are associated with these two potential problems.

Processing for this activity is the responsibility of the cost account managers.

---

<table>
<thead>
<tr>
<th>Activity/Event</th>
<th>1997</th>
</tr>
</thead>
<tbody>
<tr>
<td>contract award</td>
<td></td>
</tr>
<tr>
<td>system requirements review</td>
<td></td>
</tr>
<tr>
<td>software specification review</td>
<td></td>
</tr>
<tr>
<td>preliminary design review</td>
<td></td>
</tr>
<tr>
<td>design and development of operating system</td>
<td></td>
</tr>
<tr>
<td>design and development of context scheduler</td>
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<tr>
<td>design and development of time management function</td>
<td></td>
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<tr>
<td>design and development of file manager</td>
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<tr>
<td>design and development of input/output function</td>
<td></td>
</tr>
<tr>
<td>operating system integration</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 6.18.*

*Example Detailed Schedule*
1. The cost account managers develop the summaries/subprojects identified on the intermediate schedule in greater detail (activities) in accordance with the following requirements:
   a. Distinguishing each activity from all other activities in the cost account.
   b. Defining quantifiable activities in terms of a physical product that can be assigned a completion date.
   c. Making each activity the responsibility of a single functional organizational element.
   d. Specifying the minimum set of documents, resources, or products from other activities required to start work (start event).
   e. Clearly defining completion criteria based on accomplishing a specific task (completion event).
   f. Identifying activity duration.
   g. Identifying fixed start and/or completion dates.
   h. Defining predecessor (products required to start the activity) and successor (products produced by the activity) relationships with associated lead/lag times.

   It is imperative that contractual requirements not be modified during this process.

2. The cost account managers answer the following when generating activities:

**Figure 6.19.**
*Detailed Schedules Detailed Process Flow*
a. Is work missing or not required?
b. Does the work definition need modification to satisfy the requirements of the cost account?
c. Should the work be broken down further?
d. Should the requirements be broken down further?

3. The cost account managers include material-support activities (events) on the detailed schedules as appropriate. Such activities include:
   a. Generating engineering bills of material
   b. Generating manufacturing bills of material
   c. Material procurement planning
   d. Generating requisitions
   e. Generating a stocking plan
   f. Scheduling
   g. Expediting support groups
   h. Expediting receiving's distribution of material
   i. Inspecting/accepting material
   j. Rejecting/returning material
   k. Committing material
   l. Inspecting material
   m. Releasing material

4. The cost account managers determine whether the interdependency network is acceptable, based on the following criteria:
   a. All detailed schedule dates support all intermediate schedule dates.
   b. All activities have at least one predecessor and successor.
   c. All activities are mapped to the extended contract work breakdown structure.
   d. All events are connected to activities.

5. The cost account managers determine whether the intermediate schedule is affected (i.e., whether any intermediate schedule date is changed as a result of detailed schedule development).

6. The cost account managers submit the detailed schedules to the program manager. If the detailed schedules require changes they are returned to the program planner, otherwise the program manager signifies approval by signing the detailed schedules. If dates on the detailed schedules do not correspond to the dates established by the intermediate schedules, then the following options are available for reconciling differences:
   a. Identifying alternate plans for accomplishing the work.
   b. Reevaluating interpretations of the requirements to ensure the requirements are satisfied but not exceeded.
c. Considering additional or more highly skilled resources to accomplish the work.
d. Reevaluating schedule/risk tradeoffs.

The detailed schedules should:

1. Be depicted as interdependency networks or Gantt charts.
2. Identify early, late, and baseline dates for each activity and event.
3. Identify relationships (dependencies, successor/predecessor) among activities and events (start-to-start, finish-to-start, and finish-to-finish), as illustrated in figure 6.20.
4. Identify the float (slack time) of each activity and event.
5. Identify the critical activities and events.
6. Identify lead and lag times between activities and events.

Generating the preliminary detailed schedules may involve negotiation when the interdependency network is unacceptable and the cost account managers have attempted to reconcile the differences. This activity is the responsibility of the program planner and cost account managers and consists of:

1. Negotiating the adjustment of intermediate schedule date(s).
2. Negotiating the adjustment of detailed schedule date(s).
3. Determining whether the detailed schedules are affected, i.e., whether any detailed schedule date is changed as a result of negotiating detailed schedules.
4. Determining whether requirements have been changed as a result of this activity which happens when they have been reallocated or reinterpreted (if requirements change, the requirements database should be modified).

![Figure 6.20.](image-url)

*Lead and Lag Relationships*
Once the detailed schedules have been deemed acceptable and no effect on either the intermediate or master schedules is perceived, work packages and planning packages should be identified from the detailed schedules. Processing for this activity is the responsibility of the cost account managers and consists of seven steps:

1. The cost account managers examine the cost account’s requirements and define the work packages/planning packages by determining whether:
   a. Work is missing or not required.
   b. The work belongs in this cost account.
   c. The work belongs in the work package/planning package.
   d. The work definition needs modification to satisfy the requirements of the extended contract work breakdown structure.
   e. The work should be broken down further.
   f. The requirements should be broken down further.
2. The cost account managers assign to each activity a unique identifier for each element in the extended CWBS.
3. The cost account managers assign each work package/planning package a unique extended CWBS element title.
4. The cost account managers convert planning packages to work packages within the approved cost account budget at completion, cost account supplemental schedule events, and cost account requirements identified in the requirements database. This conversion must be accomplished prior to starting the effort identified in the planning package.
5. The cost account managers determine whether the extended CWBS dictionary is affected, i.e., whether a work package/planning package description has been generated or modified or whether extended CWBS elements have been added or deleted.
6. The cost account managers ascertain that each planning package/work package consists of:
   a. A description (located in the applicable extended CWBS dictionary)
   b. Requirements (located in the requirements database)
   c. A schedule
7. The cost account managers assign each work package/planning package identified to one and only one functional organization.

Once the detailed schedules have been approved and it has been verified that the intermediate and master schedules are consistent, then the schedule baseline is established and is ready for the program manager’s approval. The program planner
is responsible for establishing the schedule baseline by recording all early dates as baseline dates.

Keep in mind that having a program planner assumes the program is of sufficient size to be afforded this luxury. In the prior examples of obtaining a landscape estimate, the estimator was the program manager as well as the scheduler. In that scenario the program manager was also the proposal manager, cost manager, cost account manager, and all others not otherwise assigned a responsibility.

**Human Resource Plan**

The objective of this activity is to formulate a concise, meaningful, and practical program-level strategy for managing human resources in the manner most suitable to fulfill the program goals.

Resource planning as a philosophy requires that resources be identified for each detailed schedule activity and assigned in the program’s scheduling tool. The human resource plan, then, is an automated time-phased report (by activity, CWBS element, or program) generated by the program planner utilizing the program’s scheduling tool.

Development of the human resource plan is an iterative process. A first-look, high-level initial plan is done early in the program planning stage. After cost account plans have been generated, an updated plan is developed using the cost accounts as a basis.

Figure 6.21 depicts an example of a human resource plan.

Figure 6.22 depicts the process flow for generating the human resource plan and should be referenced when reading the following paragraphs.

Processing for this activity consists of six steps:

1. The functional organization planning resources, together with the program management office, identify human resources utilizing the extended CWBS and dictionary and the preliminary responsibility assignment matrix. Processing consists of determining functional organization personnel requirements and preparing an individual functional organization input in accordance with the resource-loading procedures for the program’s scheduling tool.

2. The program planner, utilizing the individual functional organization inputs and the intermediate schedule, integrates these inputs into the resource plan.
**Figure 6.21.** Example Human Resource Plan

<table>
<thead>
<tr>
<th>Status Date: December 22, 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run Date: December 31, 1998</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>HR Name</th>
<th>Project Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/06/99</td>
<td>John Doe</td>
<td>Coded Description</td>
</tr>
<tr>
<td>11/07/99</td>
<td>Jane Smith</td>
<td>Coded Description</td>
</tr>
<tr>
<td>11/08/99</td>
<td>Mike Johnson</td>
<td>Coded Description</td>
</tr>
<tr>
<td>11/09/99</td>
<td>Sarah Davis</td>
<td>Coded Description</td>
</tr>
<tr>
<td>11/10/99</td>
<td>David Brown</td>
<td>Coded Description</td>
</tr>
<tr>
<td>11/11/99</td>
<td>Emily Taylor</td>
<td>Coded Description</td>
</tr>
<tr>
<td>11/12/99</td>
<td>Richard Gray</td>
<td>Coded Description</td>
</tr>
<tr>
<td>11/13/99</td>
<td>Olivia White</td>
<td>Coded Description</td>
</tr>
<tr>
<td>11/14/99</td>
<td>William Black</td>
<td>Coded Description</td>
</tr>
<tr>
<td>11/15/99</td>
<td>Emma Rose</td>
<td>Coded Description</td>
</tr>
<tr>
<td>11/16/99</td>
<td>Matthew Jones</td>
<td>Coded Description</td>
</tr>
<tr>
<td>11/17/99</td>
<td>Sarah Davis</td>
<td>Coded Description</td>
</tr>
<tr>
<td>11/18/99</td>
<td>David Brown</td>
<td>Coded Description</td>
</tr>
<tr>
<td>11/19/99</td>
<td>Emily Taylor</td>
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<td>11/20/99</td>
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</tr>
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<td>11/21/99</td>
<td>Olivia White</td>
<td>Coded Description</td>
</tr>
<tr>
<td>11/22/99</td>
<td>William Black</td>
<td>Coded Description</td>
</tr>
</tbody>
</table>

Budget: Coded Description Resource Coded Description Year Run Date: December 31, 1998
3. The functional managers/business area directors, cost account managers, and program planner assign resources by name utilizing the individual functional organization inputs. This activity consists of two steps:
   a. The functional manager/business area director assigns resources by name usually three months prior to the scheduled start date of a work package. This activity is processed outside the program management planning process and is therefore done in accordance with the given functional manager’s or business area’s process.
   b. The cost account manager/program manager reviews assignments. If changes are required then the cost account manager/program manager negotiates with the functional managers/business area director. Otherwise the program manager approves the assignment of resources.
4. The program manager determines whether the human resource plan meets program requirements by considering the following:
   a. Budget
   b. Schedule
   c. Performance
   d. Identification and reduction of resource loading peaks and valleys
   e. Method of resource acquisition (human resources organization approval as applicable)
   f. Duplication/discontinuation of resources
5. Two additional details for consideration after resources have been loaded are whether the intermediate schedule has been affected and whether the preliminary responsibility assignment matrix has been affected. If so, then modifications are required.

6. The program manager reviews the human resource plan. If it requires changes it is updated. Otherwise the program manager signifies approval by signing it.
Choosing an Organizational Structure

Types of Organizational Structures

Theorists have devised many ways to partition an organization into sub-units with the intent of improving efficiency. Additionally, the intent of partitioning an organization is to decentralize authority, responsibility, and accountability. The mechanism through which partitioning is accomplished is called “departmentalization.” In all cases the objective is to arrive at an orderly arrangement of inter-dependent components.

Many basic management courses refer to the three variable formula below:

\[
\text{Accountability} = \text{Authority} + \text{Responsibility}
\]

Authority is the power granted to individuals (possibly) by their position in the company so they can make decisions for other individuals to follow.

Responsibility is the obligation incurred by individuals in their roles in the formal organization to effectively perform assignments.

Accountability is being totally answerable for the satisfactory completion of a given assignment.

In the above formula, which they teach us in management school, if you are given any two variables without the third there is a high probability of some form of failure. Certainly this seems most obvious when we are given responsibility and held accountable but have no formal authority to execute. Likewise having authority and responsibility, without accountability, promotes subjectivity in decision making.
Choosing an Organizational Structure

Traditional

In the traditional organizational structure organizational units are based on distinct common specialties such as engineering, manufacturing, and finance. Figure 7.1 depicts an example of a traditional organization structure.

There are many advantages to the traditional (functional) structure. Below lists some of the more pertinent ones:

1. Easier budgeting and cost control is possible. This is true because all costs related to the above finance organization are rolled up to a single functional manager.
2. Efficient use of collective experience and facilities.
3. Institutional framework for planning and control. Under this type of organizational structure planning as well as control is administered from a single functional stovepipe at the division level. (A stovepipe is a hierarchically organized function or discipline within an organization.)
4. All activities benefit from the most advanced technology. Great strength comes from focusing at the top the most state-of-the-art methodologies, technologies, and practices, then disseminating these throughout all organizations utilizing functional resources.
5. Allocates resources in anticipation of future business. When using a functional organization structure the functional manager has responsibility for allocating resources based on immediate needs as well as future needs.
6. Effective use of production elements.
7. Career continuity and growth for personnel. Under a single functional um-
brella, the functional manager can ensure that all personnel under that umbrella receive like education and can ensure that, for example, more senior personnel are assigned projects with increasingly greater responsibility or visibility, thus aiding in career opportunities and development.

8. Well suited for mass production of items.
9. Communication channels are vertical and well established.

The traditional (functional) organization has many disadvantages as well. Again, the predominant ones are discussed below:

1. There is no central project authority. With this type of organizational structure the many functions simply come together, usually centered around the type of program, and contribute to the accomplishment of the program’s goals.
2. Little or no project planning or reporting. Without a single program manager to be held accountable for the program’s overall tasks the functional managers concern themselves with their functional responsibility, therefore causing potential programmatic concerns.
3. Weak interface with the customer, no single focal point. While this may not always be true, the absence of a program manager may cause multiple interfaces through functional managers.
4. Poor horizontal communication across functions. Employees whose care and feeding come from a functional stovepipe will generally take great care to nurture those individuals in that stovepipe who have supervisor control. Naturally a stronger bond with functional management will occur over interfaces with horizontal functions.
5. Difficult to integrate multidisciplinary tasks.
6. Tendency of decisions to favor strongest functional group. This is true especially if the functional group is taking the lead on a given program.
7. Response to customer needs is slow, primarily because functions are more concerned with functional activities than program activities.
8. Ideas tend to be functionally oriented.
9. Projects have a tendency to fall behind schedule. This stems from a lack of a single program manager tending to programmatic concerns.

Product

In a product organizational structure distinct operating units are organized around, and given responsibility for, a major product or product line. Figure 7.2 depicts a typical product-oriented structure.

Product organizational structures are centered around major product or
brand lines. For example, if an organization produced dish soaps, toothpaste, facial tissue, etc., each might become a product structure and have its own product manager. Worth noting in the above is that other functions are replicated within each product organization. This is discussed further below.

Advantages and disadvantages of this type of organizational structure are discussed below.

Advantages:

- Strong control by a single product authority.
- Rapid reaction time. The product manager has all of the resources he/she needs to be successful, and can command these resources in any way required to satisfy the customer’s changing needs.
- Encourages performance, schedule, and cost tradeoffs.
- Personnel are again loyal to a single individual. Where that individual was the functional manager in the traditional structure it is the product manager in this type of structure.
- Interfaces well with outside units. Here a single product manager is given primary responsibility for interfacing with other units both externally and internally.
- Good interface with customer.
- Strong communication channels. It helps in this type of structure that all employees have a common goal: to produce a single product or brand of product. This builds a unified allegiance to a single cause.
Disadvantages:

- Inefficient use of resources, duplication of effort. This may be the single greatest argument against this type of organizational structure. The fact that in the above example engineering, finance, etc., are duplicated for every product line implies full-time employees are being used where part-time employees are adequate.
- Does not develop strong functional technology. Single individuals performing a single function on the product do not have the time or the breadth of exposure to see what the latest and greatest methodologies, techniques, and practices may be.
- Does not prepare for future business. Without functional oversight the entire product organization is focused on design, development, and delivery of a single product or brand. If greater vision does exist, it typically is limited to similar products.
- Less opportunity for technical interchange among projects.
- Minimal career opportunity and continuity for project personnel. In other words there may be limited growth potential.
- Difficulty in balancing work loads as projects phase in and out. Individuals may not have work in a particular time frame but must be kept busy doing something until that specific type of function is again in demand.

**Matrix**

The matrix structure is a hybrid organization that attempts to balance the use of human resources as they are shifted from one project to another. It can be viewed as a project organization superimposed over a functional organization. Figure 7.3 is an example of a typical matrix organizational structure.

The matrix structure is more complex than either the traditional or product oriented structures. To this end, it requires some basic ground rules to be successful.

- Participants must spend committed time on a project. This ensures a degree of loyalty.
- Horizontal as well as vertical channels must exist for making decisions.
- There must be quick and effective methods for conflict resolutions.
- There must be good communication channels between managers.
- All managers must have input into the planning process.
- Both horizontal and vertical managers must be willing to negotiate for resources.
- Horizontal line must be willing to operate as a separate entity except for administrative purposes.
Project management is more behavioral than quantitative. Interpersonal and communicative skills are extremely important attributes of the project manager.

In a matrix organizational structure:

- There should, ideally, be no disruption due to dual accountability.
- A difference in functional management judgment should not delay work in progress.

Advantages of this type of organizational structure are:

- Combines the strengths of both project and functional organizations.
- Provides a good interface with the outside customer.
- Promotes effective interdisciplinary task integration.
- Promotes an efficient use of production resources.
- Promotes effective project control as programmatic concerns are assigned to a single individual.
- Promotes career continuity and professional growth as each functional individual has a home after project completion.
- Perpetuates technology. Functional resources gain the benefit of a functional strength, which can be transferred to the program of the day.
- Functional knowledge is available for all projects on an equal basis.

Disadvantages of this type of organizational structure include:

- Dual accountability of personnel. This is perhaps the biggest threat to this type of structure. Personnel will generally favor whoever produces their
performance review and subsequently has control over their income adjustments. Confusion here can derail a unified effort.

- Conflicts between project and functional managers. This issue will be discussed in more detail below.
- Profit and loss accountability is more difficult.
- There are continuously changing priorities, especially on the part of the functional managers, who control the resources.
- The balance of power between functional and project managers must be watched. Later we'll discuss their respective perspectives of what is important.
- Functional managers might be biased towards their own priorities.
- Because of the duality of authority employees may not feel a strong commitment to a single source.
- Employees may feel confused about loyalty.

Project managers have different concerns than do functional managers. A project manager is concerned with:

- What is to be done?
- When will the task be done?
- What is the importance of the task?
- How much money is available to do the task?
- How well has the total project been done?

The functional manager, on the other hand, has a more hands-on concern, as listed below:

- How will the task be done?
- Where will the task be done?
- Who will do the task?
- How well has the functional input been integrated into the project?

Project Management

The project management structure attempts to further organize the project/functional (matrix) structure by providing a single point of authority, responsibility, and accountability for all projects, in much the same manner as a functional manager.

Figure 7.4 depicts the typical project management structure.

The advantages and disadvantages of this form of organizational structure are listed below.

Advantages:

- Better overall control of projects. A single director of projects can work with the numerous project managers to ensure uniformity in execution.
Choosing an Organizational Structure

Criteria for Selecting an Organizational Structure

When looking for reasons why an organization selects one form of organization versus another, three points are applicable:

1. Technology—Functional organizations tend to have greater process and technology focuses.
2. Communications—Traditional and product organizational structures tend to provide clearer communication paths.
3. Responsibility—Product structures very clearly identify the responsible party; matrix structures are not as clear.

**Concluding Remarks**

To summarize:

- No single structure is optimal for all organizations.
- Organizational structure can, and will, adjust to meet changing requirements.
- There is no such thing as a good or bad organizational structure; there are only appropriate and inappropriate ones.

**Program Organization Chart**

The program personnel, while they may be the same personnel involved in the creation of the program's baseline, are those individuals responsible for execution of the program in accordance with the program's created and approved performance measurement baseline.

The program organization consists of all personnel assigned to the program as depicted in an organization chart. The program responsibility assignment matrix is the intersection of the program organization personnel (to the cost account level) with those extended CWBS elements identified as cost accounts.

Figure 7.5 depicts an example of a program organizational chart.

Figure 7.6 depicts the detailed process flow for establishing the program's organization and the program organization responsibility assignment matrix and should be referred to when reading the following paragraphs.

Identifying the program organization is required prior to the generation of the preliminary responsibility assignment matrix. The program organization is based on an understanding of the way in which work is to be organized for execution on the program. The extended CWBS provides the initial perspective of how the program's work is organized. The program management office, with assistance from the functional organizations, allocates key program personnel as responsible persons for the successful execution of the identified work elements. These key personnel will then form the program's management structure as shown on the program organization chart.

Once the program's organization has been identified and approved the next activity is the assignment of identified work elements from the extended CWBS to responsible individuals.
Figure 7.5.
*Example Program Organization Chart*

Figure 7.6.
*Program Organization Chart Detailed Process Flow*
Figure 7.7. Example Program Organization Responsibility Assignment Matrix
Program Organization Responsibility Assignment Matrix

The program organization preliminary responsibility assignment matrix has exactly the same format and intent as the preliminary responsibility assignment matrix described in a previous chapter. The purpose of the program organization responsibility assignment matrix is twofold: to assign program individuals to the identified work to be performed, and to assign budgets to cost accounts. Figure 7.6 and figure 7.7 depict a detailed flow process for creating the matrix and a program responsibility assignment matrix.

Once the program's organization has been identified and approved, the next activity is the assignment of identified work elements from the extended CWBS to responsible individuals. This assignment is depicted in the preliminary responsibility assignment matrix. The CWBS elements on the vertical axis of the matrix are those representative of major elements of work: the cost accounts. The individuals shown on the preliminary responsibility assignment matrix as being responsible for the work elements are the cost account managers. Both cost accounts and cost account managers are defined in greater detail in Chapter 9.
Risk Management

Risk management is a formal process for managing program risks.
Risk can be defined as the probability of an undesirable event or situation occurring and the consequence of that occurrence.

For example:

- A stock price drop causes a paper loss
- An interest rate increase causes higher home payments
- A plane crash causes multiple casualties

When discussing risk we must also address rewards. There must always be some potential gain from successfully executing an activity with risk. As the potential gain increases so does the acceptability of higher levels of risks. If the consequence of the risk occurrence decreases the acceptability of assuming the risk increases.

Figure 8.1 depicts this relationship.

Additionally there is the consequence versus acceptability of the risk. In this trade-off the higher the consequence of the risk, the lower the acceptability of the risk, and vice versa. Figure 8.2 depicts this relationship.

Risk management is a process composed of four distinct yet dependent activities. Risk management is composed of:

- Risk planning
- Risk assessment
- Risk analysis
- Risk handling
Risk Planning

The intent of risk management planning is to force organized intelligent thought on the tasks of identifying risks and, subsequently, on eliminating, minimizing, or controlling the expected consequences of risk occurrences.

Planning risk management requires basic support from other individuals/functional organizations as well as a focused effort.

- Management buy-in: management must provide the necessary resources to perform the required program risk planning.
- Functional management buy-in: functional management has the most knowledgeable individuals on discipline-specific risks.
- Key system areas should be targeted for the risk management process (program level, hardware, software, etc.).

Risk, again, is defined as the probability of an undesirable event occurring and the consequence of the occurrence. Figure 8.3 depicts this relationship.

Notice from the table on the following page that if the probability of the risk is low and the seriousness is equally low, then the risk is basically negligible. In other words, if it occurs we will handle it through normal risk mitigation decision making. As the probability of occurrence goes up and the seriousness of the occurrence goes up risks move from moderate to significant.

Formal risk mitigation is the process of determining what preventive actions can reduce the probability of risk occurring, what type of monitoring systems exist to detect risk, and what contingent actions can be applied to reduce the consequences should risk materialize.

Risk Assessment

Risk assessment is concerned with identifying the risks and then quantifying them so as to be able to address only those that pose the greatest probability of occurring and the most serious consequences should they occur.
Risks can be identified through any number of sources:

- Expert opinion
- Analogy comparisons
- Evaluation of program plans

Quantification is characterized as:

- Creating a rating system for identified risks
- Getting all parties to agree on the rating system
- Keeping the rating system relatively simple (high, medium, low)

In general, at the highest level, we are attempting to move risks through various known states as follows:

- Knowns—an event or situation containing no uncertainty.
- Known unknowns—we know they exist but don’t know much about them. For example, I know the scientific discipline of bioengineering exists, but I don’t know much about it.
- Unknown unknowns—typified as an event or situation that could not have even been imagined, for example, diseases.

Further, risks exist in every discipline or function. Below some of these risks are identified.

Corporate business risks:

- Business risk—includes the chances of both profit and loss.
- Pure or insurable risk—includes only the chance for loss, not profit.
Risk Management

- Direct property (fire, storm, flood)
- Indirect property (renting alternative equipment)
- Liability (bodily injury, personal injury, property damage, lawsuits)
- Personnel (loss of key individuals)

Program/Project risks:

- Technical risks (performance related)
  - Material properties (metal, plastic, fiberglass)
  - Physical size of the entity (6 lbs., breadbox size)
  - Speed of the entity (0 to 60? Yes!)
  - Operating environment (nuclear threat, salt, sand, sun, moisture, etc.)
  - System complexity (design/integration issues)
- Program risks (resource oriented)
  - Material availability
  - Personnel availability
  - Communication problems
  - Labor conflicts (strikes, walkouts, slowdowns)
  - Personnel skill mix
    - What's required
    - What we possess
    - What we need
- Supportability risks (associated with fielding or maintaining the system)
  - Reliability and maintainability
  - Field training
  - Interoperability with other systems
  - Transportability
  - System safety
- Cost risks (concerned with program cost growth)
  - Overhead rates
  - Estimating errors
  - Sensitivity to other risks
    - Technical
    - Programmatic
    - Supportability
    - Schedule
- Schedule risks (concerned with program schedule issues)
  - Activity parallelism
  - Quantity of elements on the critical path
  - Estimating error
Risk Analysis

Risk management analysis is concerned with further definition and description of the identified risks. During this phase of the risk management process we determine:

- The likely causes of the risks
- Variation of the risks
- Magnitude of the risks
- Consequences of the risks
- Possible ways of dealing with the risks

Techniques for dealing with the risks include:

- Decision analysis
- Estimating relationships
- Network analysis
- Life cycle cost analysis
- Risk factors
- Performance tracking
- Cost performance report analysis
- Independent technical assessment
- Independent cost estimates

Decision analysis, also known as expected monetary value technique:

- Computes the expected value for each alternative
- Uses decision trees to depict the relationships

For example, as an organization should we conduct 100% of the tests of our 500 widgets we have to produce?

Givens:

- Field failure rate is 4%
- $10,000 per widget for testing (500 widgets × $10,000 = $5 million)
- If tested, there are reassembly costs of $2,000 for each passed widget
- If tested, the cost to repair a failed widget is $23,000
- A fielded failed widget is $350,000 to repair

Figure 8.4 depicts a decision tree for this problem.
If our objective is to minimize cost, then we would select the alternative with the lowest expected monetary value, which, in this case, would be to test each widget.

Estimating relationships is an analysis method characterized by the following:

- Review characteristics from previous programs that exhibited cost problems.
- Create a model relating characteristics and cost implications (problem = % cost overrun).
- Compare current program characteristics to those in the model.
- Reserve sufficient funds for this program.

Network analysis, as a risk management analysis technique, is based on network diagramming, and utilizes the following activities.

- Identify tasks based on the work breakdown structure
- Depict interrelatedness of activities
- Assign resources
- Review durations and critical path
- Examine dependencies
- Assure work is accounted for
- Examine resource loading

Life cycle cost, as a risk management analysis technique, is based on the life cycle cost of a similar project. There are two basic steps in this technique.

1. Perform single variable sensitivity analysis, varying:
   a. Production rates and quantities
   b. Design trade-offs
   c. Resource projections

![Decision Analysis Decision Tree](image-url)
d. Repair and warranty variables  
e. Reliability growth  

2. Examine the whole project from cradle to grave

Risk factors, as a risk management analysis technique, are intended to estimate the added costs due to identified risks. It is characterized as follows:

- Determine program costs by work breakdown structure element.
- Determine the percent additional cost per element due to risk.
- Each element may have a different weighted factor.
- Weighted factors are multiplied by risk costs.
- Recalculate new program costs with the increase due to risk estimates.

Performance tracking, as a risk management analysis technique, is what we refer to as technical performance measurement and is discussed later in this chapter. In a nutshell the basic activities are:

- Identify and baseline technical performance parameters (a list of some typical performance parameters are identified below).
- Make monthly assessments of progress towards achieving those parameters.
- Note variations from the baseline parameters.
- Determine corrective actions.

Typical technical performance parameters for performance, reliability, producibility, maintainability, quality assurance, and supportability are detailed below.

Typical technical parameters (performance) are:
- Speed (miles per hour)
- Weight (pounds)
- Range (miles)
- Power (kilowatts)
- Climb rate (feet/second)
- Takeoff distance (feet)
- Turn rate (degrees/second)

Typical technical parameters (reliability) are:
- Mean time between failures (hrs/days)
- Mean time to repair (hrs/days)
- Probability of component/assembly failure (0 – 1.0)
- Life cycle cost analysis ($)
- Design to cost ($)

Typical technical parameters (producability) are:
Risk Management

- Capital ($)
- Manpower (people count)
- Facilities (square feet)
- Material ($)
- Equipment (machinery required)
- Schedule (time)
- Risk (0 – 1.0)

Typical technical parameters (maintainability) are:
- Standardization (%)
- Modularity (%)
- Update ability (0 – 1.0)
- Special equipment ($)
- Frequency (schedule, time)
- Costs ($)

Typical technical parameters (quality assurance) are:
- Scrap, rework, and repair (% of labor)
- Yield (% of 1st time inspection successes)
- Supplier rating (%)
- Customer satisfaction (0 – 1.0)
- Software (lines of code in violation per 1000 lines of code)

Typical technical parameters (supportability) are:
- Parts inventory ($)
- Costs ($)
- Resources (manpower, equipment, facilities)
- Modularity (%)
- Operational availability (%)

Cost report performance, as a risk management analysis technique, is a review of the cost and schedule variances from the baseline plan. Its basic activities are highlighted below and discussed in considerably more detail in the chapter on management cost/schedule control systems.

- Determine baseline for cost and schedule
- Review monthly and cumulative variances
- Review performance trends (past, present, and future)
- Review written explanation of variances

Independent technical assessment, as a risk management analysis technique, is the same as the cost report performance technique, except with an outside or
independent party. The basic activities are the same as with the cost report performance technique identified above.

Independent cost estimates, as a risk management analysis technique, look at the cost and schedule estimates by an independent source. Basic activities and features of this technique include the following:

- Cost and schedule estimates are developed by an organization outside of the program office
- Independent organization cross-checks program office estimates
- Helps to prevent overlooked costs or optimistic estimates

In transitioning from risk management analysis to risk management handling we must remember there are three basic things we need to focus on: preventive actions, risk monitoring systems, and contingent actions. These are depicted in Figure 8.5.

As depicted in figure 8.5, preventive actions help us to reduce the probability of the risk occurring. Risk monitoring systems help to detect the risk should it materialize. Contingent actions help to reduce the seriousness of the occurred risk.

**Risk Handling**

Once risks have been identified and quantified there are four ways to handle the risks.

1. Avoidance—accept a lower-risk choice. Avoid the higher-risk choice.
2. Control—best stated as, “I am aware of the risk, and will do my best to mitigate the occurrence and effect.”

3. Assumption—accept the consequences should the risk occur. One mechanism to minimize the impact of assuming the risk is to share the risk with the customer. In the home building example the builder might suggest that should the price of lumber go up the customer kick in half of the total cost impact.

4. Knowledge and research—it’s a continuing process to understand the risks and their impacts, as well as how to curb the events which might trigger the risk’s occurrence.

Let’s look at an example of how all of this fits together. The Software Engineering Institute has a capability maturity model (CMM) for software which helps an organization to determine how mature their software processes are. One key area of the CMM is called “software project tracking and oversight.”

The purpose of software project tracking and oversight is so that management can take effective actions when the software project’s performance deviates significantly from the plans.

Software project tracking and oversight involve tracking and reviewing the software accomplishments and results against documented estimates, commitments, and plans, then adjusting these plans based on the actual accomplishments and results.

To satisfy these requirements we proposed an integrated dual approach composed of the following.

- Track high-risk events that could cause cost, schedule, and technical performance problems. These are risks with a:
  - High probability of occurrence
  - High seriousness should they occur
- Track standard performance metrics as part of each phase of the software development life cycle.

The key to software project tracking and oversight is the identification, quantification, baselining, and statusing of high-risk events. As outlined in previous discussions, these objectives are accomplished through the following:

1. Risk management
   - Risk planning
   - Risk assessment
   - Risk analysis
   - Risk handling
2. Technical performance measurement
   - Identification of key performance parameters
   - Definition of a technical performance measurement baseline
3. Earned value management (discussed in the next chapter)
   - Monitoring of technical performance
   - Signaling when performance deviates from the plan
   - Identification of the need for corrective action

Summarizing risk management:

- Risk planning—sets out the requirements for performing risk management.
- Risk assessment—the process of identifying and quantifying program risks.
- Risk analysis—the process of evaluating program impacts as a result of risk assessment.
- Risk handling—the process of executing management actions to mitigate or eliminate risk.
- Risk management—a continual process through all program phases and the umbrella function of the above five steps.

Figure 8.6 depicts the basic risk management phases.
A management cost/schedule control system and the government’s terminology of earned value management are synonymous concepts. Both are defined as a disciplined framework in which complete program planning takes place, work is authorized and scheduled consistent with the contract, performance is measured against a predetermined plan, and significant variances to either budget or schedule are highlighted for corrective action. This chapter deals with this type of cost and schedule control system.

**Concept Examples**

First, a few examples to help lay the foundation for concept development.

In figure 9.1 your child has come home from college after two semesters. You are delighted to hear that she/he has only spent $7,000 of the $10,000 you had budgeted. The question here is “Are you happy?”

In Figure 9.2 you have agreed to a negotiated price of $100,000 for a new home which was to have been built in five months. After *four* months your builder says he spent $95,000. Are you happy?

Figures 9.1 and 9.2 ask similar questions: Are you happy? In both cases you have cost ($7,000 out of $10,000 and $95,000 from a budgeted $100,000) and schedule (two semesters and four months) information. But what’s missing?

What’s missing is an element of performance.
Features and Benefits

A management cost/schedule control system or earned value management has a number of features and benefits.

- Adds more discipline to the planning process
- Places predetermined value on measured performance
- Compares work scheduled to work performed
- Compares work performed to money spent

Additionally:

- Detailed planning forces need dates from other managers and interfaces
- Detailed planning finds things “not thought out” in the proposal phase
- Monthly performance data identifies problems early and quantifies them, which helps make improved decisions
• Monthly performance data analysis reinforces functional management commitment and monitoring
• Improves communications internally and with the customer
• Project is much better controlled

Historically, earned value management originated with the government’s Department of Defense in 1967. It began as the cost/schedule control systems criteria and has since been referenced under numerous names (C/SCSC, Cspec, EV, CS Squared, performance measurement, The Criteria). In any case earned value management is really not a system by definition but instead a set of 35 management system requirements. These 35 requirements are broken into five logical groupings:

1. Organization—to define the contractual effort in using the work breakdown structure, assigning responsibilities for the performance of the work, and accomplishing this within an integrated management cost control system.
2. Planning and budgeting—to establish and maintain a performance measurement baseline for control of the work.
3. Accounting—to accumulate cost of work and materials such that comparisons can be made to the baseline.
4. Analysis—to measure earned value and analyze variances and development costs at completion.
5. Revisions and access to data—to incorporate changes and allow access by the customer to the data.

For discussion purposes we are simply trying to bring consistency and formality to a process in which products may not necessarily be produced in a consistent or formal manner.
Definitions

Before continuing, a few definitions are in order.

The program manager’s role and responsibilities include:

- Responsibility for program profit or loss
- Single management focal point for the program
- Coordinates the program’s resources for allocation
- Approves program budget
- Authorizes the accomplishment of work
- Selects and manages cost account managers
- Ensures proper earned value management discipline is followed
- Uses earned value management to isolate problems and stimulate timely corrective action

The cost account manager’s role and responsibilities include:

- Plans the work for the discipline he/she is responsible for
- Manages the work to the plan
- Monitors cost and schedule to the plan
- Uses earned value management to report performance
- Responsible for developing corrective action plans

The program planner and cost administrator may be the same person or two people depending on the size of the program. They have the following roles and responsibilities:

- Responsible for maintaining the program’s cost, schedule, and performance baseline
- Responsible for generating monthly schedule and cost performance reports
- Ensures a controlled baseline change process
- Assists program manager (PM) and cost account manager (CAM) in analyzing program variances and ensures corrective action entries are in accordance with control process

WBS, Dictionary, and Schedules

Remember, at this point we have created a work breakdown structure with attendant dictionaries and developed master, intermediate, and detailed schedules. The schedule development is from the top down but the statusing of the schedules is from the bottom up. Figure 9.3 depicts this relationship.

It’s now time to focus on the simplicity of the earned value management con-
cept. In theory it really is not very difficult to comprehend. In practice, however, implementing a system which satisfies the 35 management system requirements discussed earlier can be quite complicated and require great discipline.

**ABC's of EVM Are “S,” “P,” and “A”**

Earned value management and all of its calculations are centered on the budgeted cost of work scheduled (S), the budgeted cost of work performed (P), and the actual cost of work performed (A). These and other concepts are discussed in the following pages.

Let’s begin by looking at figure 9.4.

Looking only at the budgeted cost of work performed (BCWS) line, as a cost account manager, I was asked to determine how much effort (person-months) it would take to go from contract award to the preliminary design review (PDR). In this example I would have said 4 man-months. The cost manager, knowing that each man-month was worth $10,000, assigned $40,000 to the accomplishment of this work at PDR. Therefore on the budgeted cost of work scheduled line you see the $40K. I may have provided 6 man-months (MM) to get to the critical design review (CDR) and 8 MM to get to the test readiness review (TRR). Again, on the
BCWS line you will see that $60,000 and $80,000 have been identified as the worth of those respective efforts.

Looking at the budgeted cost of work performed line (BCWP) we see that once we get to PDR, CDR, and TRR, and the work is truly completed, I, as a cost account manager, get credit to the amount that I said it would take to accomplish the milestones.

If we look at the mapping of BCWS to BCWP, S, as one might expect, would look somewhat like figure 9.5.

We see that credit earned for work performed tracks to the value that I, as a cost account manager, said it would take to do the work. Notice that the total of the BCWS dollar amounts ($40K, $60K, $80K) equals the budget at completion of the program for this cost account.
Figure 9.6 depicts how work is actually accomplished and the introduction of actual costs.

Notice that PDR has been filled in. This means that we accomplished PDR when we were supposed to and received the $40,000 ($40K) credit we had planned on. This is depicted on the budgeted cost of work performed (BCWP) line. If we look just below the BCWP line we see that actual cost to perform that work was only $30,000 ($30K). Therefore, at that time, we were actually ahead by $10,000.

CDR slipped a little in time. On completion of CDR, however, we received the $60K worth of performance credit we said it would take. Notice we do not get the $60K until we accomplish the CDR even if the CDR slips in time. Looking down the ACWP line at actuals we see that we really did spend $60K to get to the original completion date and, in fact, spent an additional $20K to get to the completed CDR for a total of $80K. Therefore, at CDR, we have spent $110K and have only got credit for our scheduled $100K worth of work.

Looking at TRR we see that it is not filled in, which means it has not yet been completed and therefore we do not get our remaining $80K of performance credit. Why? We didn’t get it because we did not complete our performance of TRR. Once TRR is completed we will get our $80K of performance credit. Looking only at budgeted cost for work scheduled and budgeted cost for work performed we see that at this point in time we should have credit for $180K but only have credit for $100K. This says that we are behind schedule! If we were not behind schedule then BCWP (work we performed) would be exactly like BCWS (work we had scheduled
to have complete at this time). Comparing BCWS to BCWP at any one point in time will tell us if we have a schedule problem.

Now look at the actuals incurred. We see that we spent $190K to get to TRR and are not finished yet. Comparing the credit we received for work performed (BCWP) to the actual cost of performing the work (ACWP) we see that we have overspent our budget, or in other words, we have a cost overrun.

So, in figure 9.6, we see that we are behind schedule and over budget!
Looking at this scenario in another depiction we see figure 9.7.
This figure depicts a number of things:

1. Budgeted cost of work performed (BCWP) is not a direct one-for-one mapping to budgeted cost of work scheduled (BCWS). In fact, BCWP is a stair-step function that gets incremented as credit is actually earned.
2. The actuals dollar amount at time now is $190K.
3. Once TRR is accomplished, then BCWP will be equal to BCWS, which is how we know when all of the work has been completed.

Cleaning up the above chart still more, we see figure 9.8.
In the this figure we see:

1. The difference between BCWS and BCWP is schedule variance.
2. The difference between BCWP and ACWP is cost variance.
3. The actual cost of work performed (ACWP) plus the estimate to complete the remainder of the work is equal to the estimate at completion (EAC).
4. The contract budget base (CBB) minus management reserve (MR) is the performance measurement baseline (PMB) or what we refer to as the budget at complete (BAC).
Types of Variances

There are three basic variances:

1. Schedule variance (current and cumulative)
   
   \[
   \text{Schedule Variance (SV)} = \text{BCWP} - \text{BCWS} \\
   \text{a negative answer is unfavorable}
   \]

2. Cost variance (current and cumulative)
   
   \[
   \text{Cost Variance (CV)} = \text{BCWP} - \text{ACWP} \\
   \text{a negative answer is unfavorable}
   \]

3. Completion variance
   
   \[
   \text{Variance at Completion (VAC)} = \text{BAC} - \text{EAC} \\
   \text{shows estimated overrun or underrun}
   \]

The estimate at complete (EAC) is the actual cost of work to date plus the cost of remaining work.

\[
\text{EAC} = \text{ACWP} + \text{ETC} \quad \text{(estimate to complete)}
\]

This is also referred to as the latest revised estimate (LRE).

EAC is a very subjective estimate and must be generated in a rational, consistent manner. When estimating an EAC, consider:

- Performance to date (current and cumulative variances and efficiencies)
Impact of approved corrective action plans
Known/anticipated downstream problems
Best estimate of the cost to complete remaining work on this cost account

A summary of the earned value language we have used so far is depicted in figure 9.9.

Past Performance Variances

Past performance variances are considered to be the following:
- Cost Variance (CV = BCWP – ACWP)
- Schedule Variance (SV = BCWP – BCWS)
- Variance at Completion (VAC = BAC – EAC)

The program’s percent complete can be calculated by dividing the cumulative credit earned (BCWP) by the total budget at complete (BAC).

\[
\text{Percent Complete} = \frac{\text{cumulative BCWP}}{\text{BAC}}
\]
What this says is that the program is X percent complete based on cumulative performance to date and the budget at complete.

**Past Trends**

It’s good to know if we have a cost or schedule variance and what the new estimate is to complete the entire effort. It is also good to know what percent of the overall program is complete according to the original budget to complete the program. Additionally, however, we really would benefit from knowing at what efficiencies we have been performing. In other words, have we been performing at 100% efficiency or have we been performing at a mere 50%? Past efficiencies will give us some insight into what efficiencies we can expect to perform at in the future assuming things remain relatively stable.

There are two past efficiency indices:

Cost Performance Index (CPI) = \( \frac{\text{cumulative BCWP}}{\text{cumulative ACWP}} \)

This index says for each dollar spent X amount of performance was earned.

Schedule Performance Index (SPI) = \( \frac{\text{cumulative BCWP}}{\text{cumulative BCWS}} \)

This index says for each dollar spent X amount of schedule was achieved.

**Future Trends**

There are also two future trends that predict the efficiency we would have to perform at in order to meet our newly revised estimate to complete the program.

The first future trend is the to complete performance index (TCPI).

Where \( TCPI = \frac{\text{BAC} - \text{cumulative BCWP}}{\text{LRE} - \text{cumulative ACWP}} \)

This says the remaining baseline budget divided by the remaining estimated funds determines the efficiency factor necessary to complete within the LRE.

There are other variations on this future prediction. One in particular places greater weight on the cost performance index than the schedule performance index. This is called an independent estimate at complete (IEAC) and reads as follows:

\( \text{IEAC} = \text{Actuals} + \left( \frac{\text{BAC} - \text{cumulative BCWP}}{.8 \text{CPI} + .2 \text{SPI}} \right) \)

Based upon past cost and schedule efficiencies this formula predicts the program’s cost at completion.
Exercise

For each BCWS/BCWP/ACWP row in Figure 9.10 place an “X” in the appropriate schedule and cost columns.

Figure 9.11 depicts the correct answers.

<table>
<thead>
<tr>
<th>BCWS</th>
<th>BCWP</th>
<th>ACWP</th>
<th>On Schedule</th>
<th>Ahead Of Schedule</th>
<th>Behind Schedule</th>
<th>On Cost</th>
<th>Underun</th>
<th>Overrun</th>
</tr>
</thead>
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<tr>
<td>$100</td>
<td>$100</td>
<td>$100</td>
<td>X</td>
<td></td>
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<td></td>
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<td>$100</td>
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<td>X</td>
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<td>$300</td>
<td>X</td>
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</tr>
</tbody>
</table>

Selection of Earned Value Techniques

In earned value management the time-phased distributed budget is made up of the sum of the cost accounts. Cost accounts come in two distinct flavors: discrete and level of effort.

The earned value technique and milestone definition are part of the performance measurement baseline.
There are four rules that apply to the calculation of earned value:

1. Performance measurement must take place at the lowest possible level (work packages) and must be objective.
2. The calculation of earned value (BCWP) must be done using methods consistent with the way the plan (BCWS) was established.
3. Once the BCWP is reported to the customer and to management no retroactive changes may take place except for the adjustment of legitimate accounting errors.
4. Each work package has a single earned value technique.

At this point we have already completed the following:

- Master program schedule, intermediate schedule, and detailed schedules
- Work breakdown structure and attendant dictionaries
- Responsibility assignment matrix
- Cost accounts and work packages
- Resources identified and assigned to activities
- Each work package has been assigned one earned value technique

During this phase the following efforts must be completed:

- Identify earned value technique for each work package
- Identify earned value milestones for each work package
- Review assigned techniques for adequacy
- Review and approval of baseline data

There are basically six major types of earned value techniques.

1. X/Y techniques
   a. 0/100 (usually 1 month or less)
   b. 25/75 (2 months or more)
   c. 50/50 (2 months or more)
   d. 40/60 (2 months or more)
2. Milestone weights
3. Milestone weights with % complete
4. Percent complete
5. Apportioned effort
6. Level of effort

Of the above six types of earned value techniques all are discrete with the exception of number six, level of effort. A discrete milestone has a definite, scheduled occurrence in time.
Discrete work packages can be thought of as being in three distinct categories:

1. If the work package is in the future, and has not yet started, then BCWP = 0% of the BAC. This implies no credit has been awarded for work performed.
2. If the work package is in progress, then BCWP will be greater than 0% but less than 100% of the BAC. Remember, 100% means all work is complete.
3. If the work package is complete, i.e., no work remains to be completed, then BCWP will be 100% of BAC.

_X/Y Technique_

In the X/Y technique some percentage of full credit is earned on initiation of the activity and the remainder of the performance credit is earned on completion. The milestone signifies the initiation and completion of the activity.

If the activity is one month in duration then a 0/100 technique is most appropriate. If the activity is planned to occur in two subsequent periods then the X/Y method that most closely resembles the planned level of effort (BCWS) should be used.

Figure 9.12 depicts an example of this type of technique. Figure 9.12 is an example of a 25/75 application.

The point illustrated by this example is that 25% of the total performance credit is earned when the activity begins and 75% performance credit is earned
when the activity is completed. Note that performance credit, when discussing X/Y methods, is always associated with start or completion milestones.

Again, in example #2 the completion did not occur on the scheduled completion date even though BCWS (S) indicated it should have. The performance credit therefore was not awarded until one period later, when the work was complete. As before, since the amount of performance credit, that should have been earned at the original completion date was not the same as the amount of credit actually earned (P) we can immediately tell that we have a schedule variance from plan.

**Milestone Weights**

Milestone weights mean that some predefined weight has been assigned to each milestone in the activity. The amount of performance credit earned is the weight of the milestone times the total amount of performance that could be earned for the entire activity.

Milestone weights are used if the activity is greater than two months. In this scenario monthly milestones are recommended. Figure 9.13 depicts an example of the milestone weights technique.

Notice that “S,” the planned effort, represents the dollars required to accomplish the respective milestone. “P,” the planned performance credit, is earned when the milestone is completed. In the event a milestone slips out in time performance credit “P” will be earned when the milestone is completed.

What is a sufficient milestone? A milestone should be:

- Objective—milestones should be explicitly defined based upon a predetermined criterion or a tangible product.

<table>
<thead>
<tr>
<th>MONTH ONE (JUNE): BEGIN WORK</th>
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<tbody>
<tr>
<td>1 △</td>
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<tr>
<td>S</td>
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<td>P</td>
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<table>
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<tr>
<th>MONTH TWO (JULY): COMPLETE MILESTONE #2</th>
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</thead>
<tbody>
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<td>1 △</td>
</tr>
<tr>
<td>S</td>
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<tr>
<td>P</td>
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*Figure 9.13.*

*Example of Milestone Weights*
• Auditable—the value of work associated with a milestone should be determined by quantitative analysis producing a result that is repeatable.

Milestone Weights with Percent Complete

Basic practices of this technique are:

• Used if an activity is greater than two months
• Used if each milestone represents the completion of products with essentially equal value
• Milestones are monthly (recommended)
• Work performance is based on an objective measurement of how much work toward the milestone has been accomplished
• Requires objective measurable milestones

The utilization of this technique requires an objective measurement criterion. For example: we are building 100 widgets in the factory. The plan calls for 20 per month. Each milestone has a value of 20 widgets. If we only build 18 the first month 90% of the milestone value is reported as earned value (BCWP).

Figure 9.14 provides an example of this technique.

Referencing this figure, for simplicity of discussion, let’s assume for milestone #1 that 100 units, each valued at $1.00, are to be completed. By milestone #1, only 85 units are complete, therefore $85 of performance credit is awarded. By mile-

![Month 1 Status](image)

<table>
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![Month 2 Status](image)

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<td>90</td>
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</table>

*Figure 9.14.*

*Milestone Weights with Percent Complete*
stone #2, 90 units more have been completed. Note that of the 90 units completed 15 went toward the first 100 in milestone #1 and 75 went toward the 100 units of milestone #2.

**Percent Complete**

Basic rules for the percent complete earned value technique are:

- Used if activity is greater than two months.
- Work can be divided into objective factors. For example, number of drawings completed divided by the total number of drawings planned.
- A formula is required that computes performance as a percentage of total BAC. The formula is established at the time the technique is selected and must be recorded in the work package dictionary. The formula must be applied consistently over the life of the work package.

This approach allows for a monthly estimate of the percentage of work completed always on a cumulative basis. This technique, while initially appearing to allow for varying degrees of latitude in subjectivity, is actually utilized only with an attendant, objective, quantifiable formula for determining the progress of the effort. Examples of situations in which this technique is applicable include lines released and drawings issued.

**Apportioned Effort**

Apportioned effort should be used when the activity is greater than two months. It should also only be used when a task has a direct relationship to another task.

Apportioned efforts are those efforts that have a direct performance relationship to some other discrete activities, called their reference base. When determining either the monthly or cumulative earned performance credit (BCWP) for the apportioned effort the value will always reflect the same percentage as its referenced base.

With respect to schedule variances, apportioned effort always reflects the position of the related base work package. With respect to cost variances, however, they reflect their own cost performance as related to the earned performance credit (BCWP) of their respective bases. Figure 9.15 depicts the utilization of this technique.

What is apportioned is the performance credit (P) of the work package to that of the reference-based work package, i.e., if the referenced-based work package receives 10% performance credit, then the apportioned work package will receive 10% performance credit.
Cost Account Plans

The last activity in the program management planning process is the generation of cost account plans. This activity is represented here as a post-contract award activity because final contract information related to requirements, schedules, and costs is not known until after the contract has been awarded/definitized. Although it is possible to create cost accounts prior to contract award, these cost accounts would have to be revisited after contract award. Creating cost accounts prior to contract award provides little benefit.

The cost, schedule, and technical performance measurement baseline is not complete until the cost accounts have been generated.

Generating cost account plans involves the detailed planning of the contract statement of work, budget, and schedule, via work packages and planning packages. A cost account is a control point for cost, schedule, and performance planning; work execution; and performance measurement. Cost account responsibility is assigned to a cost account manager. Cost accounts contain information about the work to be accomplished, milestones, milestone techniques, predicted start dates, and any resources associated with the work.

Successful completion of this process concludes the planning phase of the program management process and therefore establishes the program’s performance measurement baseline.

Figures 9.16 and 9.17 depict an example cost account plan and the process for generating the cost account plans. Note that the example in figure 9.16 is specific
**Figure 9.16. Example Cost Account Plan**

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</table>

**Tasks Details:**
- DOE: Document
- DOE: Specification
- DOE: Design
- DOE: Detailing
- DOE: Finite Element Analysis
- DOE: Testing

**Notes:**
- Project Schedule:
- Milestone Dates:
- Project Management Plan:
- Risk Management Plan:
- Cost Control Plan:

**Project Timeline:**

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</table>

**Project Notes:**
- Budget:
- Timeline:
- Quality Control:
- Safety:

**Contact Information:**
- Project Manager: John Doe
- Client: ABC Corporation
- Phone: 123-456-7890

**Sponsorship:**
- Funding Source: Federal Government
- Grant ID: 123456789

**Project Goals:**
- Improve efficiency
- Reduce costs
- Enhance product quality

**Risk Management:**
- Identified Risks:
- Mitigation Strategies:

**Project Status:**
- Status:
- Approval:
- Milestones:

**Document Control:**
- Version Control:
- Change Control:

**Conclusion:**
- Summary of Achievements:
- Lessons Learned:
- Recommendations for Future Projects:

---

Endnotes:

**References:**

---

**Appendix:**
- Project Team:
- Stakeholders:
- Financial Reports:

---

**Glossary:**
- DOE: Design
- DOE: Specification
- DOE: Test

---

**Acronyms:**
- DOE: Design
- DOE: Specification
- DOE: Testing

---

**Tables:**
- Task Allocation
- Resource Allocation
- Milestone Dates

---

**Figures:**
- Example Cost Account Plan
- Project Timeline
- Task Details

---

**Diagram:**
- Flowchart of Project Cycle
- Gantt Chart of Project Schedule
to a given tool and company. It is provided here for example purposes only. As other systems and other tools are used, the format will be different.

Cost account plan detailed processing, as depicted in figure 9.17, consists of the following subprocesses.

1. The cost account manager schedules and costs all resources, utilizing the work package descriptions from the extended CWBS dictionary and human resource plan. There are eight steps in this subprocess:
   a. Scheduling resources by month in accordance with the planning package/work package level.
   b. Specifying each human resource item by resource code.
   c. Identifying, in the performing department field, the specific human resources required to execute a planning package/work package (this identification should be used consistently wherever this resource appears).
   d. Leveling the resource loading for the cost account by adjusting planning package/work package schedules where schedule float exists (peaks or valleys in the resource loading should be resolved by changing planning package/work package dependencies and durations when possible).
   e. Providing the list of scheduled resources to the project accountant, who generates the resource costs for the cost account; these costs make up the package's budgeted cost for work scheduled).
f. Determining whether the target cost is exceeded, i.e., whether the planned cost account budget at completion exceeds the target cost.
g. Determining whether cost reduction has been attempted by:
   i. Substituting lower cost resources
   ii. Using alternate plans, including rescheduling
   iii. Minimizing the work to meet the requirements
   iv. Reevaluating the interpretations of the requirements to ensure the requirements are satisfied but not exceeded
   v. Reevaluating the cost/risk tradeoffs
h. Determining whether detailed schedules need to be changed, i.e., whether resource leveling violates the detailed schedules.

2. The cost account manager(s), program manager, and functional organizations resolve the cost account scope if the target cost is exceeded and cost reduction has been attempted by the cost account manager. This activity consists of three steps:
   a. Waiting until all cost account managers have completed the scheduling and costing of all resources.
   b. Exploring the potential for an increased cost account target cost.
   c. Exploring the potential for a reduction in cost account scope.
      (If requirements have changed, then the requirements database needs to be changed. If cost account target costs have changed, then target cost in the responsibility assignment matrix may need to be reallocated, otherwise work definition changes.)

3. The cost account manager and the project accountant assign an earned value technique and define the earned value milestones. This activity follows the program manager’s approval of the human resource plan for the cost account, the intermediate schedule, and the cost account budget. It consists of seven steps:
   a. Evaluating planning packages (earned value techniques/milestones are only required for work packages, not planning packages, because performance is not measured against planning packages)
   b. Specifying a single earned value technique for each work package
   c. Providing a description for each earned value milestone that is documented as part of the cost account plan; is explicit and based upon predetermined criteria or a tangible product; and is quantified such that the result is repeatable
   d. Selecting the percent complete earned value technique for material cost accounts/work packages
e. Scheduling earned value milestones associated with travel in relation to the technical work that they are supporting

f. Evaluating the earned value techniques, earned value milestones, and the cost account plan (earned value techniques are correct when they meet the requirements stated in company guidelines; earned value milestones and attendant descriptions are correct when they are defined in accordance with the requirements stated in this activity; the cost account plan is correct when the cost account manager has confirmed its completeness and accuracy in accordance with the organization’s program management process)

g. Updating the extended CWBS dictionary whenever a work package description is modified.

4. The program manager and the project accountant establish cost and schedule variance thresholds. Cost and schedule variance thresholds should:

a. be imposed by contract and/or by the program manager;

b. be established within one of several time frames: cumulative to date, reflecting performance on a cumulative or total basis through the current reporting period; the current month, focusing only on the last accounting month of performance; or the variance at completion, which incorporates all actuals to date and makes a projection to the end;

c. be determined by establishing plus and minus percentage and dollar amounts with respect to functional organization, element of cost, level of extended CWBS, and stage of the program;

d. be communicated via a program directive.

(The establishment of higher thresholds for under-run or ahead-of-schedule conditions should be considered to minimize the generation of analyses and explanations of variances that do not have potential for adverse impact.)

5. The cost account managers, functional organization(s), and the program manager approve the cost account plans by signing them. This becomes a contract between the cost account manager and program manager and authorizes the work.
It must be remembered that there is nothing more difficult to plan, more doubtful of success, more dangerous to manage, than the creation of a new system. For the initiator has the enmity of all who would profit by the preservation of the old institutions and merely lukewarm defenders in those who would gain by the new ones.

—Niccolo Machiavelli

**Execution Phase**

A great deal of the thought in this chapter comes from the work of Quentin Fleming (Fleming 1992, 106).

Once the performance measurement baseline has been established the next step is to monitor and report progress against the plan. While it might seem fitting to do a comprehensive review of all cost and schedule budgets a more efficient way is to monitor performance on an exception basis, commonly referred to as management by exception.

In a management cost/schedule control system, performance variances cause particular attention to be focused only on those areas which have exceeded reasonable, previously set limitations. These reasonable limits are called variance thresholds and are nothing more than outer limit cost and schedule parameters. Any time such parameters or thresholds are exceeded the management cost/schedule control system procedures call for a special type of analysis to take place and for formal reporting of the results of the analysis to the customer. These special analyses are documented in what’s called variance analysis reports (V ARs) or sometimes performance analysis reports (PARs). Therefore, in a management cost/schedule control
system, when a performance threshold has been penetrated beyond a previously agreed limit a flag is waved indicating that some form of action is required.

The customer, behaving in much the same manner as the program manager, sees only a small portion of these variance analyses reports. The customer therefore is also managing by exception, only at a higher level. Internal to the company, however, program management may go through all variances to assess their full impact to the program and take corrective action before the problem becomes sufficient enough to be raised to the customer.

Variance thresholds may be expressed in either absolute terms (for example, $10,000 over or under a budget value, or 10 days ahead or behind schedule) or as a percentage of some particular base (for example, 10% ahead or behind a cost value or schedule date). Positive variances, an under budget or ahead of schedule condition, are sometimes allowed to exist at twice the value of a negative condition. This is true because typically positive variances are more likely related to a poor plan than to poor performance. However, there is no universal agreement on this issue and many organizations set the same threshold values for both positive and negative variances. A chronic positive performance condition could be reflecting a more fundamental problem (for example, the basic method for planning the work in the first place, i.e., the distribution of effort in the work scheduled [BCWS]).

During the contract’s performance period, management cost/schedule control system variance thresholds may be tracked at three distinct points of reference:

1. Cumulative to Date—reflecting performance on a cumulative or total basis through the current reporting period.
2. Current Month—focusing only on the last month of performance.
3. Estimate at Complete—which incorporates all actions to date and makes a projection to the end of the program.

It is not uncommon for the buying customer to impose thresholds at the cumulative to date point and, if it’s a government customer, for all three points to be imposed. There is a group of management cost/schedule control system followers that believe reporting at all three points is excessive. This group takes the position that cumulative to date thresholds are all that is required for good performance monitoring. They claim that the current month threshold is too prone to accounting fluctuations to measure progress and results only in excessive paperwork (VARs).

As well, there is mixed opinion on the value of setting estimate at complete (EAC) thresholds. Some claim that the EAC is too subjective. However, since one of the primary purposes of imposing a management cost/schedule control system is to obtain a reliable EAC it seems a weak argument to argue that EAC isn’t worth monitoring.
We need to also remember that a management cost/schedule control system is a quantitative tool to assist the program manager in managing his/her program. By itself, it is not the entirety of the skills or tools required to manage a program effectively.

A variance analysis report will vary significantly in format as the tool and the organization change. Figure 10.1 depicts an example of a company- and tool-specific variance analysis report.

There are a few things to take note of in figure 10.1.

1. All of the formulas are properly displayed so that anybody reading the VAR can tell how the figures were calculated.
2. Monthly and cumulative (cum) numbers are provided for each primary activity, in this case the PES project level and the software development effort.
3. Notice also the thresholds on the right side of the form. There are no standard thresholds for the industry. Each customer or, minimally, the contractor imposes these prior to contract award. It is, as stated above, the manner in which management by exception takes place and therefore is subjective and up to the program manager, and/or the customer. The program manager might, in some cases, set tighter thresholds than the customer so that the program manager will see a problem before it hits the customer’s higher level thresholds.

All variance analysis reports should meet four basic requirements.

1. They should be prepared by the responsible cost account manager, the one closest to the variant condition, and not by an outside planner, scheduler, or budgeter.
2. They must explain separately each cost and schedule variance and its present and potential impact to the program.
3. They should state the actions taken, or to be taken, to solve the problem.
4. The variance analysis report should be reviewed with, and approved by, the next-higher level of management.

The formalization of the variance analysis process requires that a contractor go through a series of defined steps any time performance is outside tolerance. It also requires that such analysis be documented so that a contractor’s program manager and, if required, the customer may trace through each problem area at a subsequent date.

In summary, variance thresholds:

- Are pre-established at the beginning of the program
Identify areas requiring management attention
• Need not match the contract thresholds set by the customer
• Can be changed over time

A variance analysis report:
• Is required when variances exceed the thresholds
• Analyzes at the cost account level
• Is a memo for the record

As part of the variance analysis report, causes of the problem must be reported. When discussing the cause of the problem:

• Discuss cost variance and schedule variance separately
• Clearly identify the reason for the variance
• Isolate significant labor rate variances
• Place emphasis on the qualitative, not quantitative, aspects of the problem
• Place emphasis on the specific, not the general
• Place emphasis on only the significant problems, not all problems

When discussing the impact on the program:

• Describe the specific cost, schedule, and technical impact to the program
• Address the intermediate schedules
• Describe the impact to other cost accounts
• Assess the need to revise the estimate to complete the job

Under the corrective action planning portion of the variances analysis report:

• Describe specific actions to be taken to alleviate or minimize the impact of the problem. Examples of poor corrective action plans:
  ▪ None required
  ▪ I plan to work harder
  ▪ I should be able to make up the overrun downstream
• Include the individual or organization responsible for the required action
• Include schedules for the actions and get-well dates
• If no corrective action is possible, explain why
• Include results of corrective action plans from previous variance analysis reports
• Examples of poor causes cited for variances include:
  ▪ This cost account is overrun because I spent more than I planned
  ▪ I am overrun because engineering charged more hours than we had agreed
  ▪ I am overrun because I worked more hours than I planned
  ▪ I used more computer time than I planned
It took longer than I thought

In government contracting, there are three primary management cost/schedule control system report types:

- **Contract Funds Status Report (CFSR)**—Prepared by accounting and the program manager to advise the customer of the funds spent and funds remaining to complete.
- **Cost Performance Report (CPR)**—Prepared by the program manager to explain the status of the program, reasons for variances from plan and corrective action undertaken. Requires written analysis of current and cumulative to date variances.
- **Cost/Schedule Status Report (C/SSR)**—Prepared by the program manager to explain the status of the program, reasons for variances from plan, and corrective action undertaken. Requires written analysis of cumulative to date variances only.

Figure 10.2 depicts an example of a cost performance report specific to a tool and organization.

There are numerous detailed activities to be performed by either the program manager, administrator/planner, cost account managers, or functional managers. Figure 10.3 depicts these activities in the form of an execution phase responsibility assignment matrix.

**Change Management**

The program management change management process defines the process by which program management identifies and manages the changes that impact the program during planning and execution. This process defines the management and control of the changes to the program baseline, which is established during program planning. Change management provides the planning organization and the program organization (PO) with a methodology to identify external and internal sources of change to determine a change’s impact to the program and to communicate this impact to the customer and upper management in order to begin the process of implementation or elimination of the change.

The change management process is highly dependent upon effective documentation and communication. If the documentation and communication process is not completely implemented the change management process will not be effective. Change identification and communication of change impact are totally dependent upon effective program organization communication and thorough
## Example Cost Performance Report

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
<th>Budget</th>
<th>Variance</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item1</td>
<td>1000</td>
<td>1200</td>
<td>-200</td>
<td>-16.67</td>
</tr>
<tr>
<td>Item2</td>
<td>2000</td>
<td>1800</td>
<td>200</td>
<td>11.11</td>
</tr>
<tr>
<td>Item3</td>
<td>3000</td>
<td>3200</td>
<td>-200</td>
<td>-6.25</td>
</tr>
</tbody>
</table>

**Figure 10.2**
documentation of the change and the events causing the change. All channels of
the program organization communication network must be open and functioning
properly for a change to be detected in time to control its impact.

Another process on which change management is totally dependent is
defining the requirements—in particular the generation of the requirements data-
base. Generation of the requirements database requires the identification of all
program requirements (technical, supportability, cost, schedule, and program-
matic) and the mapping of each identified requirement to an element of work in
the extended contract work breakdown structure (CWBS). It is this process that
provides the basis for determining if, later in the program, a new requirement has
been added or an existing requirement has been deleted or modified.

The change management process is highly dependent upon effective docu-
mentation and communication, and requirements management.

There are three basic strategies for dealing with change:

1. Proactive—based on change control through early identification and resolu-
tion before the change can have an impact on the program. The change
is controlled by planning.

2. Reactive—a reactive strategy relies on detection of the change through
variance analysis after the change has impacted the program. Reactive
strategy employs corrective action.

<table>
<thead>
<tr>
<th>EVM Implementation Task</th>
<th>Functional Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Program Office</td>
</tr>
<tr>
<td></td>
<td>Program Manager</td>
</tr>
<tr>
<td>1. Determine Performance Monthly</td>
<td>P</td>
</tr>
<tr>
<td>2. Coordinate Budgeted Cost For Work Performed (BCWP) Input With Cost Account And Functional Managers</td>
<td></td>
</tr>
<tr>
<td>3. Calculate Budgeted Cost For Work Performed And Input To Cost System</td>
<td></td>
</tr>
<tr>
<td>4. Analysis Of Status Reports</td>
<td></td>
</tr>
<tr>
<td>5. Update Schedules And Evaluate</td>
<td></td>
</tr>
<tr>
<td>6. Review Cost Schedule Plan</td>
<td>S</td>
</tr>
<tr>
<td>7. Prepare Variance Analysis And Estimate At Completion As Required</td>
<td></td>
</tr>
<tr>
<td>8. Request And Review Variance Analysis</td>
<td></td>
</tr>
<tr>
<td>9. Initiate Cost Account Changes As Required</td>
<td>S</td>
</tr>
<tr>
<td>10. Approve Changes to Cost Account Budgets</td>
<td>P</td>
</tr>
<tr>
<td>11. Maintain Baseline Control</td>
<td>S</td>
</tr>
<tr>
<td>12. Update And Review Cost System Plan As Required</td>
<td></td>
</tr>
</tbody>
</table>

P — Primary Responsibility
S — Secondary Responsibility

**Figure 10.3.**
*Execution Phase Responsibility Assignment Matrix*
3. Inactive—an inactive change allows the change to impact the program with no corrective action.

It is the responsibility of each member of the planning organization and the program organization to adopt a proactive strategy toward change. This is accomplished by being aware of the requirements identified in the requirements database (that drive his/her functional assignment) and immediately communicating and documenting any suspected change, whether caused internally or externally, to the program manager.

General requirements for dealing with change in the change management process include:

- A change shall be incorporated into the program baseline only after the contract modification has been negotiated unless otherwise directed by the commercial customer or government contracting officer in writing.
- Incorporating the change only after it has been planned and approved by the program manager.
- Conversion of an informal change to a formal change should occur as soon as it is detected. Informal changes are defined as changes identified via an informal documentation and communication path from either an external or an internal source. The detrimental aspect of informal changes is that they may be incorporated without change to the program baseline and remain undetected until a cost account variance has been exceeded.

Figure 10.4 depicts the change management process.

![Diagram of Change Management Process](image-url)
Identifying the change is the responsibility of each member of the program organization (PO). Any informal changes should be documented in writing. If the change is a contract change the requirement is either:

- New
- A deletion of a requirement
- Modification of an existing change

If the program’s cost, schedule, or performance measurement baseline has been impacted then sometimes an organization will require a special form be filled out called a baseline change request (BCR). It is good practice to use a form of this nature for fully documenting the requested action. Before any action is executed a separate charge number is usually established to capture the accumulated costs associated with determining the impact of the potential change. In all cases the customer should be notified if the change has an external impact.

Figure 10.5 depicts the identify change aspect of the change management process.

The process for identifying the change is executed when a suspected change has occurred to the contract baseline or program baseline. Except as indicated, this activity is the responsibility of the cognizant program organization member utilizing the requirements identified in the requirements database and in the definitized contract and consists of the following:

Figure 10.5.
Identify Change Process
1. Informal Change?—the change requirement(s) is documented in writing when the change is informal.

2. Contract Change?—compare the suspected change with the requirements in the requirements database and the definitized contract. If the suspected change is a new requirement, a deleted requirement, or a modified existing requirement, then a change to the definitized contract has occurred. (Be aware of so-called derived requirements. Each derived requirement should be considered a new requirement [a change to the definitized contract] unless system engineering can demonstrate that the derived requirement is totally in support of an existing requirement.) If the program performance baseline has been affected by the change, either in budget or schedule, then a baseline change request is required.

3. Program Baseline Change?—a baseline change request (BCR) is required when the suspected change alters the program baseline plan identified in the program management planning phase. Otherwise the change management process is stopped.

4. When a definitized contract change has occurred, the change document is provided to the program manager.

5. A separate charge number(s) is established by the cost manager (CM) to accumulate costs for determining the impact of potential changes. The change is entered into a contract change log (CCL) by the program administrator.

6. External Change?—a formal notification of change is prepared by the contract administrator (CA) and submitted to the customer when the change is customer-induced. The CCL is updated to indicate submittal of the notification of change.

When determining the impact of the change it is the responsibility of the program manager and the program organization member to:

- Convene a meeting to discuss the significance of the impact within a reasonable period of time from the change identification. The meeting should include, as a minimum, the impacted program organization members.
- Estimate a rough order of magnitude impact to cost, schedule, and technical performance baseline.
- Determine if impact is negligible. If so, the change might be submitted to the customer as good will. In this case the organization would submit a no-cost change proposal to the customer.
- Submit a change proposal to the customer for any external change requested and make sure the change proposal is accompanied by a request for equitable adjustment (REA).
Figure 10.6
Determine Impact of Change Process

Figure 10.6 depicts the process flow for determining the impact of the change as part of the change management process.

Implementing the change is the primary responsibility of the program manager. The customer, in government contracts, may direct that a change be implemented prior to negotiation under terms of the definitized contract.

If the customer rejects the change proposal then, in government contracts, a request for equitable adjustment may be filed through the claims process as defined by the contract. If no request for equitable adjustment is filed then the work is performed without monetary compensation.

Implementing the change as depicted in figure 10.7 consists of the following:

1. Customer-Directed Change?—when a customer directs that a change be implemented before the change has been negotiated and this direction is allowed under the definitized contract the following should occur:
   a. The PM and cost manager (CM) establish special charge number(s) to segregate the cost of execution of the implemented change.
   b. A request to change the baseline (BCR) is executed using the change proposal’s updated plan to modify the program baseline.
   c. The updated program plan is executed in accordance with the program management process after the baseline change request has been incorporated.
   d. The impact (cost, schedule, etc.) of planning the change before and after negotiation of the change is included in the change proposal.
2. The request for equitable adjustment (REA) and/or change proposal is negotiated in accordance with the bidding process.
3. Definitized Contract Modification?—when the contract modification is received a baseline change request is executed to incorporate the change or, in the case of a directed change (government work only), any modifications to the change proposal as a result of negotiations. The updated program plan is executed in accordance with the program management process after the baseline change request has been approved.

4. REA?—when a customer rejection is received and the change is external, the claims process is executed. The claims process receives as input all formal and informal change documentation produced during the change management process. Otherwise, for internal changes, a customer rejection terminates the change management process.

5. Update the contract change log (CCL) to indicate receipt of the customer input.

Figure 10.7 depicts the process flow for implementing the change as part of the change management process.

**Recognizing Changes**

Effective management of contract changes requires recognition of changes before they occur or as soon thereafter as possible. To recognize changes program management (program manager, contract administrator, program office personnel, and cost...
account managers) must be familiar with: (a) what is required by the contract; (b) the change provisions in their contract; and (c) the law (Federal Acquisition Regulations [FAR], Uniform Commercial Code [UCC], etc.) governing their contract.

When referring to the following text it is imperative that program management recognizes that the company can be either a buyer or a seller, either the prime contractor, subcontractor, or lower tier subcontractor.

To enhance change recognition and processing, answers to these questions are provided in the text that follows:

- What is a change?
- What determines how a contract is changed?
- How do contractual relationships affect changes?
- Why are government contract changes unique?
- Why do changes occur?
- When are changes likely to occur?
- What are the elements of a change?
- What common names are given to the changes?
- What types of change orders occur?
- Who has authority to order changes?
- When can changes be ordered?
- What changes can be ordered?
- What response does a change order require?
- When is changed work performed?
- How does compensation for changes occur?

What Is a Change?

Simply stated, a contract change has the effect of making the work different than (a) required by the contract and (b) planned and baselined in the performance measurement baseline (PMB).

A change does not necessarily imply a requirement for more work. It may require less work or merely different work. If it affects the PMB (e.g., cost, schedule, technical performance, work breakdown structure, or other aspect of performance) it is a change.

These two contexts, the contract and PMB, are both relevant to the change management process. Since the objective of the program management process is to plan, organize, and implement work in conformity with contract requirements, these two contexts, although not identical, are very closely related. Each is equally the concern of the program manager, program office personnel, and cost account managers, for the following reasons:
• Senior management has asserted that programs shall be “managed to the contract requirements.”
• PMB variances frequently provide the first indication that an informal or constructive change has occurred (refer to informal changes or constructive changes below).
• The PMB provides a barrier to performing work that is not required by the contract.

Performance Measurement Baseline

In the performance measurement baseline (PMB) context changes or revisions have the effect of making the cost, schedule, or technical performance different than the planned budget, planned schedule, and/or planned technical performance as defined by cost accounts. “Different than planned” is the operative term.

The PMB forms the baseline for all work authorized by the contract and includes (a) the contract work breakdown structure (CWBS) and its attendant dictionary; (b) the responsibility assignment matrix (RAM); and (c) all approved cost account plans. Cost account plans and their associated work/planning packages define (in terms of planned budget, schedule, and technical performance requirements) the work to be performed. The PMB is established at or very near the time of contract award. Once established all changes to the PMB must be preceded by a baseline change request approved by the program manager.

Changes to the PMB may be necessitated by contract changes or by internal conditions that require replanning within the scope of the contract. Scope, as it applies to the PMB, is bounded by three parameters: the contract budget base, the contract schedule, and the contract performance requirements.

Internal conditions causing the work to be different than planned and requiring changes to the PMB are cost, schedule, or technical problems that have caused the original plan to become unrealistic. Therefore, one requires (a) reorganization of the work or people to increase efficiency of operations or (b) different engineering or manufacturing approaches than originally contemplated.

Whenever a significant variance occurs, or replanning becomes necessary, the cost account manager should perform an in-depth review of cost, schedule, and technical problems to determine if any informal changes have occurred.

Contract

From a contract perspective the change management process is concerned with any change that has the effect of making the work different than required by the contract. The operative words are required and by the contract.
Contract changes fall into two broad categories: formal and informal. For more detail refer to: “Formal Changes,” “Formal Change Orders,” “Informal Changes,” and “Informal Change Orders” (pp. 181, 182, 185).

The contract is the paper or papers that collectively contain the parties’ agreements concerning the work that is to be performed and includes the following:

- A specification and/or statement of work
- Deliverable contract line items (CLINs) and a contract data requirements list (CDRLs)
- Delivery schedule
- Price (ceiling, target, or both) for fixed-price contracts or cost (target, ceiling, or both) for cost-reimbursement contracts
- All specifications and standards incorporated by reference
- When so stipulated by the contract, the contractor’s proposal
- Any other documents which form the basis for the agreement
- An order of precedence for contract documents

**Government Contracts**

Many government contracts are completely formed (definitized) at the time of award, when the contract is signed by both parties. Anything prepared or referenced at a date later than contract award, or any subsequent desire, suggestion, or direction expressed by a customer representative, is not generally part of the contract.

Government contracts not completely formed (definitized) at the time of contract award include indefinite-delivery, time and materials, labor-hour, letter contracts, and agreements (basic ordering agreement [BOA]). These contract types are definitized subsequent to contract award via a bilateral (negotiated) contract modification at a time determined by the contracting officer. Between contract award and contract definitization, desires, suggestions, or directions expressed by a government representative may be part of the contract. Prior to incorporating any new work or changed work into the PMB the contract administrator shall obtain written confirmation from the contracting officer.

**Commercial Contracts**

In commercial contracting it is much easier to enter into or change a contract. Absent specific contract language to the contrary, any change, whether written or verbal, that is offered and accepted in good faith by parties having either actual or
apparent authority constitutes a contract (new or revised). It is literally possible to fall into a contract. Therefore, in commercial contracting it is imperative that the program manager, program office personnel, and cost account managers understand and adhere to their contract change provisions, especially when discussing planned or actual changes.

**What Determines How a Contract Is Changed?**

A contract’s changes clause or provisions determine how contract changes will be accomplished. Contracts involving the government are significantly different than most commercial contracts.

**How Do Contractual Relationships Affect Changes?**

Prime contracts with the government are governed by the Federal Acquisition Regulations (FAR) and some variant of the FAR. The FAR includes several types of changes clauses which may be used with one or more contract types.

Subcontracts with government prime contractors or one of the prime’s subcontractors are unique forms of commercial contracts in that FAR clauses may be flowed down from the prime’s contract. Alternatively, the subcontract may include change provisions or clauses very similar to the government’s clauses.

Contracts with other governments are treated as government contracts if they are foreign military sales (FMS) or U.S. Government financed. Otherwise they are commercial contracts and the change provisions are whatever the parties agree to in the contract.

Commercial contracts include any change clauses or provisions agreed to by the parties. Typically changes are agreed to by the parties prior to performing the change and neither party has the right to unilaterally direct or make a change. Any change implemented or demanded without mutual agreement constitutes a breach of the contract.

**Why Are Government Contract Changes Unique?**

Government contract changes are substantially different than most commercial contracts in the following regards:
• The government can unilaterally issue a change order for in-scope changes without prior contractor approval.
• The contractor has a duty (legal obligation) to perform in accordance with the change order.
• The contractor is obligated to provide the government a written notification of change for any change.

Why Do Changes Occur?

From program management and change management perspectives it is very important to know whether a change is internally (the company) or externally (buyer or seller) driven.

Changes are frequently initiated by both the buyer and seller because of:

• Information unknown at the time of contract award that later becomes available (e.g., defective specifications, impossible requirements, superior knowledge, etc.)
• Differing interpretations of a requirement
• Bid or solicitations mistakes
• Overly optimistic estimates
• Unanticipated limitations on funding
• The urgency of the requirement (e.g., acceleration of performance)
• Advances in technology
• Requirements that are either ambiguous, inconsistent, or inaccurate

An ambiguity is more than a mere disagreement; it is an uncertainty of meaning (e.g., a requirement is either vague or easily interpreted in multiple ways). An inaccuracy is an error (e.g., 10 seconds vs. 1.0 second). An inconsistency exists when a requirement has been defined more than once, the definitions differ, and the difference cannot be resolved by application of document precedence (e.g., the system spec states: [a] The radio shall weigh 10 lbs. maximum; and [b] The radio shall weigh 5 lbs. maximum).

Internally Driven Changes

Internally driven (ordered) changes are caused by acts or omissions of the party to the contract (i.e., the company) and do not occur at the behest of the customer, a subcontractor, or some other outside force.

Internally driven changes can affect the company’s contract with the buyer (government or prime), seller (subcontractor), or both.
Certain changes of this type may occur as the result of manufacturing problems, supply problems, labor inefficiencies, or other factors causing negative variances from plan. Others may stem from the discovery or application of an improved or different process or product component resulting in positive variances from plan or in superior performance at no change in cost or schedule. In either case a corresponding change to the performance measurement baseline (program plan) is implied.

Internally driven changes fall into two broad groups: formal and voluntary. Refer to “Formal Changes” and “Voluntary Changes” below (pp. 181, 183).

**Externally Driven Changes**

Externally driven (ordered) changes are caused by acts or omissions of the other party to the contract (i.e., the customer or subcontractor). These are the more commonly occurring and require the most attention by program management.

Externally driven changes can affect the company’s contract with the buyer (government or prime), seller (subcontractor), or both.

Externally driven changes may also occur as a consequence of circumstances that are not the responsibility of the company. Indeed, certain external changes may occur which are neither the responsibility of the company, its customer, nor its subcontractor. Included in this type are acts of God or of the public enemy (fires, floods, epidemics, strikes) to the extent that such causes are unforeseeable and beyond the control, fault, or negligence of the parties.

Externally driven changes fall into two broad groups: formal and informal. Refer to the sections on formal changes and informal changes.

**When Are Changes Likely to Occur?**

Changes can occur at anytime during the life of a contract. Changes are more likely to occur: (a) at or immediately following contract award; (b) during reviews or meetings; (c) when the buyer/government furnishes property; (d) whenever there is a failure to cooperate; or (e) during the process of inspecting/testing contract/subcontract deliverables.

**At or Immediately Following Contract Award**

When a contract is awarded on a competitive basis the requirements of the contract awarded may differ from the solicitation requirements that were bid and negotiated.
by the competing parties. Differences usually reflect the customer's desire to improve the contract based on information gained during the competition phase.

**During Reviews or Meetings**

Reviews (program, design, test readiness, CDRL, etc.) or meetings (technical interchange, working groups, etc.) frequently provide a forum for discussing requirements ambiguities, inaccuracies, and/or inconsistencies, as well as differences in the parties' interpretations of requirements.

System requirements reviews (SRR), system design review (SDR), preliminary design review (PDR), and critical design review (CDR) are almost certain to expose requirements ambiguities, inaccuracies, inconsistencies, and/or differing interpretations, which are properly resolved via formal contract modifications executed as soon after each review as possible. It is always in the best interest of the parties to formally resolve issues relating to contractual requirements when they arise. It is imperative that program management (either buyer's, seller's, or both) incorporate changes into their program's performance measurement baseline as soon as, but not before, changes are confirmed by the other party (i.e., buyer or seller) to the contract.

Common attempts at resolving differing requirements interpretations are:

- The buyer (e.g., government) insists the seller (e.g., the company) embrace the buyer's clarifications and perform accordingly.
- To assign one of the parties an action item(s) to analyze the requirement(s) and to either recommend solutions for, or to resolve, specification inconsistencies and inaccuracies.

**When the Buyer/Government Furnishes Property**

Delivery of buyer/government-furnished property (a) later than the date specified by the contract; (b) other than specified by the contract (substitution); (c) not suitable for the intended use; or (d) that is defective is likely to be a compensable contract change.

Impact to contract performance due to operational failures or latent defects incurred during the intended use of the subject property also constitute constructive/compensable changes.

**Whenever There Is a Failure to Cooperate**

The buyer may be said to fail to cooperate when its representatives:

- Fail to take an affirmative act that is needed for the seller to perform the contract successfully.
• Interfere with the seller’s performance.
• Are tardy in acting upon virtually any kind of submittal that is required before seller’s performance can go forward.
• Are negligent in coordinating the work of several sellers who are working simultaneously on the same product.

One area where a failure to cooperate may occur more frequently than others involves contractor/subcontractor data requirements lists (CDRLs/SDRLs). A failure to: (a) submit draft CDRLs/SDRLs to the buyer as scheduled; (b) submit draft CDRLs/SDRLs which are complete and accurate; (c) review draft CDRLs/SDRLs and deliver comments to seller promptly; (d) approve final CDRLs/SDRLs in accordance with contract terms; (e) perform inspections or witness tests in accordance with approved test plans/procedures; (f) perform inspections or witness tests promptly; and (g) accept deliveries in accordance with contract requirements are all likely to constitute constructive/compensable changes.

Program management, especially cost account managers, should be alert to the potential for changes due to their involvement as either a buyer representative receiving and using data from subcontractor(s) (SDRLs), as a seller representative submitting data (CDRLs or SDRLs) to their customer, or both. Involvement will include (a) either generating or reviewing documents or both; or (b) generating comments, incorporating comments, or both.

During the Process of Inspecting/Testing Contract Deliverables
In the process of inspecting or witnessing testing of contract deliverables the government sometimes imposes requirements that go beyond contract terms. Government inspectors or witnesses may impose a higher standard of performance, improperly reject work, interfere with performance, or enforce (mandate) excessive test requirements. Any of these actions are likely to constitute constructive/compensable changes.

What Are the Elements of a Change?
Changes are made up of two elements: the change element and the order element.

Change Element
The change element may describe the change requirements in terms of why, what, when, how, and/or available fund or agreed-to price.

In general, the change element relates to the difference between (1) the work as the parties bargained for when the contract was awarded or when the contract was
last modified and (2) the work to be performed, or the work being performed, or both.

Changes have been given a variety of common names, which relate to the change element, e.g., cardinal change implies an out-of-scope change (for more detail refer below to the sections on cardinal changes and out-of-scope changes).

As it relates to constructive change doctrine, the change element is:

- That part of the actual performance that went beyond the minimum standards demanded by the terms of the contract ordered by the government
- Any interpretation of the contract that is either incorrect or unreasonable, making the contractor’s work more costly.

**Order Element**

The order element identifies whose acts or omissions caused the change. There are several types of changes orders. Refer to the below section “What Types of Change Orders Can Occur?” (pp. 183–85).

**Common Names Given to Changes**

Changes are frequently referred to as cardinal, compensable, constructive, formal, etc. Each name generally reflects a single aspect of a change. Therefore, it is likely that several names will apply to a single change, e.g., an informal change may also be called a compensable change, a constructive change, and an in-scope change.

Some common names given to changes with their meanings, are as follows:

**Administrative Changes**

Administrative changes are not changes that affect either the change management process or the PMB, as they do not affect the work performed or the substantive rights of the parties. Examples include changing mailing address, the paying office, etc.

**Cardinal Changes**

Cardinal changes are out-of-scope changes that constitute a breach of government or commercial contracts. Refer to the section below on out-of-scope changes.
Compensable Changes

Compensable changes are changes meriting an adjustment to the contract price, or schedule, or both, to provide the damaged party or parties consideration for changed performance. Note: both parties may be entitled to consideration.

Constructive Changes

Constructive changes are a special category of informal changes existing only within government contracting. Constructive changes are never formal, they are seldom readily identifiable as a change, and they do not originate from procedures designed to contain their effects. Constructive changes may not be identifiable until their cost and schedule impacts are noticed and attributed to an act or omission of the government.

The constructive change is a legal artifice of government contracting which the courts have used to maintain certain of the parties’ rights and obligations under a contract in spite of government conduct which would, in a commercial contract, be construed as a breach of contract. See also “Constructive Change Orders,” “Constructive Notice,” and “Recognizing Constructive Changes.”

Engineering Changes

An engineering change proposal (ECP) is prepared for any change in the program technical baseline that affects the contract. This applies equally to unsolicited and solicited (or directed) ECPs. The format of an ECP is in accordance with the contract, customary practices of the general or business area manager, or as specified by the customer, as applicable.

Formal Changes

Formal changes include documentation that, as a minimum, specifies what is to be changed. Formal changes may also include when and/or how the change is to be implemented, a price negotiated, and delivery scheduled. Refer to the section below entitled “Formal Change Orders” (p. 185).

For government contracts formal changes are documented using a Standard Form 30, Amendment of Solicitation/Modification of Contract, or by telegraph under unusual or urgent circumstances (FAR 43.201©). Formal changes may be referred to as bilateral or unilateral contract modifications. Refer to the sections below dealing with unilateral changes (pp. 183, 185).

For commercial contracts methods for implementing contract changes are
prescribed by, and specific to, each contract. Formal changes are executed in writing and signed by authorized persons representing the parties prior to performing the changed work. The change document typically includes the negotiated change, price, and delivery schedule.

**Forward Priced Changes**

Forward priced changes are formal changes that are bid, negotiated, and priced prior to the start of work. Priced options are a category of forward priced changes.

**Informal Changes**

Informal changes are (a) often effected by means other than writing, (b) ordered by someone other than the contracting officer, (c) the most likely to threaten a program’s success, and (d) frequently the cause of contract disputes (claims, in government contracting; breach, in commercial contracting).

Informal changes have the practical effect of formal changes in that they (1) reflect the same customer intent to influence performance as would a formal change, and (2) they require adjustment to, or result in a variance relative to, the current performance measurement baseline. Informal changes, by their very nature, often do not clearly reflect a corresponding intent to adjust the contract price or schedule to accommodate the changed performance.

In government contracting, informal change includes a special category, constructive changes. Refer to the section on page 184.

In commercial contracting, informal changes are synonymous with voluntary changes (refer to section entitled “Voluntary Changes”). Such changes frequently occur as a result of conversations between engineers representing the parties or as a result of a business decision involving customer relations.

**In-Scope Changes**

In-scope changes apply to government contracts only.

In-scope changes are considered to be within the general scope of the contract so long as the modified job is essentially the same work as the parties bargained for when the contract was awarded. As an example, supplying 500 radios versus 50 radios is essentially the same work.

**Negotiated Changes**

The preferred way of amending a contract is through a negotiated change. Such changes meet the same tests of validity as does the underlying contract, e.g., some aspect of (changed) performance is promised or allowed in exchange for some
valuable consideration and the agreement is freely entered into by both parties without coercion on either side (i.e., the change is not directed).

In government contracting negotiated changes are bilateral changes. For commercial contracts, negotiated changes may be either formal (written) or informal (oral). However, formal changes are preferred as a matter of policy for obvious reasons.

**Out-of-Scope Changes**

Out-of-scope changes constitute breach of contract for both government and commercial contracting. The legal department should be consulted prior to notifying the customer that a change is out-of-scope.

In government contracting out-of-scope changes are considered outside the general scope of the contract as they have the effect of making the work as performed essentially not the same work as the parties bargained for when the contract was awarded. An example is the development of a general purpose computer versus the development of a radio. Changes of this type are frequently confused with in-scope changes or informal changes.

In commercial contracting, out-of-scope changes are any changes not agreed to by the parties prior to their implementation (price of the change need not be discussed).

**Unilateral Changes**

Unilateral changes include (a) administrative changes; (b) change orders in accordance with the contract changes clause; (c) changes authorized by clauses other than changes clause (e.g., property clause, options clause, suspension of work clause, etc.); and (d) termination notices.

**Voluntary Changes**

Voluntary or volunteered changes occur when one party provides, and the other accepts, a different (usually higher) level of performance than required by the contract without consideration and without actually changing the contract.

Performing work pursuant to a change order issued by someone who is not the contracting officer may be interpreted as performing volunteered work.

Voluntary changes are the opposite of compensable changes and are often confused with informal changes.

**What Types of Change Orders Can Occur?**

Changes to contracts may be ordered in substantially different ways depending on whether the contract is government, commercial, or a mix of government and
commercial. Each type supports different conventions with respect to unilateral (directed) changes, duties of the parties, scope of the contract, etc.

Government contracts with prime contractors and prime contractor contracts with subcontractors generally include a changes clause that permits the government to unilaterally order in-scope changes to the contract.

Constructive Change Orders

Constructive change orders can occur: (a) as the result of contacts between government and the company employees; (b) when the government requires the company to follow defective government-furnished specifications; or (c) when government-furnished property is furnished late or in a condition that is unsuitable for its intended use.

During the performance of a government contract there are frequent contacts between employees of the government and the company on many facets of the contract work. Any one of these contacts can give rise to: (a) a constructive order, written or oral, to perform work, but not specifically identify the work as a change to the contract, and (b) liability for a constructive change.

The most common variety of constructive change order occurs when the government insists that the company follow an interpretation of the contract (frequently referred to as a clarification) that calls for a more expensive level of performance. It is an axiom of government contract law that a contractor is entitled to follow the least expensive means to achieve the specified performance of the contract.

As a general rule clarifications are compensable changes whenever something more is required of the contractor than the least expensive, reasonable, and logical interpretation of the contract terms permit. Two possible exceptions are: (a) when the contractor fails to seek clarification of known patent or obvious ambiguities prior to contract award, and (b) the contractor’s current interpretation is not consistent with interpretations stated or implied in the contractor’s proposal or during negotiations.

Action item resolution frequently calls for a more expensive level of performance. Accordingly, action item resolution is likely to be a compensable change. Compensable efforts include (a) effort to arrive at a mutually acceptable resolution, and (b) effort to incorporate the acceptable resolution into the performance measurement baseline (changed performance).

Government Directives

Government directives may be formal change orders or constructive change orders, the difference being determined by the authority of the person ordering the change. Refer to the sections in this chapter “Formal Change Orders,” “Informal Change Orders,” and “Who Has Authority To Order/Make Changes?”
Formal Change Orders

Formal change orders are those that are executed in writing by someone specifically authorized to modify the contract. Distinctions between formal and informal changes differ significantly between government and commercial contracting.

In the case of the government, contracting formal change orders may only be issued by the principal contracting officer (PCO) or by the administrative contracting officer (ACO) when authority has been delegated to the ACO in writing. Formal government change orders are accomplished by use of the Standard Form 30 (SF 30) Amendment of Solicitation/Modification of Contract or by telegraphic message under unusual or urgent circumstances, provided that certain criteria are met. Change orders may be effected by bilateral or unilateral contract modifications. Because the government’s right to make changes is provided in the contract changes clause, neither consent of the contractor nor new consideration is necessary for a change order to be issued. Similarly, disagreement on an equitable adjustment does not render the change ineffective. Refer to the section on unilateral contract modifications below.

In the case of commercial contracting it is much easier to change the contract. Absent specific contract language to the contrary, any change, whether written or verbal, that is offered and accepted in good faith by parties having either actual or apparent authority constitutes a new contract. It is literally possible to fall into a contract. Therefore in commercial contracting a formal change order is a change order enacted within the provisions of the contract. Informal change orders are treated as either a contract breach or a voluntary change. Refer to the section in this chapter entitled “Who Has Authority to Order Changes?”

Unilateral Contract Modifications

Unilateral changes (or unilateral modifications) are unique to government contracts and afford the government the ability to order in-scope changes to the contract without the contractor’s consent. Further, the contractor has a duty to proceed; that is, he must execute the change order or be held in breach of the contract.

Informal Change Orders

For government contracts, refer to sections above entitled “Constructive Change Orders” and “Government Directives.”

For commercial contracts the company should respond in the same manner as prescribed for formal change orders.
Who Has the Authority to Order Changes?

Authority to order contract changes varies significantly between government and commercial contracts. Laws recognize several doctrines relating to authority: actual, implied, and apparent (or ostensible).

**Government Contracts**

The company’s program managers, contract administrators, and cost account managers must be aware of (a) the authority of the various government personnel with whom they deal, such as contracting officer (CO), administrative contracting officer (ACO), contracting officer’s technical representative (COTR), program manager, project engineers, inspectors, and the like, as each person has specific limitations (i.e., actual authority) regarding what they can and cannot do; and (b) each company representative’s signature authority, as well as the authority they and other program personnel exercise or induce the government or subcontractors to reasonably believe exists.

**Government Team**

It is the company’s responsibility to ascertain accurately that a person who purports to act for the government stays within the bounds of his/her authority.

The contracting officer (CO) and, when the CO has delegated authority in writing, an administrative contracting officer (ACO) are the only two government agents having the requisite authority to issue a change order or modify a contract.

Prior to responding to a contract modification or change order issued by the ACO, written delegation of authority is obtained from the CO.

Neither the program manager, the contracting officer’s technical representatives (COTR), nor other agents of the government have the requisite actual authority to issue change orders or direct changes. However, acquiescence, implied authority, and ratification have been found by the courts to be exceptions to the lack of actual authority.

**Acquiescence**—If an authorized official (CO or ACO) does not expressly ratify the unauthorized act of an agent but knows of and does not challenge or impeach the act it may be concluded that the CO/ACO has authorized the act through acquiescence (e.g., if the government PM, COTR, or agent directs a change in the presence of the CO/ACO and his direction is not challenged, it may be concluded that the CO/ACO has authorized the act through acquiescence).

**Constructive Notice/Knowledge**—The CO/ACO may be deemed to have con-
structive notice or knowledge of a fact if (a) he or she would have discovered the fact through the exercise of reasonable care, or (b) the person committing unauthorized acts prepared extensive daily written reports, even though the reports did not indicate to whom they were distributed.

Implied Authority—Implied authority is usually found when the authority appears to be an integral part of the duties that have been assigned to the particular person who required the change. For example, the government employees found to have implied authority have been delegated authority by contracting officers and have been project managers, engineers, inspectors, and other persons who are directly involved in contract administration.

Ratification—Ratification is the adoption of an unauthorized act which results in the act being given effect as if it were authorized originally. Ratification may sometimes be found by the court when the contracting officer normally relies on an inspector and is in constant communication with that person; then knowledge of any change orders issued by the inspector is imputed to the contracting officer.

Contractor Team

The law as it relates to the authority of the contractor team involved in the performance and administration of the contract differs significantly from that of the government team. Two doctrines dealing with contractor team authority are actual and apparent (or ostensible).

Actual Authority—Within the company, signature authority for contracts and bids or amendments or modifications thereto for materials to be furnished or services to be rendered to the U.S. Government (or to any department, agency, or division thereof) or to other purchasers of the corporation for its subsidiaries’ products or services is delegated in writing to various individuals, at varying dollar levels, by the company president.

Signature authority for memorandums of understanding (MOUs), memorandums of agreement (MOAs), teaming agreements, license agreements, license and technical assistance agreements, and joint venture agreements is delegated in writing to various officers of the corporation by the board of directors.

Joint venture agreements must also receive approval of the board of directors.

Information relating to specific individuals and their dollar levels can be obtained from the division contract directorate of the legal department.

Apparent Authority—Apparent (or ostensible) authority is that authority which, though not actually granted, a contractor knowingly permits its agent to exercise, or which the contractor considers the agent to possess.
The company may place an agent of the corporation in a position that gives rise to liability under the doctrine of apparent authority in the following ways: (a) by appointing the agent to a managing position (e.g., contracts manager, project director, etc.) or (b) whenever another party (e.g., the government, a subcontractor, a vendor, etc.) is induced by the company to reasonably believe that such an agency exists even though no actual authority was, in fact, conferred on anyone. If the company fails to correct the erroneous impression of an apparent authority relationship, the company will continue to be liable to third parties who act thereunder in good faith.

**When Can Changes Be Ordered?**

Contracts usually include language (changes clause) which affords both buyer and seller the flexibility to initiate in-scope changes or changes within the general scope of the contract.

Government contract changes clauses provide contracting officers the right to issue written change orders directing the contractor to make changes that the changes clause authorizes the contracting officer to order without the contractor's consent. A government changes clause or similar provision will be included in nearly all contracts involving the government (prime contractor or subcontractor).

For commercial contracts without change provisions, any change to the "work that the parties bargained for when the contract was awarded" constitutes a breach of contract.

**What Changes Can Be Ordered?**

Contract changes clauses are frequently specific as to what kinds of changes can be ordered.

In government contracting, changes that the contracting officer can unilaterally order are specifically delineated in the contract changes clause. Changes clauses vary as a function of contract type. Program management office personnel and cost account managers should ask their contract administrator to identify which of the following changes are permissible on the contract they are performing:

- Specifications (including drawings and designs)
- Drawings, designs, or specifications when the supplies to be furnished are to be specifically manufactured for the government in accordance with the drawings, designs, or specifications
- Statement of work or description of services to be performed
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• Time or place of services to be performed
• Manner or method of performance or work
• Place of inspection, delivery, or acceptance
• Method of shipment or packing of supplies
• Place of delivery
• Amount/type of buyer/government-furnished facilities, equipment, materials, services, or site

For commercial contracts what, when, and to what extent changes will be permitted are as negotiated by the parties to the contract.

What Response Does a Change Order Require?

Notification of all company-initiated changes—formal change orders, informal change orders (including constructive change orders or government directives)—should be given to the customer in writing by the contract administrator within time limitations established by the contract or as soon after receipt or detection of the order as practical.

To ensure timely customer notification, notices can be transmitted in two parts: (a) brief description of the change and identification of the party issuing the order and (b) detailed description(s) of the change(s), its/their impact to work bargained for when the contract was awarded or last modified, and the added cost (dollars and schedule) to perform work in accordance with the change order.

Accordingly, program management office personnel and cost account managers shall notify the contract administrator in writing whenever they believe they are in receipt of a change order (formal, constructive, or directive).

Responses to Formal Change Orders

As a minimum all formal change orders must be acknowledged in writing by the contract administrator within the time limits specified by the contract. Other actions taken by the company will be as specified in the change order or as directed by the business area manager or program management or both.

For government contracts the company is required by law to provide the contracting officer with specific information prescribed by the notification of changes clause (Federal Acquisition Regulation [FAR] 52.234–7).

For commercial contracts, company change notifications shall provide all information required by the contract’s change provisions. In the absence of specific change notification requirements, the contract administrator should provide essentially the same information as required for government contracts.
Responses to Informal Change Orders

When the company considers that the government has effected or may effect a change in the contract that has not been identified in writing and signed by an authorized agent, it is necessary that the company notify the government in writing as soon after receipt or detection of the order as practical, but definitely prior to receipt of final payment.

Constructive Notice/Knowledge

The CO/ACO may be deemed to have constructive notice or knowledge of a fact if:

- He/She could have discovered the fact through the exercise of reasonable care.
- The government has actual knowledge of the facts that constitute the constructive change.
- The person committing unauthorized acts prepared extensive daily written reports even though the reports did not indicate to whom they were distributed.

To minimize the company’s reliance on constructive notice/knowledge, program management personnel (program manager, program management office personnel, and cost account managers) shall provide the contract administrator with the information required to submit a formal notice to the government.

When Is Changed Work Performed?

Prior to starting any work that is either different than defined or not defined (changed work) in the performance measurement baseline (PMB), the PMB should be revised in accordance with an approved baseline change request (BCR). Further, the contract administrator shall obtain written authorization from the buyer’s contracting officer prior to the program manager giving approval to any BCR involving changed work initiated at the behest of any buyer representative.

Government Contracts

When changes are implemented or when changed work is performed is determined in part by the type of change order.
Commercial Contracts

Prior to their execution formal changes will be agreed to by the parties to the contract in writing. At a minimum, change agreements will include the negotiated description for each change and either the separate or aggregate delivery schedule(s) or price(s).
Once the program management planning phase has been completed, the program team is ready to begin execution. The newly created plan will form the basis for all immediately identifiable activity. I say “all immediately identifiable activities” because, as most program managers recognize, a plan will inevitably change. But from the beginning one might ask, How good is the plan that the program team is preparing to execute?

To answer this question we need to perform an evaluation of the plan. As one might guess, even performing an evaluation has a process. Appendix A in the back of this text has a complete program management plan evaluation. In appendix A, a program was selected to use in implementing the program management planning process. The program was an awarded cost-plus contract consisting of engineering development with production options. The contract value was approximately $40,000,000 at sell price and extended over a five-year period. Of the $40,000,000 selling price $20,000,000 was for engineering development, leaving $20,000,000 for production options. Two of the five years were dedicated to the development of the product, with the remaining three years dedicated to the product’s production. What follows in the remaining paragraphs of this chapter is an overview of a process for performing an evaluation.

**Committee of Stakeholders**

The process for performing an evaluation begins with the creation of a committee of stakeholders. A committee of stakeholders should represent organizational in-
Evaluating the Program Plan

interests and the program under study. The committee plays an integral role by assisting in the following:

- Generating the program’s goals and objectives
- Generating evaluation instruments
- Validating data-gathering items and instruments

Primary Activities

The primary activities associated with performing an evaluation include:

- Identify and organize the stakeholder group
- Develop goals and objectives
- Develop data-collection instruments
- Identify the target program
- Collect data
- Perform analysis of data
- Report findings to the stakeholders

Figure 11.1 depicts these activities and their proposed duration. Note, of course, that the duration of each activity varies based on the complexity of the program being evaluated. Figure 11.1 is for illustrative purposes only.
Interviewing Program Participants

Part of the process of collecting data is interviewing program participants in the development of the program management cost, schedule, and technical performance measurement baseline. When selecting program participants to be interviewed for the evaluation is it important that they represent numerous applicable disciplines. In building a home these might include:

- Plumbers
- Electricians
- Masons
- Framers
- Finishers, etc.

When working with an organization that develops hardware and/or software systems the disciplines would most likely be:

- Hardware engineering
- Software engineering
- System engineering
- Accounting
- Quality assurance, etc.

Outcome-Based Evaluation Methodology

There are many types of evaluation methodologies that can be used. This discussion assumes the use of an outcome-based evaluation methodology. Outcome-based evaluation utilizes the following steps:

1. Identify the desired outcomes of the program to be studied
2. Identify behaviors acceptable as evidence that the outcomes have been realized
3. Create data-collection instruments and procedures to collect data to determine whether the acceptable behaviors have been demonstrated
4. Execute the data-collection procedures to collect the data
5. Transcribe the data, which provides individuals other than the researcher with the opportunity to make their own interpretations of the results
6. Interpret the data and make judgments as to whether the behaviors accept-
able as evidence are demonstrated, the outcomes satisfied, and the questions addressed from the findings.

The data collected helps to determine whether the behaviors acceptable as evidence were demonstrated and the outcomes subsequently satisfied. For example, given the outcome “create a cost, schedule, and technical performance measurement baseline,” evidence that this baseline was not only created but created with adequacy might include:

- Was the work adequately defined?
- Are tasks depicted as time-phased interdependent activities?
- Have resources been assigned to activities?
- Has a time-phased resource budget been generated?

Our objective, then, is to collect evidence that these activities were properly performed, supporting our judgments about the adequacy of the objective being satisfied, i.e., that a cost, schedule, and technical performance measurement baseline was created.

A sample interview item that might be asked of our program participants could be: “Which documents did your functional organization use to extract their stated and derived requirements?”

This question serves two purposes:

1. It establishes whether requirements were identified at all.
2. It establishes whether requirements were identified from the right contract documents.

Another sample interview item might be: “Please describe the organization and sequencing of the work to be performed.” This second question allows judgments to be made as to the quality of the baseline with implications to the three formal contract documents:

1. Statement of work
2. Specification
3. Contract provisions

An example of a sample Likert Scale item might look like figure 11.2. A sample multiple-choice question that might be used as a data-collection instrument follows the figure.
1. Relative to identifying the requirements for purposes of organizing the work I believe that:
   a. All contract documents were thoroughly scanned
   b. All contract documents were minimally scanned
   c. Some contract documents were scanned more thoroughly than others
   d. Not all contract documents were scanned

2. Relative to the assignment of costs to the work breakdown structure elements I believe that:
   a. All costs were allocated appropriately based on sound evidence
   b. Costs are allocated appropriately in most cases
   c. Costs allocated do not appear to consider the actual effort of the work to be performed
   d. When implemented most cost estimates will require major revisions

Figure 11.3 depicts a sample observation form as a data-collection instrument for evaluation.

**Summary of Outcome-Based Evaluation Data Analysis Method**

Let us summarize the data-analysis method for outcome-based evaluations:

- Identify outcomes that represent the desired outcomes for the program to be studied.
- Identify behaviors/activities acceptable as evidence that outcomes have been satisfied.
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1. Create data-collection instruments and procedures to collect data that subsequently aid in the determination of whether the behaviors acceptable as evidence have been demonstrated.

2. Execute the data-collection procedures to collect the data as defined by the data-collection instrument methodology.

3. Transcribe the resultant data collected. This provides individuals other than the researcher with the opportunity to read the results of data-collection instruments and make their own interpretation of those results.

4. Interpret the transcribed data and make judgments as to whether:
   - The behaviors acceptable as evidence were demonstrated
   - The outcomes were satisfied
   - The research questions can be addressed from the findings

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**Figure 11.3. Example of an Observation Form**

<table>
<thead>
<tr>
<th>No utilization of documents</th>
<th>Continuous utilization of documents</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>No utilization of higher-level schedules</th>
<th>Continuous use of higher-level schedules</th>
</tr>
</thead>
</table>
Managers, Leaders, and Entrepreneurs

Over the many years I have been involved with teaching, instructing, and facilitating courses and sessions on management and management methodologies and practices. There has always been interest in discussing the differences between managers, leaders, and entrepreneurs. Perhaps it’s natural curiosity to seek to better understand these individuals and their roles and responsibilities in an attempt to compare ourselves to them.

Given these many discussions, I thought it might be interesting to look at the research and body of accumulated knowledge on what each of the above are, their similarities, or lack thereof.

The following discussion therefore is meant to heighten our awareness to what exists in the way of material from research and practice so that we can make our own conclusions and subsequently find our similarities and differences.

Defining Management

Management refers to the process of completing activities efficiently and effectively with and through other people.

- Efficiency is defined as getting more output from the given input.
- Effectiveness is defined as achieving organizational goals. In other words, doing the right things.

Efficiency is concerned with the means, while effectiveness is concerned with
the ends. Is it possible, then, to be efficient but not effective? Sure. An individual can be highly efficient, can do a great deal of work, and can do it with minimal resources. But that does not mean that what got done was what was intended to be done. On the other hand one can do what is intended to be done but do it with considerably more resources (money, people, equipment, etc.) than another, thus inefficiently.

Pictorially one can chart this relationship based on resources used versus goal attained. Figure 12.1 depicts such a relationship.

From Figure 12.1 it can be seen that as goal attainment increases we move from ineffective to effective. As resource usage increases (i.e., we waste more resources to accomplish the same objective) we move from efficient to less efficient. The result, then, when looking at the extremes, is low goal attainment with low resource utilization yields, an efficient/ineffective rating. In the opposite diagonal corner, high goal attainment and high resource utilization yields an inefficient/effective rating.

Is there an ideal? High goal attainment with low resource utilization is ideal. This combination yields an efficient/effective rating.

Management Functions

In the early part of the twentieth century a French industrialist by the name of Henri Fayol proposed that all managers perform five management functions: plan, organize, command, coordinate, and control. In the mid-1950s two professors at the University of California–Los Angeles drew upon Fayol’s work and used the functions of planning, organizing, staffing, directing, and controlling as the framework for a management textbook that for 20 years was the most widely sold text on the subject (Robbins 1999, 11).

In the context of program/project management we frequently do not include the management function of staffing. Staffing, from a matrix or project management organizational design perspective, is performed by the functional managers.
The program manager provides the requirements to the functional managers, who then provide the required resources.

For example, as a contractor responsible for the overall construction of a new home I might provide the blueprints to the electricians for pricing and performing the work. As the program manager I am interested, of course, in the quality, timeliness, and cost of the work but have little interest in the labor grade of the individuals performing the work. Neither do I care about how many individuals it takes to perform the required tasks so long as it does not affect the overall quality, schedule, or price of the effort.

Each of the below management functions is performed during both the planning and execution phases of the program life cycle. In other words, during planning of a program we perform all of the functions of planning, organizing, leading, and controlling. Only during the planning phase are we applying these basic functions to the planning team for purposes of planning the program. During execution, then, we perform these basic management functions again, only this time it’s for the ever-changing aspects of execution.

**Planning**

The planning function involves the process of identifying the work to be performed, determining which of the requirements of the job are required by the customer (stated requirements) and which are required by internal processes or required in support of the customer’s stated requirements (derived requirements). The basic premise is to identify what is required to satisfy the program’s overall goal and objectives.

In traditional management terminology, planning is defining goals, establishing strategy, developing plans, and coordinating activities.

**Organizing**

Organizing, from a program management perspective, involves grouping like work together into some form of work breakdown structure. The work, which is organized into a work breakdown structure, is described in a dictionary of some form and subsequently assigned to an individual or organization to be performed. Organizing the work is based on a sound definition of what the requirements are to accomplish the overall objectives of the program. These requirements were identified in the planning function.

Again, in a traditional management sense, organizing is determining what needs to be done, how it will be done, and who is to do it.
Leading

Leading is used, generally, when we’re talking about oversight of program personnel. The terms managing, directing, influencing, motivating, or whatever are all synonyms to the term leading. A large, but less discussed, part of leading is conflict resolution.

Controlling

Controlling is concerned with establishing, collecting, and reviewing metrics. The purpose of metric collection and review is to be able to determine better the overall health of the program during the execution phase. Identification of applicable, reflective metrics will significantly aid in management by exception or management through thresholds (types of management control mechanisms).

Management Roles

In the late 1960s Henry Mintzberg performed a detailed study of five top managers at work. What he discovered challenged several long-held notions about the manager’s job. In contrast to the predominant views at the time that managers were reflective thinkers who carefully and systematically processed information before making decisions, Mintzberg found that his managers engaged in a large number of varied, unpatterned, and short-duration activities. There was little time for reflective thinking because the managers were constantly interrupted. Half of these managers’ activities lasted less than nine minutes each. In addition to the insight on what managers did, Mintzberg categorized their activities into three broad categories representing a total of 10 different, but highly interrelated, roles (Robbins 1999, 13). The three categories are: interpersonal, informational, and decisional.

Interpersonal

All managers are required to perform duties that involve people who are subordinates as well as those outside of the organization. These duties are categorized as interpersonal, ceremonial, or symbolic in nature. They can basically be broken into three subcategories: figurehead, leader, and liaison.

A figurehead is a symbolic head. In this capacity the manager performs routine duties of a social nature, such as greeting guests, signing documents, and the like.

As a leader the manager is tasked to motivate and move people toward a common goal. This might involve performing a staffing function as well as ensuring adequate training for subordinates.
As a liaison the manager acts as a go-between linking the organization and the outside world. In the case of a manager being a liaison between the company as a whole and the outside world, the manager might sit on other companies’ board of directors or on university committees.

**Informational**

The informational role that a manager plays is involved with the monitoring and disseminating of information as well as acting as the organization's spokesperson.

As a monitor of information the manager acts as the nerve center for the collection of related and applicable information. This information may come from many sources, including magazines, books, seminars, conferences, and the like. The manager must then disseminate this information to the appropriate individuals within the organization.

As the spokesperson for the organization the manager must communicate information to outsiders on the organization’s plans, actions, intent, and positions as appropriate and applicable.

**Decisional**

In the decisional role the manager must act as an entrepreneur, disturbance handler, resource allocator, and negotiator.

As an entrepreneur the manager is responsible for visualizing and bringing to reality visions of greater opportunities. Identifying, seeking out, and acting upon potential opportunities typify this activity.

As a disturbance handler the manager must maintain a level of harmony among the organization's participants. Disturbances may take on many forms, including problems with personnel as well as impacts from outside forces such as competitive forces. Another form of disturbance, one that is not readily discussed, originates from a parent organization beset by short-term demands and, ultimately, crises. The adage “a lack of planning on your part does not constitute a crisis on my part” is not applicable when the lack of planning originates from a parent organization's authority.

As a resource handler the manager must allocate sufficient resources such as people, facilities, and equipment to perform the many activities of the organization or program.

And finally, as a negotiator, the manager may be called on to represent the organization's interest in some form of contract negotiation. An example is a union negotiation.
Management Skills

Generally it is accepted that a manager requires certain skills, which may be categorized into three broad groupings: technical, human, and conceptual.

Technical Skills

Technical skills are those that support the knowledge, or actual doing, of the tasks to be performed. This is especially true of middle management, or better yet, first-line supervisors. These individuals are more involved with the day-to-day operations of the organization.

For example, I have spent many years in the discipline of software engineering. Because of this I am versed in the many forms of programming languages, design methodologies, and terminology in general, allowing me to provide valuable insight into this discipline. As time progresses, however, technical skills become obsolete and somewhat antiquated. For this reason continuous life-long learning is required if we wish to stay abreast of our technical disciplines.

As we move into higher and higher levels of management it is not expected that we maintain such sharp skills. In fact, as we progress into higher levels of management we are expected to contribute in a different manner and apply a different set of skills, such as human or conceptual.

Human Skills

Human skills are those skills that allow us to work harmoniously with others inside and outside of our organization. These skills not only help us to work with individuals but with groups. There is a significant body of training and education available to help managers to develop these skills. Aside from the obvious and readily available training associated with effective listening and communicating, group problem solving, and motivation, I have a particular fondness for personality instruments, which allow managers to better understand their personality preferences and those of their teams.

Conceptual Skills

Conceptual skills are those that we use to think and conceptualize about abstract situations. The frequently heard term “thinking out of the box” is more likely to materialize when the manager has strong conceptual skills.

Conceptual skills allow individuals to (1) focus on connections between data
and (2) focus on patterns, meanings, or theoretical explanations of the data. Managers with strong conceptual skills tend to be visionary and imaginative, have an accurate feeling for what is going on, and make decisions based on theoretical projection of future possibilities of what they “see.”

Figure 12.2 depicts the relationship between conceptual, human, and technical skills as a manager moves through the lower, middle, and top layers of management.

**Leaders**

Managers are appointed. Their ability to influence is based on formal authority inherent in their positions. Leaders, on the other hand, may be appointed or may emerge from within a group. Leaders influence others to perform beyond what might normally be expected.

All managers should ideally be leaders. This enhanced capacity can increase the efficiency of their performance.

Not all leaders necessarily have skills in other management functions such as planning, organizing, and controlling.

Numerous studies and detailed works have addressed leaders and leadership. Basically, these efforts fall into three categories of efforts: trait theories, behavioral theories, and contingency theories.

**Theories of Leadership**

During the 1920s and 1930s trait theories of leadership evolved. These theories focused on those characteristics used to differentiate a leader from a non-leader. The process was really quite simple: select recognizable leaders, isolate traits, and make recognizable generalizations.

Traits thought to be indicative of a good leader include the following:

- **Drive**—leaders have a high effort level.
- **Desire**—leaders have a strong desire to influence others.
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- Honesty and integrity—leaders build trusting relationships, they are truthful and not deceitful.
- Self-confident—leaders seem to lack self-doubt.
- Intelligence—leaders are sufficiently intelligent to gather, synthesize, interpret, and apply large amounts of data.

When all was said and done it became obvious that traits alone could not adequately define who might make a good leader and who would not. Therefore, researchers refocused their attention to behaviors.

Note that had trait theorists been successful it would have created a basis for selecting the right people to assume formal leadership positions in organizations. In contrast, if behavioral studies had turned up key determinants of leadership then people could be trained to be leaders.

There are four primary behavioral studies in this category of leadership studies: University of Iowa, Ohio State University, University of Michigan, and the Blake and Mouton Managerial Grid.

The University of Iowa identified three behavioral dimensions:

1. Autocratic—a leader who centralizes authority, dictates work methods, makes unilateral decisions, and limits subordinate participation.
2. Democratic—a leader who involves subordinates in decision making, delegates authority, encourages participation in deciding work methods and goals, and believes firmly in feedback as an opportunity for coaching.
3. Laissez-faire—a leader who gives groups complete freedom to make decisions and complete work in whatever way they see fit.

Results from the University of Iowa studies were mixed although it was expected that the democratic style of leadership was most effective.

The Ohio State studies sought to identify independent dimensions of a leader’s behavior. They began with over 1,000 dimensions and ultimately settled with two: initiating structure and consideration.

1. Initiating structure—is the extent to which roles are structured to attain goals. Initiating structure organizes work, relationships, and goals. It assigns tasks and expects standards of performance and the meeting of deadlines.
2. Consideration—is the extent to which a person has job relationships characterized by mutual trust and respect for subordinates’ ideas. It also provides for a high regard for subordinates’ feelings.
In the Ohio State studies a high-high leader, that is, high in initiating structure and high in consideration, achieved high subordinate performance and high satisfaction. But, like the University of Iowa studies, the results were mixed and therefore inconclusive.

About the same time as the Ohio State studies there were also studies done at the University of Michigan. These studies attempted to measure leaders along two axes: employee orientedness and production orientedness.

1. Employee orientedness is premised on interpersonal relationships.
2. Production orientedness focuses on task or technical aspects of the job.

The University of Michigan studies found that employee oriented leaders were generally associated with high group productivity and higher group satisfaction. But, like studies before it, they were unable to provide consistent results to make conclusive findings.

The behavioral findings of these earlier studies formed the basis for the Blake and Mouton Managerial Grid. The managerial grid uses “concern for people” and “concern for production” as the X and Y axes. It uses nine possible positions along each axis, creating 81 different categories of style. The five key positions include:

1. Impoverished management—low concern for people and a low concern for production. Leader exertion of minimal effort to attain organizational goals is all that is required to maintain a successful workforce.
2. Task management—high concern for production and a low concern for people.
3. Country club management—high concern for people with a low concern for production. In this scenario, the focus is on the people to the exclusion of the tasks.
4. Middle of the road management—this scenario maintains adequate task efficiency and employee morale.
5. Team management—Typified by a high concern for people and a high concern for production.

The managerial grid generally provided that managers performed best with a high concern for people and a high concern for production. Figure 12.3 depicts the relative positions of these management positions.

In general, the behavioral theories of leadership:

- Provided little success in identifying patterns of leadership behavior
- Failed to create consistent generalizations
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• Had varied results based on circumstances
• Led to the realization that the problem was more complex than isolating traits or preferred behaviors

The next wave, and the current thinking, is referred to as contingency theories of leadership.

Contingency theories focus on the leader’s ability to change leadership styles based on situational specifics.

One contingency theorist was Fred Fiedler. Fiedler believed that we should not attempt to change the leader’s style but, instead, attempt to match the leader to a more compatible organizational situation. According to Fiedler leader-member relations, task structure, and the position power of the leader are the three primary factors that should be used for moving leaders into situations more appropriate for their leadership style.

A leader-member relation is the degree to which a leader feels accepted by his/her followers. Task structure is the degree to which the goals and tasks to be performed are outlined clearly. Position power is the degree to which the leader has control over the rewards and punishments the followers will receive.

Hersey-Blanchard is another model premised on situational theory. The Hersey-Blanchard model focuses on task and relationship behaviors with an implication as to the maturity of the followers. This model identifies four basic quadrants representing four leadership styles:

1. Telling—representative of a high task and low relationship situation. In this quadrant the leader defines roles and tells people what, how, when, and where to perform the various identified tasks.
2. Selling—representative of a high task and high relationship situation. The leader provides both directive and supportive behaviors.
3. Participating—representative of a low task and high relationship situation. In this scenario the leader and the followers share in the decision making.
4. Delegating—representative of a low task and low relationship situation. In this scenario the leader provides basic direction.

Another contingency theory is House’s Path-Goal theory. This leadership theory assumes four leadership styles:

1. Directive—
   a. Leader tells subordinates what is expected of them
   b. Leader schedules work to be done
   c. Leader tells how to do it
   d. Similar to the initiating structure of the Ohio State studies
2. Supportive—
   a. Leader is friendly and shows concern for the needs of the subordinates
   b. Synonymous with the Ohio State dimension of “consideration”
3. Participative—
   a. Leader consults with his/her subordinates
   b. Leader uses subordinates’ suggestions when making decisions
4. Achievement oriented—
   a. Leader sets challenging goals
   b. Leader expects subordinates to perform at their highest level

In conclusion, in deciding the best leadership style, contingency theory recognizes the three key elements of any leadership situation:

1. Leader’s style—stems from trait theories
2. Leader’s behavior (how the leader interacts with subordinates) stems from behavioral theories
3. Leader’s situation—stems from the work of contingency theorists

Power
A discussion on managers and leaders would not be complete without some reference to power and its implications. There are five generally accepted sources of power:

1. Legitimate power—legitimate power is the result of a position of formal authority in the organizational hierarchy.
2. Coercive power—coercive power is based on fear and the negative results that might occur if the subordinate does not obey.

3. Reward power—reward power is the opposite of coercive power. Reward power is the ability to distribute fair and equitably rewards for positive performance.

4. Expert power—expert power is influence derived from an individual’s expertise. It is special skills or knowledge. Expert power is earned, not awarded.

5. Referent power—referent power arises from identifying with a person exhibiting desirable resources or personal traits. For example, “If I admire and identify with you, you can exercise power over me because I want to please you.”

Military Leadership Fundamentals

I have spent nearly my entire professional career servicing the defense industry. It is only natural that many of my acquaintances and friends have a military background. To this end I asked them for information on how the military trains and prepares leaders for command. One of the books that I found to be a wonderful source of information is entitled Taking Charge: A Practical Guide for Leaders by Perry Smith.

In his book, Smith refers to twenty military fundamentals, identified below.

1. A leader must trust his or her subordinates.
2. A leader must be a good teacher.
3. A leader should rarely be a problem solver. A leader should facilitate problem solving but let subordinates solve the problems.
4. A leader must be a good communicator.
5. A leader must manage time well and use it effectively.
6. A leader should trust his or her intuition.
7. A leader must be willing to remove people for cause.
8. A leader must take care of his or her people. “He who receives a benefit should never forget it, he who bestows should never remember it.”
9. A leader must provide vision.
10. A leader must subordinate his or her ambitions and ego to the goals of the unit or institution that he or she serves.
11. A leader must know how to run meetings.
12. A leader must understand the decision making and implementation process.
13. A leader must be visible and approachable.
14. A leader should have a sense of humor.
15. A leader must be decisive but patiently decisive.
16. A leader should be introspective.
17. A leader should be reliable.
18. A leader should be open-minded.
19. A leader should establish and maintain high standards of dignity. Dressing well, being well mannered, avoiding profanity, helping subordinates, conducting ceremonies, welcoming newcomers with a personal letter, all help to keep performance and morale high.
20. A leader should exude integrity. Of all qualities, integrity is the most important.

To further help these potential military leaders there are checklists that quickly summarize those things to think about in a given situation. For example, the checklist for when you are looking at yourself as a leader is depicted below.

- Do you allocate time to visit areas you control?
- Does everyone know what your priorities are?
- Are you reliable?
- Who tells you all the news? Good and bad?
- How well do you listen?
- Do people fear you, like you, distrust you, love you?
- What is your body language like?
- Are you considered a communicator?
- Are you considered to be a disciplinarian?
- Do you enjoy your job?
- Are you an innovator?
- Are you flexible?
- Do you maintain physical and intellectual fitness?
- Are you a deflector of pressure from above or a magnifier of pressure?
- Are you tuned in or are you out of touch?
- Are you a delegator?
- Are you a nondrinker, drinker, or alcoholic?
- Are you an optimist or a pessimist?
- Are you religious?
- What are your ethics and values?
- Are you a writer?
- Are you ambitious?
- Are you secure or are you insecure?
- Are you a philanderer?
• What is your integrity level?
• Are you intense or are you relaxed?
• Are you decisive or are you a decision ducker?
• Are you conceptually oriented?

The military also provides a number of operational checklists for leaders. Some of these are outlined below.

• Transition checklist
• Communications checklist
• Integrity checklist
• Hiring checklist
• Counseling checklist
• Hang-up checklist
• Firing checklist
• Thank you checklist
• Planning checklist
• Divestiture checklist
• Decision making checklist
• Executive skills checklist
• Meeting checklist
• Introspection checklist
• Promotion board checklist
• Antenna checklist
• Phrases to avoid checklist
• Congressional visit checklist

Relative to the transition checklist, following are useful questions to ask when you have been selected to assume a leadership position.

• What is the mission?
• What are the organization's goals, priorities, plans, programs, and budgets?
• What is the size and structure of the organization?
• What means of communication will I have (newspaper, radio, television, social gatherings, etc.)?
• Who reports directly to me? How many? Why? Why not others?
• Who is my boss? What is his/her leadership/management style? What is his/her means of communication to me?
• Am I responsible for geographically separated units? Do they report directly to me? Do they report indirectly to me?
• Which organizations, staff agencies, or individuals should I visit? In what order? How often for subsequent visits?
• What is the standard of integrity? Have there been recent violations of these standards? How frequent and what was the outcome?
• What are the standards of performance? How are they measured? What are the results of recent outside inspections, self-inspections, or audits?
• What documents should I read? In what order? Is there an annual organizational history? If not, why not?
• Are there procedures and regulations? What are the most important plans? Is there a long-range plan? If not, why not?
• What skeletons are in the closet?
• Where are the personnel shortages/weaknesses?
• What are the toughest problems I should expect to make during the first few months?
• How often do the top leaders and their subordinates go to off-site seminars together?

Entrepreneurs

Entrepreneurs can be defined as individuals who recognize and pursue opportunities where others see chaos or confusion.

Entrepreneurship is a process by which individuals recognize and pursue opportunities.

Entrepreneurs are typically associated with forming external new ventures. Intrapreneurs possess the same basic characteristics but apply their knowledge and drive to internal opportunities to the company they work for.

The most frequently reported characteristics of an entrepreneur are listed below.

• High need for achievement
• Believe they control their own destiny
• Frequently take only calculated risks
• Independent
• Prefer to be personally responsible for solving problems
• Not afraid to take chances
• A willingness to work hard
• Self-confident
• Optimistic
• Determined
• High energy levels
• Are not likely to be content in typical large bureaucracies
Managers versus Entrepreneurs

Not all small business owners or managers are entrepreneurs. Some small business managers simply operate their business, they don’t necessarily innovate.

A few noted differences between managers and entrepreneurs are detailed in subsequent sentences.

- Entrepreneurs actively seek change. Managers tend to be more custodial.
- Entrepreneurs often put their own personal financial security at risk. Managers tend to be more conservative and assume only conservative risks.
- Entrepreneurs accept risks. Managers tend to avoid risks.
- Entrepreneurs are motivated by independence and the opportunity to create financial gain. Managers tend to be more motivated by career promotions and corporate rewards such as office location, size, staff and power.
- Entrepreneurs look at business growth over the longer term. Managers tend to be more oriented to the achievement of short-term goals.
- Entrepreneurs tend to be directly involved in all phases of their organization’s operational activities. Managers tend to delegate tasks and supervise those performing the tasks.
- Entrepreneurs tend to accept mistakes as the normal part of doing business. Managers tend to avoid putting themselves in situations where they may fail or make a mistake.

How Do Entrepreneurs Get Their Ideas?

In a survey of 100 highly successful entrepreneurs:

- 71% replicated or modified an idea gained from previous employment
- 20% built temporary or casual jobs into a business
- 5% from the PC revolution
- 4% through systematic research for opportunities

Entrepreneurial Strategic Planning

The entrepreneur is driven by the perception of opportunity, rather than by the availability of resources. Managers ask a different set of questions with different priorities than does the entrepreneur.

The manager might ask:

- What resources do I control?
- What structure do we have or need to compete?
- How can I minimize the impact of others on my ability to perform?
• What opportunity is appropriate?

The entrepreneur might ask:
• Where is the opportunity?
• How do I capitalize on it?
• What resources do I need?
• How do I gain control over them?
• What structure is best?

Note the difference in order and emphasis! Entrepreneurs tend to be more concerned with what and where the opportunity is, how to capitalize on it, and then, lastly, how to accomplish the work. On the other hand, the manager, being more attuned to performance, would naturally be more concerned with how it’s done.

Continuing with entrepreneurial strategic planning, entrepreneurs tend to:

• Risk financial security
• Bypass career opportunities
• Risk family relations
• Believe that hard facts about new business startups are not applicable to them:
  ▪ 40% of the new businesses fail in the first year
  ▪ 60% fail by the end of the second year
  ▪ 90% fail by the end of the tenth year
• Entrepreneurs believe they will be in the top 10% that do not fail

Evolution of the Entrepreneurial Firm

The entrepreneurial firm develops through a natural evolution based on size.

• The firm becomes bigger than one person can handle.
• The entrepreneur hires people to perform functions (accounting, marketing, HR, etc.). Notice here the introduction of the traditional functional organizational design.
• The entrepreneur learns to delegate and manage people, or not!
• The entrepreneur tries to maintain the original small-company atmosphere as the firm continues to grow.

Concluding Thoughts

The purpose of this section is to provide insight into some of the most recent thinking, theory, methodologies, and practices as they relate to managers, leaders, and entrepreneurs, not to make culminating generalizations.
To this end it would appear on the surface that each of us has performed as a manager, leader, or entrepreneur at one point in our lives or another. I would suggest that the traits and behaviors that make one versus the other are present in all of us and, further, are more or less prevalent as we each enter into, and out of, different situations. I would suggest that sometimes, given the situation, we might behave as a manager, leader, or entrepreneur. I would further suggest that perhaps more applicable than looking at our traits or behaviors might be looking at our personality preferences. Which is exactly what we do in chapter 17, “Preferences and Psychological Typing.”
In its broadest sense, communication may be considered a chain of events in which the message serves as the basic link. The chain connects the transmitter to the receiver. Feedback provides some assurance of consistency in the encoding and decoding process.

Looking back through the window of time provides some fascinating communication milestones.

- 20,000 B.C. — approximate date of earliest prehistoric cave drawings
- 3500 B.C. — Egyptians develop hieroglyphics
- 2500 B.C. — Egyptians invent papyrus
- 1800 B.C. — first true alphabet developed in Middle East
- 540 B.C. — first public library in Athens
- 300 B.C. — Hindus invent numerals
- 63 B.C. — shorthand system invented
- 105 A.D. — Chinese develop paper
- 1477 A.D. — first printing press
- 1591 A.D. — first post office in England
- 1822 A.D. — first phonograph
- 1837 A.D. — telegraph invented
- 1876 A.D. — telephone invented
- 1877 A.D. — phonograph invented
- 1923 A.D. — television invented
- 1965 A.D. — first telecommunications satellite system launched
• 1975 a.d.—Sony introduces Betamax
• 1978 a.d.—Magnavox introduces the first laser video disc player

A few observations related to our advances in communications technology:

• Communication is a basic human activity.
• The world has become smaller because of advances in communications technology.
• Communication is not always accomplished successfully.
• To communicate effectively requires clarity of mind and singleness of purpose.
• Conviction produces authoritative statements which can be carried into the hearts of receivers.
• Effective communication between two or more people requires a meeting of the minds.

Figure 13.1 depicts the basic communications model.

This model illustrates how a message is sent through some form of communication medium to the receiver. Notice that the message is encoded by the sender and decoded by the receiver. The process of encoding and decoding is very specific to the individuals involved.

Numerous aspects of an individual’s life affect the ability to encode and decode a given message. For example, recently during a negotiation we were all on edge, looking for some form of hidden meaning in what was being said. This obviously tainted our perspective of the incoming message. Further, anything said might be interpreted in a manner inconsistent with the intent of the sender. It is easy to see, therefore, how anger, fear, uneasiness, and even joy, happiness, or any other emotion can cause disruption in the manner in which the message is encoded or decoded. How often have we heard another party say “That’s not quite what I meant”? This type of statement clearly indicates a miscommunication in that the intended message was either encoded incorrectly or simply decoded differently than intended.
Encoding and Decoding Skills

Encoding skills include writing and speaking. Decoding skills include listening and reading.

Written Communication

When involved in written communication:

- Determine the purpose of the message
- Collect and evaluate the facts needed
- Organize the material into principal topics
- Prepare first draft using conversational style of writing (i.e., write like you speak)
- Consider the intended receiver (Who is the audience?)
- Review the text

Major advantages of written communication include:

- Displays authority
- Usually more accurate than verbal communication
- Verifiable
- There is a degree of permanence
- High retention rate by receiver
- Makes for accurate and speedy reproduction

Major disadvantages of written communication include:

- If the situation is changing, the written text may be outdated soon.
- It may not take into account the reading ability of the recipient
- Slower feedback than oral communication

Speaking Skills

When making a presentation or speaking with another individual, the following should be considered.

- What are you selling?—This asks why you are making the presentation.
- To whom are you selling it?—Know your audience!
- Against what are you competing?—Consider the emotional needs of your audience. For example:
If there is fear on the part of the listener, the message might curtail his/her prestige, authority, or advancement opportunities. The listener might be unwilling to take on something new. The listener might be unwilling to leave the beaten path.

- In what environment is the message to be received?—Is it friendly, supportive, hostile, or is there organized hostility? Organized hostility is the worst kind of environment to speak in. If the organization has properly done its homework, the message is anticipated, and appropriate or inappropriate responses are prepared.

**Basic Rules for Addressing an Audience**

Talking in front of people can be very intimidating, to say the least. Even the most experienced speaker has about two to five minutes of initial adjustment. During this time, frequently, the speaker is looking for a friendly member of the audience for reassurance. When I speak in front of people, I routinely look for those individuals who smile or nod in a positive manner. Seeking out these people and looking to them during the speech helps to make me feel more comfortable with the presentation. Body language on the part of the audience, the speaker’s self-confidence and knowledge of the subject matter, the time of day/night, physical aspects of the speaker (is he/she hungry, etc.) can greatly affect the overall quality of the speech.

Basic rules when addressing an audience that help make the presentation a meaningful experience for the receivers include:

- Keep the presentation simple and brief.
- Rehearse the presentation.
- Speak clearly.
- Keep your back to the wall.
- Speak at an even rate of speed.
- Maintain eye-to-eye contact.
- Stand erect and control nervous habits. I had a bad habit of playing with the change in my pocket. Once this was brought to my attention I immediately ceased this annoyance.
- Use pause for effect.
- Relax and smile. Chances are that you know as much or more than almost anyone in the room. There will always be someone with comparable knowledge to yours but that’s generally the exception, not the rule.
- Avoid excessive statistics.
- Avoid jargon.
- Reaffirm your points in closing.
• Allow time for questions.
• Remember:
  ▪ Visual contact, facial expression, body language, and clothing account for 55% of the entire presentation.
  ▪ Tone of voice accounts for 38% of the presentation.
  ▪ The content of the presentation—i.e., the words themselves—account for only 7% of the presentation.

Questions after the Presentation

After any presentation there will generally be two categories of questions asked:

1. Probing—“What are your thoughts about . . .” “. . . I’m wondering what your reaction might be to . . .” These type of questions cause the speaker to think more deeply about the subject matter.
2. Confrontational—These types of questions are a deliberate attempt to focus the speaker on an area she/he might be avoiding. Confrontation can be positive, if handled openly and honestly without it becoming personal. I remember once, as a young engineer, I addressed a group of very senior program managers with the intent of offering instruction on our latest process modifications to our program management process. Only moments into the training session a very senior and very brash program manager, who I swear had been around since Moby Dick was a minnow, leaned back in his chair, balancing on the back two legs, and said, “I have forgotten more about program management than you will ever know.” My only response, having been trained in learner-focused adult education, was simply, “I’m sure there is a great deal of truth to that. And I hope by the time we leave here this afternoon that all of us can gain something from your advanced knowledge on this topic. That’s what makes teaching adults as much fun as it is. We all have real-life experiences to share.” He leaned forward and never said another word.

Probing questions, which require something other than a “yes” or “no” response, fall into three basic groupings:

1. Open-ended—“What is the most effective way to read, write, speak, listen, observe, and visualize?” These type of questions seek something other than a “yes” or “no” response.
2. Means/ends—“How do I get the time, energy, and budget to do what is im-
Communication Skills

3. Means only—“What do I look for? . . .” “Where would I find? . . .” This type of question is similar to the above only does not provide insight into the outcome.

Non-Verbal Communication Skills

Non-verbal communication skills, as the words imply, are those skills that are seen, as opposed to heard. They generally fall into four broad categories.

1. Physical—includes facial expressions, sense of touch and smell, and body motions
2. Aesthetic—creative expression: playing instrumental music, dancing, painting, and sculpture
3. Signs—mechanical in nature: signal flags, 21-gun salutes, horns, and sirens
4. Symbolic—makes use of religious entities or other meaningful images

Listening Skills

Effective listening is very difficult. It takes a special form of patience. Most of us tend to be thinking about what we are going to say when the speaker is done and therefore miss some of what is being said. This is complicated by the fact that we can generally think faster than an individual can speak. This “down time” allows our minds to wander in a different direction rather than to be focused on the speaker. Our ability to context-switch between what we are thinking about and the speaker is directly related to our being able to participate in an effective communication exchange.

Attributes of a good listener are discussed below. A good listener:

• Usually makes more informed decisions, because inputs received are more thorough
• Learns more in a given period of time, therefore saving time
• Encourages others to listen to what he/she says because the listener appears more attentive and better mannered

Listening is hard work. It is characterized by:

• A faster heart rate
• Quicker blood circulation
• A small rise in body temperature

A set of guidelines to follow when listening is:

• Prepare to listen—you can’t listen if you are talking.
• Recognize your own biases—understand your personal frame of reference. This also implies that you not only understand your frame of reference, but that of the speaker as well.
• Resists distractions—good listeners look and act interested.
• Keep an open mind—don’t feel threatened or insulted.
• Find an area of interest—find ways to make the message relevant to yourself.
• Acknowledge the speaker—let the speaker know that he/she has your attention.
• Show some empathy—create a climate that encourages others to communicate openly and honestly.
• Hold your fire—be patient, don’t interrupt. Let the speaker finish his/her thoughts completely.
• Listen critically and delay judgment—thorough listening produces enlightened judgment.
• Judge the content, not the delivery—ask for clarity when you don’t understand even though typically only 7% of a presentation is content-related.
• Capitalize on thought speed—we think four times faster than the communicator speaks; what do we do with the extra time?

Reading Skills

Effective reading skills are essential to our very existence and provide a depth of understanding. Efficient reading skills, the speed at which we read, are taught in numerous speed reading seminars around the globe. Key factors to consider when reading are:

• Comprehension—our ability to understand what is read.
• Determining the writer’s point of view.
• Determining whether you accept or reject the thesis of the argument.
• Discrimination in what you read—effective managers read only the most applicable material. It is not uncommon that I will receive as many as forty e-mail messages and twenty phone calls in a day. To be honest, I do not have time to read every e-mail. Therefore, it is only natural that I might
Communication Skills

spend more or less time on a given e-mail depending on its perceived applicability at the time.

Skipping Judiciously

When we are confronted with having to read large amounts of information, it is important to be able to read enough information to become knowledgeable on the subject without having to read every word. To this end skimming or skipping through the material becomes necessary. Below is a process that many have found to be of value for this purpose.

- Scan the table of contents for a rough idea of what the book or material is all about
- Read the first couple of sentences of those sections with greatest applicability
- Read thoroughly those sections which require greater understanding

Communication Barriers

In the communications model presented earlier the message that was sent from the sender and encoded was passed through some medium of communication. As the message passes through this medium there is noise and the like, which permutes the message into something potentially different than that which was sent. This noise may be identified as barriers to effective communication. Below identifies other barriers to effective communication.

- Noise—noise can be actual static or anything that distracts from the intended message
- Lack of feedback—one of the most detrimental effects on a speaker can be a lack of feedback. Even as an employee we want to know what others think of our performance; whether it be good or bad, at least we know. With knowledge about how we are performing we can make informed decisions on how to enhance our performance or simply take other action.
- Incorrect medium of communication—all too often we want to send a message and choose a medium that may be inappropriate. For example, if we were to ask our boss for a raise we probably would choose a personal medium where we set up a meeting time and sit down to discuss our concern. It would be less effective if we were to ask for our increase through an e-mail or the like.
- Mental barriers—
  - Arrogance of the sender
Assumption about the sender’s logic or rationality
Sender assumes that he/she is logical or rational
Sender’s misconceptions, self-interest, or strong emotions
Receiver not ready to receive
Problems with word selections
Use of abstract words; the more specific one can be, the more doubt that gets removed during the decoding process
Time and space barriers—finding out the ship is sinking after it’s vertical is of less value than knowing earlier
Empathy and other relationships—seeing ourselves through the eyes of others

Organizational Communication

When we talk about communication channels within an organization we are usually referring to one of three basic categories.

1. Formal—formal channels are those channels established by virtue of the organization’s design hierarchy. They are usually clearly identifiable and have a strong relationship to the reporting relationships of the managers and supervisors in the organization.
2. Informal—in informal communication channels are those typically between peers or others in the horizontal portion of the organization. In this category are work groups.
3. Unofficial—these are typically socially oriented groups. That is, friendships, cliques, and the like.

Overloading is a concept used to describe too much information being passed through a given channel. Going back to an earlier example, it’s easy for our e-mail basket to overflow. When I receive forty e-mails in a given day it’s not possible to effectively manage that quantity of input and tend to other daily matters. Therefore, one might suggest that my e-mail medium is overloaded.

It’s also important to recognize the audience’s needs and the benefits to them of receiving the message. The more relevant a message to the receiver, the more likely the message will be focused on and subsequently understood as intended.

Conducting an Effective Meeting

In a nutshell, conducting an effective meeting can be simply stated in a few quick steps:
• Establish meeting objectives
• Prepare meeting agenda
• Determine timing and physical arrangements
• Identify and invite people who can make a contribution
• Brief participants in advance
• Consider matters of protocol
Motivational Theories

What motivates individuals to produce? Why is it that what seems to motivate one person does not necessarily motivate another? I remember many times in my career where I said, “Man, if I made that amount of money I’d work all the hours anyone ever asked.” Then I did make that amount of money and it didn’t seem enough after a period of time. I remember thinking, “If they would pay me $10 per hour for every hour of overtime worked I’d work all the hours I could get.” But then, after a few weeks of making that kind of money, the money didn’t seem so important to me anymore and I didn’t want the hours.

The field of motivation seeks to understand the causation of specific actions. Motivation theorists do not necessarily agree with each other about the cause. For example, take a shooting incident: there may be three different perspectives on the cause for the incident:

1. The shooter had a bursting loose of furious anger, perhaps pent up for many years and originally directed at the parents.
2. The shooter had a history of reinforcement for violent actions. The incident was probably caused by a lack, or absence, of reinforcement at the present time.
3. The shooting incident was a result of reasoned, if not rational, decision-making. The individual simply decided that people were the cause for his misery.

Motivation may be formally defined as the willingness to exert high levels of
energy toward organizational goals, conditioned by the ability of the effort to satisfy some individual need (Robbins 1999, 50).

**Top Motivation Theories**

In this chapter we are going to discuss the top motivation theories. Namely:

- Need theories
- Goal setting theory
- Reinforcement theory
- Equity theory
- Expectancy theory

**Need Theories**

Need theories are designed to explain and predict job satisfaction. There are three theories in this category that we will examine:

1. Maslow’s hierarchy
2. Motivation-Hygiene
3. McClelland’s need theory

Abraham Maslow (1908–70) was a humanistic psychologist. Maslow’s hierarchy is perhaps the most widely recognized theory of motivation. The hierarchy is depicted in figure 14.1.

Maslow’s hierarchy assumes that we must pass through each phase before we can begin the next. At any point in time we may fall back to a previous phase but we must satisfy that phase before we can continue. The theory further says that as each lower-level need is satisfied it ceases to be a need and the next higher-level need is active.

An excellent example of this is the story of a company president who was trying desperately to build morale and a sense of family in his organization. He had just initiated two kindlier and gentler policies, namely, casual dress and 9/80 (i.e., the employee could work 80 hours in nine days and take the tenth day [Friday] off).

The organization, however, was on its third owner in as many years and had seen a reduction in workforce from 8,600 people ten years earlier to about 2,000 people. At that rate the reduction averaged 660 people per year. In this type of climate the employees were terribly concerned about their jobs and ultimately their long-term well being.

During this time an employee entered into a discussion with a member of the
human resources organization. The employee had bachelor and master's degrees in engineering and ten years of experience. The employee was nearly in tears when he explained that he was afraid to purchase a new lawn mower for fear he may not have a job.

Aside from the obvious concern this individual was experiencing, he was basically at the physiological level in Maslow's hierarchy. That is, he was concerned about being able to pay the bills and provide basic shelter for his family. The organization's president, on the other hand, was trying to satisfy a need at the social level; that is, he was trying to create a sense of belonging and acceptance.

The organization's president, on hearing this from the human resources organization, decided to change his upcoming presentation to the employees. He now addressed the brighter future that he saw by way of the opening up of key markets and how the organization was going to invest in the technology to allow entry into these markets. The employees unanimously applauded this newly revealed direction. Then the 9/80 and casual dress program had meaning and value.

The Motivation-Hygiene Theory was proposed by psychologist Frederick Herzberg in the late 1950s. Believing that an individual’s relation to his or her work is a basic one and his or her attitude toward work determines success or failure, Herzberg investigated the question “What do people want from their jobs?”

Herzberg, after significant research, determined that there existed two categories: motivators, which were factors that increased job satisfaction; and hygiene factors, which were factors that eliminated job dissatisfaction. These are depicted below.

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**Figure 14.1.**
Maslow’s Hierarchy of Needs

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1. Motivators
   a. Achievement
   b. Recognition
   c. Work itself
   d. Responsibility
   e. Advancement
   f. Growth
2. Hygiene Factors
   a. Security
   b. Supervision
   c. Work conditions
   d. Salary
   e. Relationship with peers
   f. Status

Motivators contribute to job satisfaction or lack of satisfaction. Hygiene factors contribute to job dissatisfaction or no dissatisfaction. Removing dissatisfaction factors does not necessarily make the job satisfying; making a hygiene factor better does not make us more motivated, it simply makes us less dissatisfied.

According to Dessler (Dessler 1998, 408), David McClelland and John Atkinson agree with Herzberg that higher-level needs are most important at work. They have studied three needs that they believe are especially important: affiliation, power, and achievement.

People who are high in the need for achievement have a predisposition to strive for success. They are highly motivated to obtain the satisfaction that comes from accomplishing a challenging task or goal. They prefer tasks that they have a reasonable chance of accomplishing and avoid tasks that are either mundane or too difficult.

People with a strong need for power desire to influence others directly by making suggestions, giving their opinions and evaluations, and trying to talk others into things. They enjoy roles requiring persuasion, such as teaching or public speaking, as well as positions such as leaders or clergymen.

An individual's need for power is manifested and visible through an understanding of their other needs. For example, a person with a high need for power but a low need for warm supportive relationships might become dictatorial, while one with a high need for relationships might become a clergyman or social worker.

People with a strong need for affiliation are highly motivated to maintain strong, warm relationships with friends and relatives. In meetings they try to establish friendly relationships, often by being agreeable or giving emotional support.
Goal Setting Theory

Goal Setting Theory believes that specific and difficult goals lead to higher levels of performance. Research shows:

- Specific goals increase performance.
- Difficult goals, when accepted, result in higher performance than do easy goals.
- Feedback leads to higher performance than does non-feedback.

Goal Setting Theory proposes that an individual’s purpose directs his or her actions. An example of this theory is: “Do your best” versus “Strive for 85% or higher.” The more quantifiable the goal, the more specific the goal, the more likely the motivation to perform to higher levels.

Reinforcement Theory

Where Goal Setting Theory proposes that an individual’s purpose directs his or her actions, Reinforcement Theory believes that behavior is externally caused. That is, if an act is positively reinforced within a reasonable period of time the behavior is more likely to reoccur. In other words, behavior is a function of its consequences.

Reinforcement Theory has an impressive record of predicting factors like quality and quantity of work, persistence of effort, absenteeism, tardiness, and accident rates. It offers insight into employee satisfaction or the decision to quit.

Summarizing Reinforcement Theory:

- Behavior is a function of its consequences.
- Behavior is environmentally caused.
- Ignores the inner state of individual, focuses solely on the consequences of the action.

Equity Theory

Equity theory was developed by J. Stacy Adams. It proposes that employees perceive what they get from a job as outcomes in relation to what they put into it (inputs). The employees then compare their inputs-outcomes ratio to other applicable parties.

Equity theory says that the employee can make four referent comparisons:

1. Self inside—an employee’s experience in a different position inside his or her current organization
2. Self outside—an employee’s experiences outside his or her current organization
Motivational Theories

3. Other inside—an employee’s experience to an individual or group inside the organization
4. Other outside—an employee’s experience to an individual or group outside the organization

Figure 14.2 depicts this relationship and summarizes this theory.

Figure 14.2. Perceived Comparisons

- O/Ia < O/Ib  Inequity under rewarded
- O/Ia = O/Ib  Equity
- O/Ia > O/Ib  Inequity over rewarded

Expectancy Theory

Expectancy theory offers the most comprehensive explanation of motivation to date. It was created by Victor Vroom. The theory states that the likelihood of an individual to act in a certain way depends on the strength of an expectation that the act will be followed by a given outcome and on the attractiveness of that outcome to the individual.

Basically it focuses on three relationships.

1. Effort-Performance: probability that exerting a given amount of effort will lead to performance.
2. Performance-Reward: performing at a particular level will lead to a desired outcome.
3. Reward-Personal goals: degree to which a reward satisfies a personal goal.

Figure 14.3 depicts this relationship.

1. Effort-Performance Relationship
2. Performance-Reward Relationship
3. Reward-Personal Goals Relationship

\[ \text{Performance} = f(A \times M \times O) \]

where,
- A = ability
- M = motivation
- O = opportunity

Figure 14.3. Expectancy Theory
Again, the concept is that individual effort will lead to individual performance, which will lead to organizational goals and ultimately personal goals. Performance, however, is a function of the individual’s ability, motivation, and opportunity. If either one of the three is insufficient, then the individual may not be able to perform satisfactorily enough to merit the organizational rewards perceived necessary to achieve personal goals.

A good example of this is where there is a set of identified and documented abilities, skills, and knowledge necessary to move into the next-higher job grade. However, there is not the opportunity to fill a job that requires this level of job grade. The individual therefore may have all of the necessary personal tools to move up but simply lacks opportunity. If this condition lasts for a prolonged period of time the individual may seek other employment because he/she cannot satisfy his or her personal goals. This is a very real challenge in today’s “flatter” organizational models. The solution to this is to provide peer-level, horizontal opportunities that will allow the individual the opportunity for personal growth and financial gain without having to move vertically in the organization.
Ethics refers to the principles of conduct governing an individual or group and specifically the standards used to govern conduct. Ethical decisions involve normative judgments.

A normative judgment implies that something is good or bad, right or wrong, better or worse. For example: “I see you wrote a report,” is non-normative. To say, “The report you wrote is really good,” is normative.

Ethical decisions involve morality. Morality is society’s accepted norms of behavior. A few basic definitions are therefore in order:

- Ethics—the rules or standards governing the conduct of a profession.
- Morals—being or acting in accordance with the standards of good behavior.
- Values—a principle, standard, or quality considered inherently worthwhile or desirable.

Criteria that shape ethical decisions include utility, rights, and justice.

The goal of utilitarianism is to provide the greatest good for the greatest number. Using this criterion decisions are made solely on the basis of their outcome and consequences. This criterion is consistent with like goals of efficiency, high productivity, and high profits.

Using utilitarianism one would make the argument that laying off 100 people is for the good of all who remain. But while this criterion promotes efficiency and productivity, it can ignore the rights of some individuals.

Rights as a criterion means respecting and protecting the basic rights of individuals to privacy, free speech, due process, and the like.
Under this criterion rights protect, as an example, whistleblowers who report unethical or illegal acts or practices. They also protect individuals from injury and are consistent with freedom and privacy but can create overly legalistic work environments that hinder productivity and efficiency.

Justice imposes and enforces rules fairly and impartially so there is an equitable distribution of benefits and costs. Unions favor this criterion. It justifies paying the same wage for a given job regardless of performance. It also justifies using seniority to make layoff decisions. Justice protects the interests of the underrepresented or less powerful. Justice can, however, create a sense of entitlement that reduces risk taking, innovation, and productivity.

In summary:

- Ethics refers to the principles of conduct governing an individual or group. Ethical decisions always include both normative and moral judgments.
- Being legal and ethical are not the same thing. One does not imply the other.
- Organizational leaders shape our work ethics: published codes, compliance mechanisms, hotlines, training, culture, and accountability.
Establishing Program Management as a Discipline

Over the years I have been asked many times how one might leave the classroom and establish some organized form of program or project management within their own organizations. To this end I have been sharing my personal experiences on how I have seen this done. In staying with the discipline of program management the information presented in this chapter will use some of the basic products of the program management process.

Stated requirements are requirements explicitly stated as “shall” statements in some form of contractual document. In this case, stated requirements are those requirements that we are requiring be satisfied. The stated requirements therefore are as indicated below.

- Creation of a common and consistent program management process for our programs to follow.
- Creation of a common set of activities to perform.
- Creation of common products to produce.
- Creation of common templates to utilize.
- Creation of a quality program plan to execute from.
- Program personnel identified and adequately trained.

Derived requirements include:

- Creation of a core program management office.
• Definition and development of process, product, and notation standards.
• Identification of program management office personnel.
• Provision for an administrative functional stovepipe.
• Auditing on-going programs for adherence to the defined process.
• Establishing program metrics based on company/organizational thresholds.

An organization chart depicting the basic core program office personnel might look like that in figure 16.1.

Notice that the program office is lead by a manager whose name is S.T. Pang. We have labeled this block with the nomenclature “A01.” This makes referencing easier when we create the next product, which is the program office responsibility assignment matrix.

Note that there are three managers. The first manager, “B01,” is responsible for the generation of the program management process and the assurance that programs are adhering to this process. Manager “C01” is responsible for the identification and training of program management office personnel and their training and career development. Manager 3, “D01,” is responsible for the creation of standard tools and information systems for collecting the program data, analyzing said data, and consistently reporting it.

The PM cross-functional team is a steering committee designed to offer input on what current practices are, how the new process should be designed to incorporate the varying functional requirements and to aid in the ultimate acceptance of the new process. In the ideal sense steering committee members feel a sense of ownership and can therefore help to “sell” the new concept.

Figure 16.2 depicts the work assignments to each of the corporate program management office personnel.
The work defined in figure 16.2 is further detailed in the work breakdown structure depicted in the following figures.

Figure 16.3 is a level-three work breakdown structure.

Under work breakdown structure element “AA” we see that defining the program management process involves generating the process plan. This is essentially what this whole chapter is all about. Next we see that under this element we will need to generate standards and guides, define the training for the program management office personnel, and define the program management information system. The program management information system will, again, be created to provide a consistent and coherent mechanism to collect, analyze, and report program data to the varying levels of applicable management in the organization’s hierarchy.

The other level-two phases include the implementation of the process, quality assurance, obtaining (optionally) some form of certification (perhaps ISO 9000) and the management of program management personnel. Note that program management personnel does not necessarily include only program managers, but may, and should, include all program management office personnel, i.e., schedulers, cost controllers, support personnel, and administrative assistants.

Work breakdown structure elements “AA,” “AB,” “AC,” and “AE” are further detailed in figures 16.4–16.7.

Work breakdown structure element “AAAC” basically suggests that after all program management activities and their attendant products have been identified,
Figure 16.3 Level 3 Work Breakdown Structure

AA
- Define Program Management Process
  - AAB
    - Generate Process Plan
  - AAD
    - Implement
      - ACC
        - Support Customer Advising Process
      - ABD
        - Provide PM Programs
    - Monitor/Audit
      - ACB
        - Implement Corrective Action
  - AAC
    - Train Personnel
  - AAB
    - Standardize
  - AAD
    - Define Training System

AB
- Program Management Process
  - ABC
    - Implement PM Process
  - AAB
    - Train Personnel

AC
- Program Management Discipline
  - ABC
    - Implement PM Process
  - AAB
    - Train Personnel

AD
- ISO 9000 Certification
  - ABC
    - Implement PM Process
  - AAB
    - Train Personnel

AE
- Program Management Personnel
  - ABC
    - Implement PM Process
  - AAB
    - Train Personnel
sequenced, and properly depicted in some form of network flow diagram, this approved process becomes a functional baseline. The functional baseline becomes the foundation for developing those required standards and guides represented under work breakdown structure element “AAB.”

Work breakdown structure element “AABF” describes the generation of any corporate standard operating procedures. Typically, there exists some form of corporate mandate that requires the use of a corporate process.

Work breakdown structure “AACC” holds a slot for those activities associated with certifying a program manager. Some companies want to create a series of training and education requirements, coupled with real-world experience, that qualify a program manager for the next level of responsibility. In some cases, a test or small program is required to “certify” an individual as a program manager ready for greater responsibility.
In my experience, however, if certification is required it should be a recognized outside organization that provides it. Internal certifications are generally limited in significance to the organization in which the employee currently resides. An external certification, however, such as the Program Management Institute’s Certified Project Management Professional (PMP) certification, is recognized around the world. The PMP certification not only provides the employee with an additional item for his/her resume but also attests that the individual understands a basic body of accepted knowledge associated with the discipline of program/project management.
Establishing Program Management as a Discipline

Work breakdown structure element “ABCA” involves the acquisition of required hardware and software in support of the information system being designed and developed. This hardware may involve some form of common shared server with distributed workstations on a local area network for each program.

Work breakdown structure “ACB” involves implementing corrective actions
on the program after a variance from the program's plan has been detected. Under this element is "ACBA," which adjusts the corporation's program management process. Adjusting thresholds, "ACBB," is also applicable to the corporation's program management process.

Work breakdown structure element “AEB” is one of the more controversial elements of the program management functional stovepipe. One aspect of functional management is to take care of the feeding and nurturing of its membership. This also entails moving people from one program to another as the requirements of a given program change. Program managers responsible for a program do not want their people moved until the program manager says it is time to move them. This is in contradiction, sometimes, to the actual requirements, which might mandate that someone of lesser or greater experience is assigned at a particular time. As well, a startup program might require the services of more knowledgeable individuals.

Remember that the program management functional stovepipe should function in much the same manner as the other functional stovepipes (engineering, manufacturing, purchasing, information technology, contracts, etc.).

How long should it take to design, develop, and implement a program management process in an organization? The answer will vary based on level of management commitment, number of individuals assigned to work the process, funding, etc., but six months is not out of the question. Up to 24 months might be more realistic. Figure 16.8 was provided to illustrate how the various major activities align in a time series.

What education should the three managers have within the corporate program management office? Below identifies some potential qualifications for those three individuals.

For the manager of the program management process and subsequent adherence, qualifications might look like the following.

- Education: B.S.C.S., B.S.E.E., or equivalent; master’s in business administration or equivalent business master’s degree.
- Experience: may include a minimum ten years’ experience with emphasis on
technical management/program management; must be versed in management techniques, tools, and methodologies; must have an understanding of PM responsibilities; and must have advanced written and oral communication skills.

- Duties and Responsibilities of Position: generation and management of program management process, product and notation standards, and guides. Implementation plans must be defined and implemented. Program audits to assure adherence to process are required. Must analyze performance data. Position involves intense interaction with program managers and corporate personnel.

For the manager of training and career development qualifications might look like the following:

- Education—Bachelor’s degree in education or equivalent. Master’s degree preferred but not required.

- Experience—minimum ten years’ experience. Must be versed in educational techniques, tools, and methodologies; must have an understanding of PM responsibilities; must have advanced written and oral communication skills.

- Duties and Responsibilities of Position—position requires definition and coordination of training plans and course content. Must define and coordinate career development profiles and overall training for discipline.

And, lastly, for the manager of the information systems and tools, qualifications might look like the following:

- Education—B.S.C.S., B.S.E.E., or equivalent. Master’s in business administration or equivalent business master’s degree.

- Experience—minimum ten years’ experience with emphasis on management information systems. Must be versed in information management techniques, tools, and methodologies, and must have an understanding of PM responsibilities. Must have advanced written and oral communication skills.

- Duties and Responsibilities of Position—position includes the definition and implementation of the program management information system. Tasks include evaluating, selecting, and implementing hardware and software for the system. Responsibilities include determining data needs within the PM process and possibly writing software in support of this task.

In all cases it is absolutely mandatory that the individuals who make up the corporate program management office be senior-level and well-respected individuals in their own disciplines. If this is not the case, they will not be nearly as effective.
Have you ever been in a meeting where you suggested an idea only to have it abruptly shot down by someone else? Their reason for shooting it down may have been that the budget just didn’t exist, or the resources weren’t available, or that it simply did not compute given other considerations. Perhaps, during this same meeting, you sailed another test balloon only to have it shot down by the same person. Then, continuing in this vein, you floated another idea and it too was popped. After a number of these failed attempts to spur support for your bigger idea you may have looked over at the individual or individuals and thought how really negative that person(s) has been. And further, you may have thought that there was something about this other person that rubbed you the wrong way and perhaps you began to not like the other individual for so quickly shooting down your ideas. Perhaps you even began to think that the other individual(s) was intentionally deflating your ideas.

This section attempts to understand ourselves, and consequently others, better. In doing so we begin to realize that others may not be doing things just to irritate us but instead are doing what comes most natural to them, which is thinking differently than ourselves. They collect, organize, and present data in a manner different than we do. This does not make their methods less right. On the contrary, it brings to the table a potentially different perspective, which, when combined with our own way of doing things, creates a significant synergy.

Carl Jung, a Swiss psychiatrist, developed a theory that he believed described human consciousness. He believed that humans are born with certain mental and emotional possibilities. Jung’s thoughts were along the following lines. Humans have:
The ability to gather, store, and retrieve information by observing the world around them as well as their own memories and inner states.

The ability to reflect upon that information and organize it coherently to understand and make decisions.

Jung believed that although all humans have the capacity to observe and to organize, there are natural inborn differences in the ways people prefer to use these capacities.

Isabel B. Myers and Katherine Briggs studied and applied Jung’s theories to their understanding of individuals for eighteen years. In 1941 they began developing and testing questions that they hoped would assist people in self-understanding and increasing their understanding and appreciation of others. The eventual result was the Myers-Briggs Type Indicator (MBTI) personality inventory. The MBTI instrument operationalizes Jung’s theories and makes it possible to develop practical applications. Using the instrument and the theory provides a structured, systematic way of recognizing individual differences—one’s own and those of other people (Fitzgerald 1997, 4).

Jung believed that people had very natural ways of performing or thinking, which he referred to as preferences. Preferences are best thought of through an example. When we write our names we typically use one hand or the other. If we try to use the opposite hand to write our name we may be successful to some degree but don’t necessarily feel as comfortable in doing so. Another typical example is when we cross our arms in front of our bodies. In performing this task one hand comes up from the bottom while the other tucks down and inward. If we try to cross-over in the opposite direction most of us have to stop and think about exactly how to do that. This hesitation, or our sloppiness when writing with the other hand, is an indication of our less preferred capability. It doesn’t mean that we can not perform the act, it simply means that it is not our preferred approach to performing the act. This concept is extrapolated into our abilities to gather, store, retrieve, reflect, organize, and ultimately present or act on data around us.

Opposites, then, are two different ways of doing things. Jung identified two opposite preferences.

1. Perception (gathering information) may be performed through “sensing” or “intuition.”
2. Judgment (structuring or prioritizing) may be performed through “thinking” or “feeling.”

Jung further felt that we do not use our opposites with equal ability. We learn early to select an approach that we feel most comfortable with.
**Sensing (S) and Intuition (N)**

From a sensing, “S,” perspective, people who prefer to gather information through sensing:

- Focus on what is actual: they tend to focus on the present, the here and now.
- Focus on data available to the senses: sight, smell, touch, feel, hearing.

As leaders, they tend to:

- Be realistic and pragmatic
- Be on top of what is happening in their organizations
- Use factual data in forecasting the future and making decisions

From an intuition, “N,” perspective, people who prefer to gather data through intuition:

- Focus on connections between data
- Focus on patterns, meanings, or theoretical explanations

As leaders, they tend to:

- Be visionary and imaginative
- Have an “accurate” feel for what is going on
- Make decisions based on theoretical projection of future possibilities that they “see”

In terms of potential blind spots:

- People with a strong sensing preference are so focused on the present and their own experiences that they may find it difficult dealing with changing environments and radical rethinking of possibilities.
- People with a strong intuitive preference are so convinced of future possibilities that they may fail to consider current realities.

Individuals with a strong “sensing” preference, then:

- Rely on their senses
- Pay particular attention to details
- Are present oriented
- Are practical
- Are factual
- Like clear directions
- Are conservative in nature
Preferences and Psychological Typing

- May be literal
- Focus on the real-actual
- Trust their experience

Individuals with a strong “intuition” preference:

- Look for patterns in data
- Are future oriented
- Tend to be imaginative
- Are generally innovators
- Rely on hunches
- Look for change
- Are more figurative than their sensing counterparts
- Focus on the “big picture”
- Trust their inspiration

What’s interesting to do at this point as an exercise is to break the sensing “S” group out from the intuitive “N” group. Show both groups a brightly colored leaf and ask each group to talk about it. The sensing group will invariably describe the physical characteristics of the leaf, such as its size, shape, color, and other things they see with their eyes. The intuitive group, on the other hand, will jot down phrases of things such as “football games,” “the smell of leaves burning,” “Charlie Brown and Lucy,” “hot apple cider with cinnamon sticks.” Their descriptions are indicative of their preferred way of gathering and thinking about the data. The sensing group is much more focused on detail while the intuitive group is more pattern or “blue-sky” oriented.

Thinking (T) and Feeling (F)

When we talk about ways of making decisions the opposites here are “thinking” and “feeling.”

People who make decisions using a “thinking” perspective tend to apply logical principles to their decision making. As leaders they tend to:

- Take a detached analytical approach to problem solving
- Value clarity and accuracy
- Like to ask tough questions

People who make decisions using a “feeling” perspective tend to make decisions through a process of valuing: their own, others, and organizations to which they feel a commitment. As leaders:
• They encourage participation and consensus
• Value the contributions of others
• Routinely put themselves in others’ shoes

Both “thinking” and “feeling” are rational processes for deciding what information to use in decision making and how much weight to give different kinds of information.

Thinking decision-makers include information directly relevant and objective by their standards. Feeling decision-makers, on the other hand, include everything that is important in the situation without requiring it to be logical.

In terms of potential blind spots, thinking leaders may focus so much on logical analysis and tasks that they:

• Don’t put enough weight on the impact to other people when making decisions
• Can be overly competitive
• May not find it important to find common ground for compromise

Feeling decision-makers, in terms of blind spots, may focus so much on including others and empathizing that they:

• Lose track of tough decisions that they should be making
• Over-identify with people who are important to them
• Allow their decisions to be biased or personal

Individuals with a strong “thinking” preference, then:

• Tend to be thinking oriented. They tend to be rational, methodical, and analytical in their decision making.
• Tend to think with their head.
• Are generally objective.
• Prefer a sense of justice.
• Are typically perceptually cool.
• Are sometimes impersonal.
• Tend to critique.
• Are analytical.
• Are precise.
• Tend to be principle oriented.
• Look for reasonableness.
• Are frequently considered tough-minded.

Individuals with a strong “feeling” preference, on the other hand:
• Tend to be feeling oriented. That is, they are concerned with the impact to 
  and values of other people.
• Tend to think with their heart.
• Are more subjective.
• Like harmony.
• Are more caring.
• Typically are more personal.
• Are more appreciative.
• Tend to empathize.
• Are persuasive.
• Favor values over principles.
• Are more compassionate than reasonable.
• Tend to be more tender-hearted.

One can usually tell the difference between someone who prefers thinking 
to feeling in their decision making by asking a very simple question: “Tell me 
about. . . .” The individuals with a thinking preference will generally respond with 
something on the order of “I think. . . .” Those with a feeling preference will say, “I 
feel. . . .” Thinkers, as well, will be more object and activity oriented, whereas feel-
ers will generally be more people oriented.

**Extraversion (E) and Introversion (I)**

Aside from the way in which we gather information, “S” or “N,” and the way in 
which we structure, prioritize, and make decisions, “T” or “F,” there are differ-
ences in our orientation to the outside world and direction of energy. These differ-
ences are identified as extraversion, “E,” and introversion, “I.”

People exhibiting a strong preference for extraversion focus their energy and at-
tention primarily to the outside world, while people with a strong preference for in-
troversion focus their energy and attention to the inner world of ideas, values, and 
experience.

Individuals with a preference for extraversion:
• Are drawn towards people and things
• Actively pursue external interaction
• Draw mental and emotional energy from exchanges

As leaders, extraverted individuals tend to:
• Initiate contact
• Seek out others, action oriented
• Process thoughts out loud
• Be gregarious, enthusiastic, and expressive

Individuals with a strong preference for introversion:
• Are reflective
• Draw energy from quiet, introspective time

As leaders, introverted individuals:
• Like to receive information in written form
• Like time to process before replying
• Prefer one-on-one interactions
• May be perceived as contained and reserved, hard to “read”

Blind spots for individuals with a preference for extraversion are:
• They may act without sufficient reflection
• Their external processing may be confusing to others
• They may not give sufficient time for introverted internal processing

Blind spots for individuals with a preference for introversion are:
• They may continue to reflect when it’s time for action
• Their internal processing may exclude others who have a right to participate in the decision making
• Their eventual decision may seem to evolve out of the blue due to a lack of interaction with others
• They may seem aloof or snobbish; subordinates may feel they are being judged by their leader

Have you ever been to a party of some type and on leaving the other person in the car began a series of unending questions before you may even have had a chance to respond? The other person may have said, “What did you think of the party? Did you like it? How about that garden in the back? Wasn’t it really cool? I thought the party went pretty well. I couldn’t believe . . . .” Perhaps at this point you may have said, “Enough already! Will you just shut up for a while?”

Extraverted people tend to think out of their heads, as in the example above, sort of like a cartoon caption. Introverted people, however, like to internalize and reflect on what was said. Where extraverts tend to live by the sequence ready, fire, aim; introverts tend to collect, assimilate, reflect, and, when ready, speak. This very sequence causes me to listen when an introvert wishes to say something. I know when my introverted friends have something to say that they generally have thought it through pretty well beforehand.
Extraverts, on the other hand, formulate their final opinions as a matter of verbal discussion outside of their heads. So when an extraverted individual says something, he/she is most probably waiting to formalize the thought once a series of exchanges has taken place between the sender and the receiver. If the receiver is an introverted individual, the extraverted individual saying something he/she may not mean causes confusion unnecessarily. For example:

**Extraverted individual:** “Blah, blah, blah, blah, blah.”
**Introverted individual:** “What did you just say?”
**Extraverted individual:** “I don’t know, what?”
**Introverted individual:** “You just said, ‘blah, blah, blah, blah.’”
**Extraverted individual:** “I did! I didn’t mean it.”
**Introverted individual:** “Well if you said it you must certainly feel that way.”
**Extraverted individual:** “No. Not really. I was just talking out loud.”
**Introverted individual:** “Well if you didn’t mean it why did you say it?”
**Extraverted individual:** “I don’t know! I guess I was just talking. I really didn’t mean it.”
**Introverted individual:** “Well if you are going to be saying things just to be saying things, how will I know when you mean what you’re saying and when you don’t?”
**Extraverted individual:** “I don’t know. Just ask me, I guess.”

The point is that extraverted people will routinely formulate their opinions out loud as part of a normal dialog with another. Introverted individuals, however, will internalize and reflect, ultimately forming their opinions without such open discussion. extraverted individuals, then:

- Tend to be active communicators
- Are more outward
- Are sociable
- Enjoy people
- Favor many
- Are expressive
- Have a breadth of interests
- Tend to speak first, reflect later

Introverted individuals, on the other hand:

- Are less active and more reflective
- Are inward oriented
• Are more reserved
• Are private
• Favor few as opposed to many
• Are less expressive and more quiet
• Have a depth of interests
• Tend to reflect before speaking or acting

Judging (J) and Perceiving (P)

Some individuals direct their decision making process (thinking or feeling) toward the outside world (regardless of their extraversion or introversion). MBTI terms these individuals as judging. Individuals with a judging preference want their outside world to be orderly, clear, planned, and scheduled.

As leaders, judging individuals:
• Are uncomfortable with ambiguity
• Are impatient with process
• Focus on achieving results as quickly as possible
• Like to plan and stick to plans
• Trust their ability to get things done

Other individuals direct their process for information gathering (sensing or intuition) toward the external world (regardless of their extraversion or introversion). MBTI terms these individuals as perceiving. Individuals with a perceiving preference direct their information gathering from the outside world. Because of this they like to keep their external environment open and as unstructured as possible.

As leaders, perceiving individuals:
• Want a great deal of information
• Want decisions to emerge from the information gathering process
• Perceive goals as moving targets, temporary and changeable
• Enjoy flexibility and spontaneity
• Trust their ability to respond quickly to changing circumstances

Potential blind spots of individuals with a preference for judging:
• They can push for closure and decisions before enough information has been gathered
• They sometimes oversimplify for the sake of clarity
• Their overemphasis on following plans and adhering to time frames can feel controlling to others, especially perceivers
Potential blind spots of individuals with a preference for perceiving:

- They sometimes continue to gather information when decisions need to be made.
- They trust their ability to respond quickly to crisis but by delaying can actually encourage crisis.
- Their spontaneity and flexibility can cause undue stress on others, especially judging types.

Both the perceiving and judging types can be overly critical of each other, especially if the perceiving or judging individual is strong in that type.

Individuals with a judging preference:

- Are methodical
- Prefer structure
- Appreciate control
- Are decisive
- Are deliberate
- Are organized
- Like to plan
- Value deadlines
- Are perceived to be productive
- Are systematic

Individuals with a perceiving preference:

- Are flexible
- Tend to move with the flow
- Trust their experience
- Are curious
- Are spontaneous
- Are more open-ended
- Adapt readily
- Enjoy discovery
- Are receptive to new information
- Are more casual in their approach

Type Combinations

The MBTI personality inventory has four sets of opposites that result in 16 possible combinations. The number identified in the assessment indicates the degree to
which the individual favors a particular opposite. A table can be drawn depicting the 16 possible combinations of types. Table 17.1 reflects these combinations.

The types share a preference for ways of gathering information (sensing/intuition) and ways of making decisions (thinking/feeling).

**Combinations of sensing, intuition, thinking, and feeling**

The far left column of the table consists of the four ST types; the next column consists of the four SF types; the next column consists of the four NF types and the far right column consists of the four NT types. Even though the pairs in each column differ on their extraversion/introversion and judging/perceiving preferences, the fact that they share preferences for the way they gather information and the manner in which they make decisions means they generally will exhibit similar behaviors. For example:

1. STs (ISTJ, ISTP, ESTP, ESTJ) tend to share a focus on the bottom line realities. They are practical, logical, and tend to be drawn to technical concerns.
2. SFs (ISFJ, ISFP, ESFP, ESFJ) tend to share a focus on practical service to people. They tend to be sympathetic, friendly, and warm, and tend to be drawn to areas where they can help people on a day-to-day basis.
3. NFs (INFJ, INFP, ENFP, ENFJ) usually focus on people more globally, wanting to help improve the long-range well-being for all. They tend to be insightful, enthusiastic and value effective communication.
4. NTs (INTJ, INTP, ENTP, ENTJ) tend to focus more on developing and using conceptual frameworks. Their strength is in analyzing systems and seeing ways to improve them.

**Combinations of extraversion, introversion, judging, and perceiving**

Each row of the above type table shares the same preference for extraversion/introversion or judging/perceiving. The four types in a particular row therefore have similar orientations to the world (E/I) and similar preferences for organizing their external environment (J/P). For example:

1. IJs (ISTJ, ISFJ, INFJ, INTJ) are generally decisive introverts. They take time to process new information in their inner world. If new data fits their inner
world then they move ahead in an organized manner. If new data does not fit their inner world then they can become immovable.

2. IPs (ISTP, ISFP, INFP, INTP) are generally flexible and tolerant. They prefer to keep their external environment open. They will take new data inwards to evaluate with their preferred judging function (thinking/feeling). The data must pass logical analysis for thinkers and value standards for feelers.

3. EPs (ESTP, ESFP, ENFP, ENTP) are resourceful and energetic. They make excellent networkers and gatherers of information. Their enthusiasm carries others along with them. They handle new ideas by trying them out to see how they work.

4. EJs (ESTJ, ESFJ, ENFJ, ENTJ) love to take action to organize and structure the environment. They are decisive and energetic in making things happen. They tend to respond to new information by focusing on the goals, making plans, and proceeding according to plan.

Type and Organizational Change

In discussing organizational change Fitzgerald (Fitzgerald 1997, 12) provides the following.

1. In the top left-handed quadrant of a type table are four types that share preferences for introversion and sensing. The quick phrase to describe the IS reaction to proposals for change is, “let’s keep what we have.”

2. The types in the top right-hand quadrant of the type table share preferences for introversion and intuition. The quick phrase to describe the IN proposal for change is, “let me go away and think about it—I’ll get back to you.”

3. In the bottom left-handed quadrant of the type table are types that share preferences for extraversion and sensing. These types respond to change proposals by saying, “let’s just do it.”

4. The types in the bottom right-hand quadrant of the type table share preferences for EN and typically respond to change by saying, “whatever there is, let’s change it.”

The four types in the corner squares of the type table share a preference for thinking and judging. These types have been referred to as “tough-minded.” The combination of thinking and judging means that these types extravert their thinking, using it to plan, structure, and systemize their external environment.
They rationally analyze likely consequences of various alternatives and make quick decisions based on logic.

**Type Dynamics**

The synergy that evolves from summing the individual preferences is referred to as type dynamics. The Myers-Briggs Type Indicator® provides relative preferences on four scales:

1. Extraversion (E)/Introversion (I)
2. Sensing (S)/Intuition (N)
3. Thinking (T)/Feeling (F)
4. Judging (J)/Perceiving (P)

It is natural to conclude that each combination is simply a summation of each individual type preference. This, however, is not the case. What follows is a method to rank order our preferences, or in other words, create a hierarchy of type preferences. This hierarchy indicates those preferences we use most efficiently and those we use least efficiently.

Our type sequence is composed of four letters:

1. First letter is our preference for extraversion or introversion, which represents attitudes
2. Second letter is our preference for our perceptive mental functions of sensing or intuition
3. Third letter is our preference for mentally making judgments, either thinking or feeling
4. Fourth letter is our orientation to the outside world, either judging or perceiving

Everyone has and uses the four mental functions of sensing, intuition, thinking, and feeling every day. People simply differ in the order in which they prefer to use them and the order in which they tend to develop them as they grow. For example, for some people logical closure (thinking) is the most important activity, then they attend secondarily to the facts and details (sensing). These individuals might give less weight to the many potential possibilities (intuition) and the least weight to the people impact of decisions (feeling).

Using MBTI’s type theory, the order in which we favor these preferences is in-
**Preferences and Psychological Typing**

The four-letter type formula is a shorthand mechanism for telling us the order in which an individual prefers to use the four mental functions. Figure 17.2 depicts the order of preferences for each of the 16 type combinations.

**Extraverted Type Dynamics**

For extraverted individuals the four steps for determining the order of preferences are as follows.

1. Look at the fourth letter. If it is a “J” it points to the third letter. If it is a “P” it points to the second letter. For example, in ESTJ, J points to T; in ENFP, P points to N.

2. J/P points out one of the preferred functions that are typically extraverted. The other preferred function will typically be introverted. For example, in ESTJ, T is extraverted, S is introverted; in ENFP, N is extraverted, F is introverted.

3. For extraverted types, the extraverted function is dominant and the introverted function is auxiliary. For example, in ESTJ, T is extraverted and dominant, S is introverted and is second or auxiliary; in ENFP, N is extraverted and dominant, F is introverted and is second or auxiliary.

4. For all types the third function is the opposite of the second; and the fourth, or inferior, is the opposite of the first. For example, in ESTJ, T is #1, S is #2, N is #3, and F is #4; in ENFP, N is #1, F is #2, T is #3, and S is #4.
Introverted Type Dynamics

For introverted individuals, the four steps are nearly the same as for extraverted individuals. These steps are as follows.

1. Look at the fourth letter. If it is a “J” it points to the third letter, if it is a “P” it points to the second letter. For example, in ISTJ, J points to T; in INFP, P points to N.

2. J/P points out that one of the preferred functions is typically extraverted. The other preferred function will typically be introverted. For example, in ISTJ, T is extraverted, S is introverted; in INFP, N is extraverted, F is introverted. Extraverts show their first, or best, function to the outside world. Introverts, however, show their second-best function to the outside world, saving their best function for the inner world of ideas.

3. For introverted types the extraverted function is auxiliary and the introverted function is dominant. For example, in ISTJ, T is extraverted, so it comes second. S is introverted and is first; in INFP, N is extraverted and second. F is introverted and first.

4. For all types the third function is the opposite of the second; and the fourth, or inferior, is the opposite of the first. For example, in ISTJ, S is #1, T is #2, F is #3, and N is #4; in INFP, F is #1, N is #2, S is #3, and T is #4.

Having an understanding of our order of preferences allows us to more readily see the potential reasons for conflict in an organization, team, or even our personal lives. Figure 17.3 depicts two types indicative of this potential problem.

<table>
<thead>
<tr>
<th>Reasons for Conflict</th>
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<tr>
<td><strong>Figure 17.3.</strong> Potential Areas for Conflict</td>
</tr>
<tr>
<td>ENTJ</td>
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<tr>
<td>T</td>
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<tr>
<td>N</td>
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<tr>
<td>S</td>
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<tr>
<td>F</td>
</tr>
</tbody>
</table>

In this example the greatest strength, or most preferred function, for an ENTJ is thinking. The least preferred function is feeling. For an ISFP, however, the most preferred function is feeling, whereas the least preferred function is thinking. This type of combination poses many situations for potential conflict. For example, between two spouses one might suggest that they should buy a new home because it feels like the right time to do so. But the ENTJ spouse might suggest that the bud-
get, being reviewed over time, does not support the additional expense of the new home. The ISFP, on the other hand, might argue that money is not everything and that sometimes you simply have to proceed based on what feels like the right thing to do. The ISFP spouse might continue the discussion by reminding the ENTJ that everything has worked out in the past and it will be all right.

This type of conflict between the ENTJ’s logical, rational, and methodical position is in stark contrast to the ISFP’s spontaneous, heartfelt, value-laden approach.

**Summary Thoughts by Type**

What follows are summary comments in seven areas for each of the sixteen types. The areas for each type are: at their best, characteristics, how others see them, areas for growth, under stress, managerial practices, and type dynamics.

**ISTJ**

1. **ISTJ—At Their Best**
   a. Strong Sense of responsibility to organizations, family, and relationships
   b. Work with steady energy to fulfill commitments as stated and on time
   c. Prefer to work alone and be accountable for results; however, feel comfortable in teams when it’s necessary to do the job right

2. **ISTJ—Characteristics**
   a. Practical, sensible, and realistic
   b. Have a profound respect for facts
   c. Systematic
   d. Clear and steadfast in their opinions because they have used logical criteria based on their experience and knowledge

3. **ISTJ—How Others See Them**
   a. Calm, reserved, and serious
   b. Consistent and orderly
   c. Valuing traditions
   d. Only share their wealth of rich sensing observations and memories with close friends

4. **ISTJ—Areas for Growth**
   a. If they’ve not developed their Thinking, ISTJs may not have reliable ways for dealing with the world and instead may be preoccupied with their internal memories
b. If they’ve not developed their Sensing, they may rush into premature judgments and actions without considering new information

c. If they do not find a place where they can use their gifts and be appreciated for their contributions, they may:

i. Become rigid about time, schedules, and procedures—go “by the book”

ii. Be critical and judgmental of others

iii. Find it hard to delegate—to trust anyone else to do the job right

5. ISTJ—Under Stress
a. ISTJs may be unable to use their customary calm, reasonable judgment and get caught up in “catastrophizing”—imagining a host of negative possibilities for themselves and others.

6. ISTJ—Managerial Practices
a. Management-by-concentrated-desk time (MBCD), perseverance, and personal distance
b. Fact gathering is the most important business; wealth of information may be hidden at first; appreciates here-and-now tangibles
c. Decides in logical, objective modes; task focused
d. Organized, preplanned activity; control oriented

7. ISTJ—Type Dynamics
a. Serious, quiet, earn success by concentration and thoroughness. Practical, orderly, matter-of-fact, logical, realistic, and dependable. See to it that everything is well organized. Take responsibility. Make up their own minds as to what should be accomplished and work toward it steadily, regardless of protests or distractions.

ISFJ

1. ISFJ—At Their Best
a. Dependable and considerate, committed to people and groups with which they are associated
b. Work with steady energy to complete jobs fully and on time
c. Focus on what people need and want and establish orderly procedures to bring these about

2. ISFJ—Characteristics
a. Practical and realistic
b. Concrete and specific
c. Cooperative and thoughtful of others
d. Kind and sensitive
3. ISFJ—How Others See Them
   a. Quiet, serious, and conscientious
   b. Considerate, good caretakers
   c. Honoring commitments, preserving traditions
4. ISFJ—Areas for Growth
   a. If they’ve not developed their Feeling, ISFJs may not have reliable ways for dealing with the world and instead may be preoccupied with their Sensing memories
   b. If they’ve not developed their Sensing, they may rush into premature judgments and actions without considering new information
   c. If they do not find a place where they can use their gifts and be appreciated for their contributions, they may:
      i. Become rigid in supporting hierarchy, authority, and procedures
      ii. Feel underappreciated, resentful—complain a lot
      iii. Be overly focused on immediate impacts of decisions on people
5. ISFJ—Under Stress
   a. ISFJs can get caught up in “catastrophizing”—imagining a host of negative possibilities. They may then express these without their usual consideration for the impact on people around them.
6. ISFJ—Managerial Practices
   a. Management-by-concentrated-desk time (MBCD); perseverance and one-to-one discussion
   b. Fact gathering is the most important business; wealth of information may be hidden at first; values here-and-now tangibles
   c. Decides in terms of own priorities/loyalties and employee needs/wants; people focused; historical perspective
   d. Organized, preplanned activity; control oriented
7. ISFJ Type Dynamics
   a. Quiet, friendly, responsible, and conscientious. Work devotedly to meet obligations. Lend stability to any project or group. Thorough, painstaking, accurate. Their interests are usually not technical. Can be patient with necessary details. Loyal, considerate, perceptive, concerned with how other people feel.

INTJ

1. INTJ—At Their Best
   a. INTJs have a clear vision of future possibilities and the organization and drive to implement their ideas
b. Love complex challenges and readily synthesize complicated theoretical and abstract matters
c. Value knowledge highly and expect competence of themselves and others

2. INTJ—Characteristics
   a. Insightful, creative synthesizers
   b. Conceptual, long-range thinkers
   c. Clear and concise
d. Rational, detached and objectively critical
e. Long-range planners

3. INTJ—How Others See Them
   a. Private, reserved, hard to know, aloof
   b. Conceptual, original, and independent

4. INTJ—Areas for Growth
   a. If they’ve not developed their Thinking, INTJs may not have reliable ways for translating their valuable insights into applications that can be realized
   b. If they’ve not developed their Intuition, they may not take in enough information, or take in only information that fits their insights. They then make ill-founded decisions
   c. If they do not find a place where they can use their gifts and feel appreciated for their contributions, they may:
      i. Become aloof and abrupt, not giving enough information about their internal processing
      ii. Be critical of those who do not see their vision quickly; then they become single-minded and unyielding in pursuing it

5. INTJ—Under Stress
   a. INTJs can overindulge in Sensing activities – watching TV reruns, playing cards, overeating—or become overly focused on specific details that they normally do not notice or usually see as unimportant.

6. INTJ—Managerial Practices
   a. Management-by-concentrated-desk time (MBCD); perseverance and personal distance
   b. Potentials, theory, the big picture, and the future are most important business; insight and knowledge may be hidden at first
   c. Decides in logical, objective modes; task focused
d. Organized, preplanned activity; control oriented

7. INTJ—Type Dynamics
   a. Have original minds and great drive for their own ideas and purposes. Have long-range vision and quickly find meaningful patterns in external events. In fields that appeal to them, they have a fine power to organize a
job and carry it through. Skeptical, critical, independent, determined; have high standards of competence and performance.

**ESFP**

1. **ESFP—At Their Best**
   a. Exuberant lovers of life
   b. Live in the moment and find enjoyment in people, food, clothes, animals, the natural world and activities
   c. Focus on meeting human needs in creative ways
   d. Excellent team players, oriented to getting the task done with maximum amount of fun

2. **ESFP—Characteristics**
   a. Practical, realistic, and specific
   b. Observant, focused on current realities
   c. Generous, optimistic, and persuasive
   d. Warm, sympathetic, and tactful

3. **ESFP—How Others See Them**
   a. If they’ve not developed their Feeling, ESFPs may get caught up in the interactions of the moment with no mechanism for weighing, evaluating, or anchoring themselves
   b. If they’ve not developed their Sensing, they may focus on the sensory data available in the moment. Their decisions may be limited to gratification of their sensual desires

4. **ESFP—Areas for Growth**
   a. If ESFPs do not find a place where they can use their gifts and be appreciated for their contributions they may:
      i. Become distracted and overly impulsive
      ii. Have trouble accepting and meeting deadlines

5. **ESFP—Under Stress**
   a. ESFPs may feel overwhelmed internally by negative possibilities. They then put energy into developing simplistic global explanations for their negative pictures.

6. **ESFP—Managerial Practices**
   a. Management-by-walking-around (MBWA); frequent contact with others and doing/acting as soon as possible
   b. Fact gathering is the most important business; talk about details; responsive to the here and now
c. Decides in terms of own priorities/loyalties and employee needs/wants; historical perspective
d. Responsive to new data; flexible approach; inquisitive and laid-back attitude

7. ESFP — Type Dynamics
a. Outgoing, accepting, friendly, enjoy everything and make things more fun for others by their enjoyment. Like action and making things happen. Know what's going on and join in eagerly. Find remembering facts easier than mastering theories. Are best in situations that need sound common sense and practical ability with people.

**ISTP**

1. ISTP — At Their Best
   a. Carefully observe what is going on around them
   b. Move quickly to get to the core of a problem and solve it with great efficiency and the least effort
   c. Resist regimentation and rules, thrive on variety and novelty, enjoy the challenge of solving a new, concrete, extensive problem

2. ISTP — Characteristics
   a. Detached and objectively critical
   b. Analytical and logical problem-solvers
   c. Practical and realistic
   d. Factual and pragmatic
   e. Expedient and believe in economy of effort—doing only what’s needed with the least possible discussion or fuss

3. ISTP — How Others See Them
   a. Others sometimes have trouble “reading” ISTPs
   b. Adaptable, action-oriented risk-takers
   c. Confident, independent, and self-determined

4. ISTP — Areas for Growth
   a. If they’ve not developed their Sensing, ISTPs may have no reliable way of getting accurate data about the external world or of translating their thoughts into action
   b. If they’ve not developed their Thinking, they may get caught up in the realities around them and not take time to do the internal logical processing they need to make good decisions
   c. If they do not find a place where they can use their gifts and be appreciated for their contributions they may:
Preferences and Psychological Typing

5. ISTP—Under Stress
   a. ISTPs may erupt outwardly in inappropriate displays of emotion. The resulting explosive anger or hurt tearfulness is quite unnerving to others and embarrassing to the usually calm and controlled ISTP.

6. ISTP—Managerial Practices
   a. Management-by-concentrated-desk time (MBCD); perseverance and personal distance
   b. Sees details of cause-and-effect chains; exhibits practical realism; present orientation; a flair for seeing funny angles
   c. Deciding in logical, objective, and efficient modes is the most important business; task focused
   d. Responsive to new data; flexible approach; inquisitive and laid-back attitude

7. ISTP—Type Dynamics
   a. Cool onlookers—quiet, reserved, observing, and analyzing life with detached curiosity and unexpected flashes of original humor. Usually interested in cause and effect, how and why mechanical things work, and in organizing facts using logical principles. Excel at getting to the core of a practical problem and finding, perceiving, or judging the solution.

ESTP

1. ESTP—At Their Best
   a. Energetic, active problem-solvers, responding creatively to challenging situations
   b. Develop easy ways to do hard things and make their work fun
   c. Flexible, adaptable, inventive, resourceful, and are good team players

2. ESTP—Characteristics
   a. Practical and realistic
   b. Observant
   c. Focused on immediate experience
   d. Make decisions by logical analysis and reasoning
   e. Analytical, rational problem-solvers
   f. Straightforward and assertive

3. ESTP—How Others See Them
   a. Gregarious, fun-loving, and spontaneous
b. Adventurous risk-takers

c. Pragmatic trouble-shooters

4. ESTP—Areas for Growth

a. If they've not developed their Thinking, ESTPs will not have a useful way of selecting amongst the barrage of incoming sensory data. They may make ill-founded decisions and have difficulty setting priorities.
b. If they've not developed their Sensing, they may focus on the Sensing data that are immediately available. Their decisions may be limited to gratification of their sensual desires.
c. If they do not find a place where they can use their gifts and be appreciated for their contributions, they may:
   i. Have trouble accepting structure and meeting deadlines
   ii. Focus entirely on excitement and activity, get completely caught up in external activities
   iii. Put enjoying life ahead of important obligations

5. ESTP—Under Stress

a. ESTPs may experience negative fantasies. They may imagine that others do not really care about them, then marshal and distort their Sensing data to provide themselves with “evidence” of this neglect.

6. ESTP—Managerial Practices

a. Management-by-walking-around (MBWA); frequent contact with others and doing/acting as soon as possible
b. Fact gathering is the most important business; talk about details; responsive to the here and now

c. Decide in logical, objective modes; task focused
d. Responsive to new data; flexible approach; inquisitive and laid-back attitude

7. ESTP—Type Dynamics

a. Good at on-the-spot problem solving. Like action, enjoy whatever comes along. Tend to like mechanical things and sports, with friends on the side. Adaptable, tolerant, pragmatic; focused on getting results. Dislike long explanations. Are best with real things that can be worked, handled, taken apart, or put together.

INFJ

1. INFJ—At Their Best

a. INFJs have a gift for intuitively understanding complex meanings and human relationships
b. They have faith in the insights, which often take on a sense of sureness, of "knowing"
c. Empathetically understand the feelings and motivations of people even before the others are themselves aware of them

2. INFJ—Characteristics
   a. Insightful, creative, and visionary
   b. Conceptual, symbolic, and metaphorical
   c. Idealistic, complex, and deep
   d. Sensitive, compassionate, and empathetic
   e. Deeply committed to their values

3. INFJ—How Others See Them
   a. Private and mysterious
   b. Intense and individualistic
   c. Show compassion and caring for others; but share their internal intuitions only with those they trust

4. INFJ—Areas for Growth
   a. If they've not developed their Feeling, they may not have reliable ways of accomplishing their goals. Then their valuable insights and creativity stay locked inside.
   b. If they've not developed their Intuition, they may not take in enough information or take in only what fits with their internal pictures. Then they will make ill-founded decisions based on distorted or limited information.
   c. If they do not find a place where they can use their gifts and be appreciated for their contributions, they may:
      i. Not give others the information they used to arrive at a decision, and thus seem arbitrary.
      ii. Base their judgments on little data, on a sense of "knowing" that has little basis in reality.
      iii. Become resentful and critical.

5. INFJ—Under Stress
   a. INFJs may become obsessed with data they usually consider irrelevant or overindulge in Sensing activities such as watching TV reruns, overeating, or buying things with little meaning to them.

6. INFJ—Managerial Practices
   a. Management-by-concentrated-desk time (MBCD); perseverance and one-to-one discussion
   b. Potentials, theory, the big picture, and the future are the most important business; insight and knowledge may be hidden at first
c. Decides in terms of own priorities/loyalties and employee needs/wants; people focused; historical perspective
d. Organized, preplanned activity; control oriented

7. INFJ—Type Dynamics
a. Succeed by perseverance, originality, and desire to do whatever is needed or wanted. Put their best efforts into their work. Quietly forceful, conscientious, concerned for others. Respected for their firm principles. Likely to be honored and followed for their clear visions as to how best to serve the common good.

ISFP

1. ISFP—At Their Best
a. Live in the present with a quiet sense of joyfulness
b. Want to have time to experience each moment
c. Faithful in fulfilling obligations to people and things that are important to them

2. ISFP—Characteristics
a. Trusting, kind, and considerate
b. Sensitive and gentle
c. Observant
d. Realistic, practical, concrete, and factual

3. ISFP—How Others See Them
a. Quiet, reserved, and private—hard to know well
b. Spontaneous and tolerant
c. Prefer not to organize situations but instead to observe and support; they have little wish to dominate

4. ISFP—Areas for Growth
a. If they’ve not developed their Sensing, they may have no reliable way of getting accurate data about the external world or of actualizing their values. Their decisions will be based on little information and be overly personal.
b. If they’ve not developed their Feeling, they may get caught up in Sensing realities and not take time to do the internal valuing process by which they make their best decisions. They may avoid decision making, allowing others to decide for them.
c. If they do not find a place where they can use their gifts and be appreciated for their contributions, they may:
   i. Withdraw from people and the situation
ii. Passively resist structures and rules
iii. Be excessively self-critical
iv. Feel unappreciated and undervalued

5. ISFP—Under Stress
   a. ISFPs can, under extreme pressure, become uncharacteristically critical of themselves and others, verbalizing harsh and negative judgments.

6. ISFP—Managerial Practices
   a. Management-by-concentrated-desk time (MBCD); perseverance and one-to-one discussion
   b. See details of cause-and-effect chains; use data and practical realism to back up priorities and loyalties; present orientation
   c. Deciding in terms of own priorities/loyalties and employee needs/wants is the most important business; people focused; historical perspective
   d. Responsive to new data; flexible approach; inquisitive and laid-back attitude

7. ISFP—Type Dynamics
   a. Retiring, quietly friendly, sensitive, kind, modest about their abilities. Shun disagreements, do not force their opinions or values on others. Usually do not care to lead but are often loyal followers. Often relaxed about getting things done because they enjoy the present moment and do not want to spoil it by undue haste or exertion.

ESTJ

1. ESTJ—At Their Best
   a. Like to organize projects, operations, procedures, and people, and then act to get things done
   b. Live by a set of clear standards and beliefs
   c. Value competence, efficiency, and results

2. ESTJ—Characteristics
   a. Logical, analytical, objectively critical
   b. Decisive, clear, and assertive
   c. Practical, realistic, and matter-of-fact
   d. Systematic and pragmatic

3. ESTJ—How Others See Them
   a. Conscientious and dependable
   b. Decisive, outspoken, and self-confident
   c. Because they are straightforward in their communication, people seldom have to wonder where they stand

4. ESTJ—Areas for Growth
a. If they’ve not developed their Sensing, they may decide too quickly before taking in enough information. Then their decision will reflect their previously formed judgments or biases.

b. If they’ve not developed their Thinking, they may not have a reliable way of evaluating information and thus end up making inconsistent or overly harsh decisions.

c. If they do not find a place where they can use their gifts and feel appreciated for their contributions, they may:
   i. Become rigid and dogmatic
   ii. Become intrusive, “know-it-all” experts, overpowering others and refusing to listen
   iii. Get picky about details and be impatient with those who do not follow procedures exactly

5. ESTJ—Under Stress
   ESTJs may feel alone and unappreciated, and be unable to communicate their inner feeling of distress and despair.

6. ESTJ—Managerial Practices
   a. Management-by-walking-around (MBWA); frequent contact with others and doing/acting as soon as possible
   b. See details of cause-and-effect chains; use practical realism to back up conclusion; present oriented
   c. Deciding in logical, objective, and efficient modes is the most important business, talk focused
   d. Organized, preplanned activity; control oriented

7. ESTJ—Type Dynamics
   a. Practical, realistic, matter-of-fact, with a natural head for business or mechanics. Not interested in abstract theories; want learning to have direct and immediate application. Like to organize and run activities. Often make good administrators; are decisive, quickly move to implement decisions, take care of routine details.

**INFP**

1. INFP—At Their Best
   a. INFPs want to be involved in work that contributes to their own growth and inner development and that of others
   b. Make priority in living in congruence with their values

2. INFP—Characteristics
   a. Sensitive, concerned, and caring
b. Loyal to people or a cause  
c. Likely to be curious and creative  
d. Have long-range vision  
e. Capable of great concentration and output when fully engaged in a project  

3. INFP—How Others See Them  
a. Sensitive, introspective, and complex  
b. Original and individual  
c. Reserved about sharing their most deeply held values and feelings  

4. INFP—Areas for Growth  
a. If they’ve not developed their Intuition, they may not have reliable ways of taking information and will then fail to notice realities. Then they make decisions based solely on personal values and find it difficult to translate their values into action.  
b. If they’ve not developed their Feeling, they may not take time to do the inner valuing process by which they make their best decisions, instead going from one exciting possibility to another, achieving little.  
c. If they do not find a place where they can use their gifts and be appreciated for their contributions, they may:  
   i. Have uncharacteristic difficulty expressing themselves verbally  
   ii. Withdraw from people and situations  
   iii. Not give enough information to others, especially about important values  

5. INFP—Under Stress  
a. INFPs may begin seriously doubting their own competence and that of others, becoming overly critical and judgmental.  

6. INFP—Managerial Practices  
a. Management-by-concentrated-desk time (MBCD); perseverance and one-to-one discussion  
b. Options and possibilities for improved or new situations and relationships come easily; future orientation  
c. Deciding in terms of own priorities/loyalties and employee needs/wants is the most important business; people focused; historical perspective  
d. Responsive to new data, flexible approach; inquisitive and laid-back attitude  

7. INFP—Type Dynamics  
a. Quiet observers, idealistic, loyal. Important that outer life be congruent with inner values. Curious, quick to see possibilities, often serve as catalysts to implement ideas. Adaptable, flexible, and accepting unless a
value is threatened. Want to understand people and ways of fulfilling human potential. Little concern with possessions or surroundings.

**ENFP**

1. **ENFP—At Their Best**  
   a. Life for an ENFP is a creative adventure full of exciting possibilities  
   b. Experience a wide range of feelings and intense emotions  
   c. Keenly perceptive of people and the world around them and insightful about the present and future

2. **ENFP—Characteristics**  
   a. Curious, creative, and imaginative  
   b. Energetic, enthusiastic, and spontaneous  
   c. Warm, friendly, and caring  
   d. Cooperative and supportive

3. **ENFP—How Others See Them**  
   a. Personable, perceptive, and persuasive  
   b. Enthusiastic, spontaneous, and versatile  
   c. Giving affirmation and wanting to receive it

4. **ENFP—Areas for Growth**  
   a. If they've not developed their Feeling, they may go from enthusiasm to enthusiasm, never committing the energy necessary to actualize their insights  
   b. If they've not developed their Intuition, they may overrely on personal value judgments and fail to take in enough information. They then will not trust their own insights, be uncertain, and accept others' perceptions too quickly.  
   c. If they do not find a place where they can use their gifts and be appreciated for their contributions, they may:  
      i. Become scattered, have trouble focusing, be easily distracted  
      ii. Become rebellious, excessively nonconforming  
      iii. Ignore deadlines and procedures

5. **ENFP—Under Stress**  
   a. ENFPs may become overwhelmed by detail and lose their normal perspective and sense of options. They then tend to focus on an unimportant or distorted detail, letting it become the central fact of their universe.

6. **ENFP—Managerial Practices**  
   a. Management-by-walking-around (MBWA); frequent contact with others and doing/acting as soon as possible
b. Options and possibilities for new or improved situations and relationships are the most important business; breadth and depth of knowledge; future orientation
c. Decide in terms of own priorities/loyalties and employee needs/wants; people focused; historical perspective
d. Responsive to new data; flexible approach; inquisitive and laid-back attitude

7. ENFP—Type Dynamics
a. Warmly enthusiastic, high-spirited, ingenious, imaginative. Able to do almost anything that interests them. Quick with a solution for any difficulty and ready to help anyone with a problem. Often rely on their ability to improvise instead of preparing in advance. Can usually find compelling reasons for whatever they want.

INTP

1. INTP—At Their Best
a. Independent problem-solvers who excel at providing a detached, concise analysis of an idea or situation
b. They ask hard questions, challenging others and themselves to find new logical approaches

2. INTP—Characteristics
a. Logical, analytical, and objectively critical
b. Detached and contemplative
c. See possibilities beyond the present and obvious
d. Mentally quick, insightful, and ingenious
e. Intensely curious about ideas and theories

3. INTP—How Others See Them
a. Quiet, contained, calm, and detached observers
b. Independent, valuing autonomy
c. Prefer not to organize people or situations

4. INTP—Areas for Growth
a. If they’ve not developed their Intuition, they may not have a reliable way for taking in information and be immersed in their internal logical systems. They then find it difficult to communicate or actualize their ideas.
b. If they’ve not developed their Thinking, they may go from insight to insight, never analyzing them with a critical eye or integrating them into a whole.
c. If they do not find a place where they can use their gifts and be appreciated for their contributions, they may:
   i. Become cynical and negative
   ii. Be sarcastic and destructively critical
   iii. Isolate themselves and put off action
   iv. Engage in verbal sparring and arguments

5. INTP—Under Stress
   a. INTPs may erupt outwardly in inappropriate displays of emotion. The resulting explosive anger or hurt tearfulness is quite unnerving to others and embarrassing to the usually calm and controlled INTP.

6. INTP—Managerial Practices
   a. Management-by-concentrated-desk time (MBCD); perseverance and personal distance
   b. Options and possibilities for improved or new situations and relationships come easily; future orientation
   c. Deciding in logical, objective, and efficient modes is the most important business; task focused
   d. Responsive to new data; flexible approach; inquisitive and laid-back attitude

7. INTP—Type Dynamics
   a. Quiet and reserved. Especially enjoy theoretical or scientific pursuits. Like solving problems with logic and analysis. Interested mainly in ideas, with little liking for parties or small talk. Tend to have sharply defined interests. Need careers where some strong interest can be used and useful.

ENTJ

1. ENTJ—At Their Best
   a. Natural leaders and organization builders
   b. Conceptualize and theorize readily to translate possibilities into plans to achieve short-term and long-term objectives
   c. Strong urge to organize people and situations to get them moving in the right direction

2. ENTJ—Characteristics
   a. Analytical, logical, and objectively critical
   b. Decisive, clear, and assertive
   c. Conceptual
   d. Innovative theorists and planners
e. Disinterested in routine maintenance activities, preferring the stimulation of new challenges

3. ENTJ—How Others See Them
   a. Direct, challenging, and decisive
   b. Objective, fair, and stimulating
   c. Their verbal fluency, decisiveness, self-confidence, and urge to organize others can overpower people at times

4. ENTJ—Areas for Growth
   a. If they’ve not developed their Intuition, they may make decisions too quickly without considering alternatives or exploring possibilities
   b. If they’ve not developed their Thinking, they may not have a reliable way to evaluate their insights and make plans. Then their decision making will be inconsistent and changeable
   c. If they do not find a place where they can use their gifts and be appreciated for their contributions, they may:
      i. Become overly impersonal and critical
      ii. Be intrusive and directive—giving orders without listening
      iii. Become abrasive and verbally aggressive

5. ENTJ—Under Stress
   a. ENTJs can be overwhelmed by self-doubt, feel alone and unappreciated, and feel unable to express their distress to others.

6. ENTJ—Managerial Practices
   a. Management-by-walking-around (MBWA); frequent contact with others and doing/acting as soon as possible
   b. Options and possibilities for situations and relationships come easily; future orientation
   c. Deciding in logical, objective, and efficient modes is the most important business; task focused

7. ENTJ—Type Dynamics
   a. Frank, decisive, leader in activities. Develop and implement comprehensive systems to solve organizational problems. Good in anything that requires reasoning and intelligent talk, such as public speaking. Are usually well informed and enjoy adding to their fund of knowledge.

ESFJ

1. ESFJ—At Their Best
   a. Like to organize people and situations and then work with others to complete tasks accurately and on time
b. Conscientious and loyal
c. Sociable and outgoing
d. Want to be appreciated for themselves and for what they give to others

2. ESFJ—Characteristics
   a. Warm, sympathetic, and helpful
   b. Personable, cooperative, and tactful
   c. Practical, realistic, and down-to-earth
   d. Decisive, thorough, and consistent
   e. Sensitive to the needs of others and good at providing practical caring

3. ESFJ—How Others See Them
   a. Sociable, outgoing, enthusiastic, and energetic
   b. Organized and orderly
   c. Committed to preserving traditions
   d. Value family and social ties

4. ESFJ—Areas for Growth
   a. If they’ve not developed their Sensing, they may not take in much information before making decisions and will then jump to conclusions before fully understanding a situation
   b. If they’ve not developed their Feeling, they may be tentative and uncertain, accepting the judgments of others too quickly
   c. If they do not find a place where they can use their gifts and be appreciated for their contributions, they may:
      i. Doubt themselves and focus their attention entirely on satisfying the needs of others
      ii. Worry and feel guilty
      iii. Become controlling in their push for harmony—“we will all get along”

5. ESFJ—Under Stress
   a. ESFJs may find themselves uncharacteristically critical of others and of themselves. Their negative thoughts and opinions often trouble them greatly.

6. ESFJ—Managerial Practices
   a. Management-by-walking-around (MBWA); frequent contact with others and doing/acting as soon as possible
   b. Sees details of cause-and-effect chains; uses practical realism to back up conclusions, present oriented
   c. Deciding in terms of own priorities/loyalties and employee needs/wants is the most important business; people focused; historical perspective
   d. Organized, preplanned activity; control oriented

7. ESFJ—Type Dynamics
a. Warm-hearted, talkative, popular, conscientious, born cooperators, active committee member. Need harmony and may be good at creating it. Always doing something nice for someone. Work best with encouragement and praise. Main interest is in things that directly and visibly affect people’s lives.

**ENFJ**

1. **ENFJ—At Their Best**
   a. Highly attuned to others, using empathy to quickly understand emotional needs, motivations, and concerns
   b. Focus on supporting others and encouraging their growth
   c. Can be inspiring leaders as well as loyal followers
2. **ENFJ—Characteristics**
   a. Warm, compassionate, and supportive
   b. Loyal and trustworthy
   c. Imaginative
   d. Like variety and new challenges
3. **ENFJ—How Others See Them**
   a. Sociable, personable, congenial, and gracious
   b. Expressive, responsive, and persuasive
   c. Like their lives organized and will work to bring closure to ambiguous relationships or situations
4. **ENFJ—Areas for Growth**
   a. If they’ve not developed their Intuition, they may not see possibilities, making decisions too quickly without taking in enough information or considering factors beyond their own personal values
   b. If they’ve not developed their Feeling, their decisions may be inconsistent and poorly formulated. They may then accept the judgments of others too readily
   c. If they do not find a place where they can use their gifts and be appreciated for their contributions, they may:
      i. Worry, feel guilty, and doubt themselves
      ii. Become inconsistent and controlling in their desire for harmony
      iii. Become overly sensitive to criticism—real or imagined
5. **ENFJ—Under Stress**
   a. ENFJs may find themselves suddenly and uncharacteristically critical and faultfinding with others. They generally keep these negative opinions to themselves but they find such thoughts troubling and upsetting.
6. ENFJ—Managerial Practices
   a. Management-by-walk-around (MBWA); frequent contact with others and doing/acting as soon as possible
   b. Options and possibilities for situations and relationships come easily; future orientation
   c. Deciding in terms of own priorities/loyalties and employee needs/wants is the most important business; people focused; historical perspective

7. ENFJ—Type Dynamics
   a. Responsive and responsible. Feel real concern for what others think or want and try to handle things with due regard for the others’ feelings. Can present a proposal or lead a group discussion with ease and tact. Sociable, popular, sympathetic. Responsive to praise and criticism.

ENTP

1. ENTP—At Their Best
   a. Constantly look to the environment for opportunities and possibilities
   b. See patterns and connections not obvious to others and, at times, seem able to see into the future
   c. Good at understanding how systems work and are enterprising and resourceful in maneuvering within them to achieve their ends

2. ENTP—Characteristics
   a. Creative, imaginative, and clever
   b. Theoretical, conceptual, and curious
   c. Analytical, logical, rational, and objective
   d. Assertive and questioning
   e. Enterprising and resourceful

3. ENTP—How Others See Them
   a. Independent, autonomous
   b. Lively, enthusiastic, and energetic
   c. Assertive and outspoken

4. ENTP—Areas for Growth
   a. If they’ve not developed their Thinking, they may not have reliable ways to evaluate their insights and make plans to carry them through. They then go from enthusiasm to enthusiasm with little to show for it.
   b. If they’ve not developed their Intuition, they may not take in relevant information and have “insights” unrelated to current reality
   c. If they do not find a place where they can use their gifts and be appreciated for their contributions, they may:
      i. Become brash, rude, and abrasive
ii. Criticize others, especially those who seem to the ENTP to be inefficient or incompetent
iii. Become rebellious and combative

5. ENTP—Under Stress
   a. ENTPs can be overwhelmed by detail, losing their ability to generate possibilities. Then they focus on a minor or distorted detail, thinking that it is supremely important.

6. ENTP—Managerial Practices
   a. Management-by-walking-around (MBWA); frequent contact with others and doing/acting as soon as possible
   b. Options and possibilities for improved or new situations and relationships are the most important business; breadth and depth of knowledge show early; future orientation
   c. Decides in logical, objective modes; task focused
   d. Responsive to new data; flexible approach; inquisitive and laid-back attitude

7. ENTP—Type Dynamics
   a. Quick, ingenious, good at many things. Stimulating company, alert and outspoken. May argue for fun on either side of a question. Resourceful in solving new and challenging problems but may neglect routine assignments. Apt to turn to one new interest after another. Skillful in finding logical reasons for what they want.
Appendix A

Planning Process Evaluation Results

This evaluation uses research methods to test the effectiveness of a model for planning programs. It addresses the following questions:

1. How adequate will the cost, schedule, and technical performance measurement baseline be as a result of following the program management planning process of this study?
2. What is the quality of the performance measurement baseline resulting from following this program management planning process?
3. To what extent do the program planning team participants perceive their efforts in creating a performance measurement baseline as justified?
4. Is the methodology employed in this evaluation generalizable to other studies of planning processes?
5. Relative to integrated linear and integrated nonlinear models of planning processes, what does this study reveal?

1. Methodology

To determine the effectiveness of the planning the following steps were performed:

1. A program was selected to use in implementing the program management planning process. The program was an awarded cost-plus contract consisting of engineering development with production options. The contract value was approximately $40,000,000 at sell price and extended over a five-year period. Of the $40,000,000 selling price, $20,000,000 was for engineer-
ing development, leaving $20,000,000 for production options. Two of the five years were dedicated to the development of the product with the remaining three years dedicated to the product's production.

2. The planning model was broken into logical components representing the various activities of the program management planning process. The components were program organization planning, schedule planning, cost planning, and performance planning.

3. Individuals representing different functional organizations were selected to implement their specific tasks in each of these components of the planning process. The functional organizations represented were hardware engineering, software engineering, system engineering, subcontracts, accounting, program management, drafting, production engineering, logistics engineering, hardware quality assurance, and software quality assurance.

4. An individual representing one functional organization and implementing the specific aspect of each component was required to coordinate with other individuals implementing the other components of the planning process. This cross-fertilization of personnel provided for a more continuous and thorough evaluation of the products that passed from one activity to the next.

5. Questionnaires were completed and interviews conducted at the conclusion of each component. These questionnaires and interviews provided the data, which was analyzed to determine the effectiveness of the process. Additionally, participation and personal observation were used as a research method.

The instruments used for gathering evidence were personal interviews (appendixes C and D), questionnaires (appendixes E and F), and direct observation (appendix G). Separate interview instruments were generated for the participants and the facilitator.

A committee of stakeholders was formed to represent organizational interests and the program under study. This committee assisted in determining the goals and objectives of the program management planning process. The program's goals and objectives, then, became the focus for creating data-gathering instruments. The committee of stakeholders played an integral role in the entire evaluation process, assisting in generating the program's goals and objectives, evaluation instruments, and in validating data-gathering items and instruments.

1.1. Schedule of Events/Activities

The activities associated with this study were:
1. Identifying and organizing a stakeholder group
2. Defining implementation goals and objectives
3. Developing the data-collection instruments
4. Finding a program with which to implement the planning process
5. Implementing the planning process
6. Collecting data through questionnaires (multiple-choice and Likert), interviews, and observation in concert with the implementation of the program management planning process
7. Analyzing the collected data
8. Documenting the analysis
9. Reporting the findings to the stakeholders

Figure A.1 depicts these activities, their relative relationships, and their durations.

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<thead>
<tr>
<th>Months after initiation of study</th>
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<td>Activity</td>
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<td>Implementation of the PM Planning Process</td>
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<td>Collecting Data</td>
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<td>Analysis of collected data</td>
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<td>Documentation of the analysis</td>
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<td>Reporting of findings to stakeholders</td>
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**Legend**

- △ Start milestone of an activity
- ▽ End milestone of an activity

**Figure A.1.**

*Activity Timeline*

1.2. Participants and Instruments

The participants in the study represented the eleven functional organizations listed in section 1.

There were eighteen planning team members who supported the development of the cost, schedule, and technical performance measurement baseline. All
of these eighteen planning team members had prior experience in creating program cost, schedule, and technical performance measurement baselines outside of this program management planning process. Sixteen planning team members of this study had prior experience in creating program cost, schedule, and technical performance measurement baselines utilizing this program management planning process. This breadth of experience provided a knowledgeable perspective on which to base comparative statements on the ease of implementation and the quality of the performance measurement baseline. This is important, as it related to one of the basic questions of this study.

There were four different types of data-collection instruments used in this study: personal interviews, multiple-choice questionnaires, Likert scale questionnaires, and direct observation. These instruments were based on the identified planning process outcomes and behaviors acceptable as evidence of the outcomes. The outcomes, behaviors acceptable as evidence of the outcomes, and data-collection instruments were developed with respect to the four basic phases of the planning process: program organization planning, schedule planning, cost planning, and performance planning.

The outcomes, acceptable behaviors, and data-collection instruments were designed to tie together. For example, one question focused on how adequate the performance measurement baseline would be as a result of following the program management planning process. Many of the outcomes, behaviors, and data-collection instruments were hierarchically created to address and extract information from program personnel. As an example, one of the outcomes was a cost, schedule, and technical performance measurement baseline. Behaviors indicating that this baseline was created included defining the work, creating schedules depicting time-phased activities, identifying resources and assigning the resources to activities, and creating a budget representing the allocation of resources over time. Collecting evidence that supported successful performance of these behaviors not only implied that the outcome was successfully attained but also provided evidence from which judgments concerning the question could be made.

1.2.1. Sample Interview Items—The following interview items are examples of those used in this study:

1. Which documents did your functional organization use to extract its stated and/or derived requirements?
2. Please describe the organization and sequencing of the work to be performed.

The first interview question extracts data that identifies the types of docu-
ments used in itemizing the stated and/or derived requirements. This question serves two purposes: it establishes whether requirements had been identified at all and it establishes whether the requirements identified were from contract documents. The second question allows judgments to be made as to the adequacy or quality of the baseline, since requirements exist in three formal contract documents: the statement of work, the specification, and the contract provisions. If these contract documents were not referred to as part of the requirements collection process then requirements could be missing, which leads one to question the adequacy of subsequent activities. A program can only be planned in total when all of the requirements are known. Even then there is no guarantee as to the adequacy of the plan but certainly it will be a better plan than if requirements were missed.

The second question also elicits valuable data that allow judgments to be made on the organization of the work. In this case it establishes whether the functional organization adhered to a particular industry standard that supports a consistent product and functional organization of work by providing templates for creating a work breakdown structure. If the functional organization did not adhere to this standard, then this question, coupled with others, can identify the methodology employed in organizing work.

The complete set of participant and facilitator interview instruments for this study is in appendixes C and D respectively.

1.2.2. Sample Likert Scale Items—The following are examples of five-point Likert scale questions (answered with “strongly agree,” “agree,” “undecided,” “disagree,” or “strongly disagree”) applicable to cost planning:

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These questions have the same purpose as the interview questions: to extract valuable information that allows for judgments to be made concerning the adequacy of the baseline. Again, as with the above interview questions, the goal was to determine the extent to which requirements had been identified and to determine from which documents the requirements were extracted.

The complete set of five-point Likert scale questions for this study are in appendix E.
1.2.3. *Sample Multiple-Choice Items*—The following multiple-choice items are examples of those used in this study:

1. Relative to identifying the requirements for purposes of organizing the work I believe that:
   a. All contract documents (statement of work, specification, contract provisions) were thoroughly scanned.
   b. All contract documents were minimally scanned.
   c. Some contract documents were scanned more thoroughly than others.
   d. Not all contract documents were scanned.

2. Relative to the assignment of costs to work breakdown structure elements I think:
   a. All costs were allocated appropriately based on sound evidence.
   b. Costs were allocated appropriately in most cases.
   c. Costs allocated do not appear to have considered the actual effort of the work to be performed.
   d. When implemented, most cost estimates required major revisions.

Again, as with the interview questions and the five-point Likert scale questions, the first multiple-choice question attempts to determine what level of quality was achieved in the requirements’ collection.

The complete set of multiple-choice questions used in this study is in appendix F.

1.2.4. *Sample Observation Form*—The following observation items are examples of those used in this study:

1. Used contract statement of work, specification, and/or contract provisions for extracting program stated or derived requirements.

   - No utilization of documents
   - Continuous utilization of documents

2. Used higher-level schedules to generate lower-level schedules

   - No utilization of higher-level schedules
   - Continuous use of higher-level schedules

As in the case of the other data-collection instruments, the items above focus on collecting data from the observer’s perspective as the planning was taking place.

The complete set of observation statements for this study is in appendix G.
1.3. Data Collection Methods

This program management planning process was identified earlier as possessing an inherent sequentiality even though aspects of the process itself are cyclical and it was likened to an integrated linear model. This implies that final versions of products could not be produced until predecessor activities had completed final versions of their respective products. This did not prohibit multiple parallel activities from occurring.

Although questions pertaining to completed activities or products cannot be asked until those activities or products are completed, those questions pertaining to acquisition of requirements and general procedural activities can be asked and valid data collected. The researcher’s observation form can also be used during the real-time activities associated with implementation of the planning model.

Observation, coupled with questions not requiring the completion of activities or products, was used during the implementation of the program management planning process. All other questions were asked after the completion of the activities or products.

1.4. Data Analysis Methods

The analysis of the data was performed in accordance with standard practice when utilizing outcome-based evaluation as a method. The steps in this methodology are as follows:

1. Identify the desired outcomes of the program to be studied.
2. Identify behaviors acceptable as evidence that the outcomes have been realized.
3. Create data-collection instruments and procedures to collect data to determine whether the acceptable behaviors have been demonstrated.
4. Execute the data-collection procedures to collect the data.
5. Transcribe the data, which provides individuals other than the researcher of the particular study with the opportunity to make their own interpretations of the results.
6. Interpret the data and make judgments as to whether the behaviors acceptable as evidence were demonstrated, the outcomes were satisfied, and the questions can be addressed from the findings.

The data collected helps to determine whether the behaviors acceptable as evidence were demonstrated and the outcomes subsequently satisfied. In this study there were four outcomes, each with multiple behaviors to provide evidence that
their corresponding outcomes had been satisfied. The outcomes and their respective behaviors may be found in appendix B.

Data collected for the first two outcomes provided evidence for the first question. Data collected for outcomes one, two, and three provided evidence for the second question. Data collected for outcomes one, three, and four provided evidence for the third question. The judgments made in answering questions four and five represent researcher participation in this study and were deduced from interviews.

The results of the data collection and subsequent analysis can be found in section 2.

1.5. Summary

To determine the effectiveness of the program management planning process the following steps were performed:

1. A program was selected for use in implementing the planning process. The program selected for this study was an awarded contract.
2. The planning process was broken into logical components: program organization planning, schedule planning, cost planning, and performance planning.
3. Individuals representing different functional organizations were selected to implement their specific aspects of each component of the planning process.
4. An individual representing one functional organization and implementing the specific aspect of each component was required to coordinate with the individuals implementing the other components of the planning process.
5. Questionnaires were completed and interviews conducted at the conclusion of each component.

The instruments used for gathering evidence, from which judgments were made on the effectiveness of the planning model, were personal interviews (appendixes C and D), questionnaires (appendixes E and F), and direct observation (appendix G). Separate interview instruments were generated for the participants and the facilitators.

A committee of stakeholders was formed representing organizational interest and the program under study. This committee assisted in determining the goals and objectives of the planning process.
2. Data Results and Analysis

Appendix H charts the correspondence of the data collection instrument questions to behaviors deemed to demonstrate satisfactory outcomes. Appendix H indicates the primary behavior that each question targets.

These correspondences do not imply that a particular question is applicable only to the behavior indicated. Nearly all questions provide some form of supplemental information applicable to other behaviors.

A summary of the data collected through the participant five-point questionnaire, participant multiple-choice questionnaire, and researcher observation may be found in appendixes I, J, and K, respectively.

2.1. Program Management Planning Process Outcome #1

Outcome one was: Program personnel create a cost, schedule, and technical performance measurement baseline.

Behavioral evidence was that:

1. Program personnel define the work to be accomplished.
2. Program personnel schedule the work to be performed.
3. Program personnel allocate resources to the work to be accomplished.
4. Program personnel generate a time-phased budget.

2.1.1. Report of Evidence on Outcome #1

2.1.1.1. Participant Interview Questionnaire—All eighteen program planning team participants said that the contract statement of work and contract specification were used to extract stated and/or derived requirements. Two of the team participants also mentioned the contract provisions as an additional source for extracting stated and/or derived requirements.

✔ Eight of the eighteen team participants said they assumed responsibility for assigning requirements to specific functional organizations. Ten team participants said they were not involved in the assignment of program requirements to specific functional organizations.

✔ All eight of the team participants who were involved in the assignment of program requirements to specific functional organizations said the methodology they employed consisted of three steps: identifying the program requirement, identifying the applicable functional organizations, and assigning the requirements to the functional organizations.

✔ Ten of the eighteen team participants identified a product and functional
orientation as the organization of the work to be performed. The other eight team participants identified a functional orientation as the organization of the work to be performed at their specific branches of the work breakdown structure.

- All eighteen team participants cited the contract work breakdown structure as the document consulted prior to the organization of the work.
- All eighteen team participants said the work to be performed was identified down to the detail level.
- All eighteen team participants identified network scheduling as the scheduling technique used to link the detailed schedules.
- All eighteen team participants identified a finish-start interfacing technique as the most frequently utilized schedule interfacing technique.
- Ten of the eighteen team participants identified a bottom-up costing strategy. The other eight team participants said they adhered to the top-down costs allocated to their functional organization.
- Eight of the eighteen team participants described their methodology for determining cost account and work packages as consisting of creating detailed schedules, identifying collections of like work, and formulating these collections of like work into a hierarchical structure of cost accounts and subordinate work packages. Ten team participants said their cost accounts and work packages were determined by project accounting.
- Eight of the eighteen team participants said the number of cost account managers for their functional organizations was a function of the dollar value of the work to be performed. Ten participants said they were not involved in determining the number of cost account managers for their functional organizations.
- Six of the eighteen team participants identified three development risks to their functional organizations. Ten participants identified two development risks to their functional organizations, and two participants identified one development risk to their functional organizations.
- None of the eighteen team participants was able to address the seriousness or probable impact of the developmental risks identified.
- All eighteen team participants readily identified a reporting relationship between their functional organizations and the program manager of the program.
- All eighteen team participants identified the program documents applicable to their functional organizations based on functional organization need.

2.1.1.2. Participant Five-Point Questionnaire—Sixteen of the eighteen program planning team participants strongly agreed that the contract statement of work was a vital source for program requirements. Two participants agreed.
Seventeen of the eighteen team participants strongly agreed that the contract specification was a vital source for program requirements. One team participant agreed.

One of the eighteen team participants agreed that other functional organizations provided a vital source for program requirements. Fifteen participants were undecided, and two disagreed. The one instance of a functional organization providing a program requirement that was not imposed by the customer was the requirement in software engineering that software code walkthroughs be performed. Even though this was not a requirement from the customer this functional organization requires code walkthroughs on every program involving software.

Sixteen of the eighteen team participants strongly agreed that all elements of the work breakdown structure were expanded to at least one level below the formal government reporting level. One participant agreed, and one participant was undecided.

All eighteen team participants strongly agreed that all work breakdown structure elements at level three or below had costs assigned to them.

All eighteen team participants strongly agreed that all work breakdown structure elements below level three had their costs summarized at a level-three element.

Seventeen of the eighteen team participants strongly agreed that all required cost accounts were identified. One participant agreed.

Fifteen of the eighteen team participants strongly agreed that all cost accounts were at least one level below the reporting level. Three participants agreed.

Seventeen of the eighteen team participants strongly agreed that the cost accounts were defined such that a single functional organization could be assigned the cost account responsibility. One participant agreed.

All eighteen team participants strongly agreed that every cost account had a responsible functional organization.

All eighteen team participants strongly agreed that a matrix depicting the correspondence of the functional organization to the cost account was created.

Thirteen of the eighteen team participants strongly agreed that the master program schedule reflected the contract deliveries. Five participants agreed.

Thirteen of the eighteen team participants strongly agreed that the master program schedule reflected the customer reviews. Four participants agreed, and one participant was undecided.

Twelve of the eighteen team participants strongly agreed that the master program schedule reflected summaries of all program activities. Four participants agreed, and two were undecided.
Four of the eighteen team participants agreed that the master program schedule reflected management reserve. Ten participants were undecided, and four participants disagreed.

Fifteen of the eighteen team participants strongly agreed that the intermediate schedule depicted a level hierarchically lower than the master program schedule. Three of participants agreed.

Fifteen of the eighteen team participants strongly agreed that the intermediate schedule depicted all start/complete dates of tasks. Three participants agreed.

Sixteen of the eighteen team participants strongly agreed that the intermediate schedule depicted durations for all summaries. Two participants agreed.

All eighteen team participants strongly agreed that the detailed schedules depicted a level hierarchically lower than the intermediate schedules.

Seven of the eighteen team participants strongly agreed that each activity of the detailed schedules was distinguishable from every other activity in the detailed schedules. Ten participants agreed, and one participant was undecided.

Five of the eighteen team participants strongly agreed that each activity in the detailed schedules could be assigned to a unique functional organization. Ten participants agreed, and three were undecided.

All eighteen team participants strongly agreed that the detailed schedules depicted the duration of each activity.

All eighteen team participants strongly agreed that the detailed schedules depicted the predecessor relationship for each activity.

All eighteen team participants strongly agreed that the detailed schedules depicted the successor relationship for each activity.

Two of the eighteen team participants agreed that all requirements were accurately categorized as technical, cost, schedule, programmatic, or supportability. Twelve participants were undecided, three disagreed, and one strongly disagreed.

Three of the eighteen team participants agreed that each identified requirement corresponded to an element in the work breakdown structure. Ten participants were undecided, and five disagreed.

Two of the eighteen team participants agreed that each significant risk was identified. Five participants were undecided, ten disagreed, and one participant strongly disagreed.

Five of the eighteen team participants were undecided whether each significant risk had performance parameters assigned to it. Five participants disagreed, and eight strongly disagreed.

Three of the eighteen team participants agreed that each significant risk was
objectively measurable. Two participants were undecided, five disagreed, and eight strongly disagreed.

- Seven of the eighteen team participants strongly agreed that each element of work was assigned to the most appropriate functional organization. Eleven participants agreed.
- Nine of the eighteen team participants strongly agreed that each functional organization was depicted in a hierarchical organization chart. Nine participants agreed.
- Seventeen of the eighteen team participants strongly agreed that all program documentation had been identified. One participant agreed.
- Twelve of the eighteen team participants were undecided whether a needs mapping existed between program documentation and functional organizations. Four participants disagreed, and two participants strongly disagreed.

2.1.1.3. Participant Multiple-Choice Questionnaire—Two of the eighteen team participants reported that relative to identifying the requirements for purposes of organizing their work, all contract documents were thoroughly scanned. Two participants reported that all contract documents were minimally scanned, and fourteen reported that some contract documents were scanned more thoroughly than others.

- Twelve of the eighteen team participants reported that relative to the assignment of costs to the work breakdown structure elements, costs were allocated appropriately in most cases. Six participants reported that when executed most cost estimates would require major revisions.
- One of the eighteen team participants reported that relative to the assignment of work to be performed to the responsible functional organizations or individuals, all identified work was properly assigned to the appropriate functional organizations. Sixteen participants reported that generally most work appeared to be assigned appropriately, and one participant reported that some work was not assigned at all.
- Two of the eighteen team participants reported that the master program schedule accurately reflected all contract deliveries, customer reviews, program activity summaries, and management reserve. Sixteen participants reported that the master program schedule reflected most contract deliveries, customer reviews, program activity summaries, and management reserve.
- All eighteen team participants reported that the intermediate schedule in all cases depicted a level hierarchically lower than the master program schedule, start and complete dates of tasks, and durations for summaries.
- Three of the eighteen team participants reported that the detailed schedules in all cases depicted the predecessor and successor relationships for each
task. Fifteen participants reported that the detailed schedules in most cases depicted the predecessor and successor relationships for each task, and two participants reported that the detailed schedules in some cases depicted these relationships.

✓ One of the eighteen team participants reported that requirements were appropriately assigned to one or more of the categories of technical, cost, schedule, programmatic, or supportability. Fifteen participants reported that a number of requirements, but not all, were appropriately assigned, and two participants reported that requirements in most all cases were inappropriately assigned.

✓ Two of the eighteen team participants reported that most identified risks were documented. Two participants reported that some identified risks were documented, and fourteen participants reported that few of the identified risks were documented.

2.1.1.4. Researcher Observation—The researcher observed less than continuous utilization of the contract statement of work, specification, and/or contract provisions for extracting program-stated or -derived requirements. Two examples typify this observation: in numerous instances team participants referred to one of the contract documents but not others, and in numerous instances contract documents were only partially scanned for program-stated or -derived requirements.

The researcher observed continuous use of higher-level schedules for purposes of generating lower-level schedules. It was thus clear that team participants recognized the hierarchy and interrelatedness of the master, intermediate, and detailed schedules.

The researcher observed less than continuous documentation of identified program risks. Two examples typify this observation: team participants could not agree on the probable impact of an identified risk or its seriousness should the risk materialize and therefore postponed documentation of the risk until a later time when its probable impact and seriousness were more readily ascertainable. A team participant made the decision to not communicate an identified risk to other potentially affected team participants and the risk was ignored without further consideration or documentation.

2.1.2. Summary and Analysis—Outcome one of the program management planning process identified four behaviors that, when exhibited, would indicate that this outcome had been satisfied. Outcome one was: Program personnel create a cost, schedule, and technical performance measurement baseline.

Behavioral evidence was that:

1. Program personnel define the work to be accomplished.
2. Program personnel schedule the work to be performed.
3. Program personnel allocate resources for the work to be accomplished.
4. Program personnel generate a time-phased budget.

The activities associated with this behavioral evidence are interrelated and culminate in a series of products:

1. Planning organization chart
2. Requirements database
3. Master program schedule
4. Intermediate schedule
5. Detailed schedules
6. Extended contract work breakdown structure
7. Work breakdown structure dictionary
8. Human resource plan
9. Program organization chart
10. Cost account plans
11. Responsibility assignment matrix

The following analysis is broken into sections corresponding to these products.

2.1.2.1. Planning Organization Chart and Activities—Data indicated that a hierarchical depiction of the program planning team’s personnel and management structure was created in the form of a planning organization chart.

2.1.2.2. Requirements Database and Activities—Data indicated that the contract statement of work, specification, and provisions were used as sources for program-stated and -derived requirements. Functional organization processes were not sought out as a source for program-derived requirements. Requirements were not categorized as technical, cost, schedule, programmatic, or supportability except in a few cases. In the few cases where requirements were categorized, team participants were predominantly undecided as to whether they were categorized accurately.

Data indicated that there was some identification, analysis, allocation, verification, and traceability of requirements, but requirements identification was not as thorough as required by the system engineering processes and some requirements could have been overlooked.

A more detailed discussion of requirements management and its implications is presented in section 3.2.

2.1.2.3. Master, Intermediate, and Detailed Schedules and Activities—Data indicated that the master program schedule accurately reflected all contract deliveries and cus-
customer reviews. At the level of the master program schedule, summaries of all program activities were depicted. The intermediate schedule was depicted one hierarchical level below the master program schedule. All start and completion dates of tasks were adequately depicted in the master program schedule.

Data indicated that the intermediate schedule depicted the start and completion dates of all summary activities.

Data indicated that the detailed schedules were depicted one hierarchical level below the intermediate schedule. In the detailed schedules each activity was uniquely distinguishable from another. Each activity was assigned to a single functional organization. The duration of each activity was depicted, as were the predecessor and successor relationships.

2.1.2.4. Extended Contract Work Breakdown Structure and Dictionary—Data indicated that a work breakdown structure and attendant dictionary were generated but a particular industry-specific work breakdown structure was not referred to when the program planning personnel extended their work breakdown structure. The work breakdown structure represented the understanding of the team participants.

A more detailed discussion of work breakdown structures and their implications is presented in section 3.2.

2.1.2.5. Human Resource Plan and Activities—Data indicated that the activities required to produce a human resource plan were performed and the plan was successfully and adequately produced.

2.1.2.6. Program Organization Chart and Activities—Data indicated that the program organization chart depicted work assigned to the most appropriate functional organizations and each functional organization required by the program was hierarchically depicted in the chart.

2.1.2.7. Cost Account Plans and Activities—Data indicated that the team participants predominantly agreed strongly that the cost accounts were all adequately identified, were one level below the contract reporting level, were defined in such a manner that a single functional organization assumed responsibility for each cost account, and were all adequately depicted in the responsibility assignment matrix.

2.1.2.8. Responsibility Assignment Matrix and Activities—Data indicated that the responsibility assignment matrix and associated activities were successfully created and performed. In the responsibility assignment matrix each cost account had been assigned a responsible individual. Each individual had been identified with his or her respective functional organization. Dollars were depicted at the intersection of the cost accounts and the individuals responsible for the cost accounts.
2.2. **Program Management Planning Process Outcome #2**

Outcome two was: Program personnel integrate cost, schedule, and technical functions.

Behavioral evidence was that:

1. Program personnel identify resources for each detailed schedule activity (labor grade, functional organization, commitment level).
2. Program personnel ensure that the efforts to perform the activities were tied to the activities identified in the detailed schedules.
3. Program personnel assign earned value (performance credit) techniques to work defined.

2.2.1. **Report of Evidence on Outcome #2**

2.2.1.1. **Participant Interview Questionnaire**—Ten of the eighteen team participants identified a bottom-up costing strategy. The other eight participants said they adhered to the top-down costs allocated to their functional organizations.

- Eight of the eighteen team participants described their methodology for determining cost account and work packages as consisting of: creating detailed schedules, identifying collections of like work, and formulating these collections of like work into a hierarchical structure of cost accounts and subordinate work packages. Ten participants said their cost accounts and work packages were determined by project accounting.

- Eight of the eighteen team participants said that the number of cost account managers for their functional organizations was a function of the dollar value of the work to be performed. Ten participants said that they were not involved in determining the number of cost account managers for their functional organizations.

- Six of the eighteen team participants identified three development risks to their functional organizations. Ten participants identified two development risks, and two participants identified one development risk.

- None of the eighteen team participants was able to address the seriousness or probable impact of the developmental risks identified.

2.2.1.2. **Participant Five-Point Questionnaire**—All eighteen team participants strongly agreed that all work breakdown structure elements at level three or below had costs assigned to them.

- All eighteen team participants strongly agreed that all work breakdown structure elements below level three had their costs summarized at a level-three element.
Seventeen of the eighteen team participants strongly agreed that all required cost accounts were identified. One participant agreed.

Fifteen of the eighteen team participants strongly agreed that all cost accounts were at least one level below the reporting level. Three participants agreed.

Seventeen of the eighteen team participants strongly agreed that the cost accounts were defined such that a single functional organization could be assigned the cost account responsibility. One participant agreed.

All eighteen team participants strongly agreed that every cost account had a responsible functional organization.

All eighteen team participants strongly agreed that a matrix depicting the correspondence of the functional organization to the cost account was created.

All eighteen team participants strongly agreed that the detailed schedules depicted a level hierarchically lower than the intermediate schedules.

Seven of the eighteen team participants strongly agreed that each activity of the detailed schedules was distinguishable from every other activity in the detailed schedules. Ten participants agreed, and one participant was undecided.

Five of the eighteen team participants strongly agreed that each activity in the detailed schedules could be assigned to a unique functional organization. Ten participants agreed, and three were undecided.

All eighteen team participants strongly agreed that the detailed schedule depicted the duration of each activity.

All eighteen team participants strongly agreed that the detailed schedule depicted the predecessor relationship for each activity.

All eighteen team participants strongly agreed that the detailed schedule depicted the successor relationship for each activity.

Seven of the eighteen team participants strongly agreed that each element of work was assigned to the most appropriate functional organization. Eleven participants agreed.

Nine of the eighteen team participants strongly agreed that each functional organization was depicted in a hierarchical organization chart. Nine participants agreed.

Twelve of the eighteen team participants were undecided whether a needs mapping existed between program documentation and functional organizations. Four participants disagreed, and two participants strongly disagreed.

2.2.1.3. Participant Multiple-Choice Questionnaire—Twelve of the eighteen team participants reported that costs were allocated to the work breakdown structure elements appropriately in most cases. Six participants reported that when executed most cost estimates would require major revisions.
One of the eighteen team participants reported that all identified work was properly assigned to the appropriate functional organizations. Sixteen participants reported that generally most work appeared to be assigned appropriately, and one participant reported that some work was not assigned at all.

Three of the eighteen team participants reported that the detailed schedules in all cases depicted the predecessor and successor relationships for each task. Thirteen participants reported that the detailed schedules in most cases depicted the predecessor and successor relationships for each task, and two participants reported that the detailed schedules in some cases depicted the predecessor and successor relationships for each task.

2.2.2. Summary and Analysis — Program management planning process outcome two identified three behaviors that, when exhibited, would indicate that this outcome had been satisfied. Outcome two was: Program personnel integrate cost, schedule, and technical functions.

Behavioral evidence was that:

1. Program personnel identify resources for each detailed schedule activity (labor grade, functional organization, commitment level).
2. Program personnel ensure that the efforts to perform the activities were tied to the activities identified in the detailed schedules.
3. Program personnel assign earned value (performance credit) techniques to work defined.

The behaviors indicating satisfaction of this outcome did not produce products unlike the behaviors of outcome one above. The behaviors exhibited in outcome two were simply a continuation of those activities that were begun in outcome one. It was thus the activities themselves that became subject to issues of implementation thoroughness.

Data indicated that the behavioral evidence was exhibited and therefore this outcome was satisfied. The issue was not whether the activities required to satisfy this outcome had been performed, but to what level. There were three issues concerning the thoroughness of the activities performed in satisfying this outcome: the manner in which cost account managers were assigned, the inability of the team participants to address the seriousness of identified program risks, and the varying levels of cost, schedule, and technical integration into the performance measurement baseline.

2.2.2.1. Cost Account Manager Assignment — Ten of the eighteen team participants said they were not involved in determining the number of cost account managers.
Ten participants also said that their cost accounts and work packages were determined by project accounting. Theoretically, the cost accounts, work packages, and cost account managers should have been determined by the functional organization that assumed the responsibility for the work to be performed. However, in this program, seventeen of the eighteen team participants strongly agreed that all required cost accounts had been identified. A predominance of team participants felt that the quantity of cost accounts and their associated work was satisfactory for the program of this study.

2.2.2.2. Seriousness of Identified Program Risks—None of the eighteen team participants was able to address the seriousness or probable impact of the developmental risks identified.

2.2.2.3. Performance Measurement Baseline Integration—Data indicated that this program assigned resources to the detailed activities in the scheduling tool. The intent was to later move these resources automatically into the cost tool for pricing. This automatic integration is discussed in sections 3.2 and 3.6.

2.3. Program Management Planning Process Outcome #3

Outcome three was: Program personnel recognize the added value of the program management planning process.

Behavioral evidence was that:

1. Program personnel positively acknowledge the formal framework for planning provided by the program management planning process.
2. Program personnel positively acknowledge the consistency in functional organization planning provided by the program management planning process.
3. When a problem exists during planning, program personnel utilize program management planning process data to identify where the problem exists.
4. When a problem exists during planning, program personnel utilize data from the program management planning process to quantify the extent of the identified problem.

2.3.1. Report of Evidence on Outcome #3

2.3.1.1. Participant Interview Questionnaire—All eighteen team participants identified the master program schedule and intermediate schedule as the most useful products of the program management planning process. Six participants iden-
tified the responsibility assignment matrix as one of the most useful of the products of the program management planning process.

✓ Fifteen of the eighteen team participants identified the detailed schedules and the human resource plan as the least useful products of the program management planning process. Three participants identified the responsibility assignment matrix as one of the least useful products of the program management planning process.

✓ All eighteen team participants identified an increase in formality and consistency as two of the primary differences between their previous methodology for developing a performance measurement baseline and the methodology employed under the program management planning process. Six participants added sequencing of product development as a difference between their previous methodology and the methodology employed under the program management planning process.

✓ All eighteen team participants identified new competencies that were acquired as a result of program management planning training.

✓ All eighteen team participants identified an increased awareness and appreciation for the order of product development as a reinforcement of their existing competencies.

2.3.1.2. Facilitator Interview Questionnaire—The program management planning process facilitator identified requirements identification, resource allocation, and cost account determination as the areas of the program management planning process training demanding a greater emphasis.

✓ The process facilitator identified requirements identification, proper resource determination, and scheduled network activities as the most critical areas of the process training.

✓ The process facilitator said that the responsibility assignment matrix, as important as it is, was the product that would have the least impact on the development of a performance measurement baseline.

✓ The process facilitator said that the program planning participants understood the details of developing a program's performance measurement baseline to varying degrees. The facilitator said that most team participants had a working knowledge of requirements identification, resource allocation, and scheduling techniques.

✓ The process facilitator said that those areas of the process training requiring greater emphasis were dwelled on a little longer than normal to ensure the team participants' common understanding.
The process facilitator said that the team participants applied the theoretical knowledge gained in the training to their specific functional organizations of the program.

The process facilitator said that the team participants attending the training should all have been active participants in developing the program’s performance measurement baseline for their specific functional organizations.

2.3.1.3. Participant Multiple-Choice Questionnaire—Ten of the eighteen team participants reported that every applicable functional organization was depicted hierarchically in the program organization chart. Eight participants reported that most applicable functional organizations were depicted hierarchically in the program organization chart.

One of the eighteen team participants reported that the program management training provided significant value in performing the planning activity more efficiently or effectively over what he/she already knew. Sixteen participants reported that the training provided some value over what they already knew, and one participant reported that the training provided no additional value.

2.3.2. Summary and Analysis—Program management planning process outcome three identified four behaviors that, when exhibited, would indicate that this outcome had been satisfied. Outcome three was: program personnel recognize the added value of the program management planning process.

Behavioral evidence was that:

1. Program personnel positively acknowledge the formal framework provided by the program management planning process.
2. Program personnel positively acknowledge the consistency in functional organization planning provided by the program management planning process.
3. When a problem exists during planning, program personnel utilize program management planning process data to identify where the problem exists.
4. When a problem exists during planning, program personnel utilize data from the program management planning process to quantify the extent of the identified problem.

The data indicated that the behaviors were exhibited and therefore this outcome was satisfied, as noted by the following:

1. All eighteen team participants identified an increase in formality and consistency as two of the primary differences between their previous methodology for developing a performance measurement baseline and the
methodology employed under the program management planning process.

2. Six of the eighteen team participants added sequencing of product development as a difference between their previous methodology for developing a performance measurement baseline and the methodology employed under the program management planning process.

3. All eighteen team participants identified new competencies that were acquired as a result of program management planning training.

4. All eighteen team participants identified an increased awareness and appreciation for the order of product development as a reinforcement of their existing competencies.

5. Seventeen of the eighteen team participants either agreed or strongly agreed that they supported the utilization of program management planning process reports at program reviews.

Data indicated that even though the team participants felt the detailed schedules were one of the least useful products, they accurately and adequately developed the detailed schedules.

2.4. Program Management Planning Process Outcome #4

Outcome four was: Program personnel promote the use of the program management planning process.

Behavioral evidence was that:

1. Program personnel utilize program management planning process reports at program reviews.
2. Program personnel organize their activities in accordance with the cost, schedule, and technical performance measurement baseline as defined by the program management planning process.
3. Program personnel act as consultants to other start-up programs.

2.4.1. Report of Evidence on Outcome #4

2.4.1.1. Participant Interview Questionnaire—All eighteen team participants identified the master program schedule and intermediate schedule as the most useful products of the program management planning process. Six team participants identified the responsibility assignment matrix as one of the most useful products.

✓ Fifteen of the eighteen team participants identified the detailed schedules and the human resource plan as the least useful products of the program
management planning process. Three team participants identified the responsibility assignment matrix as one of the least useful products.

- Fifteen of the eighteen team participants identified instances where they were asked by other team participants for assistance during implementation of the program management planning process. Three participants were not asked to help other team participants.
- Twelve of the eighteen team participants identified understanding process methodology (sequencing) as the help they offered to other team participants. Three participants identified product development as the help they offered to other team participants.

2.4.1.2. Participant Five-Point Questionnaire—Two of the eighteen team participants strongly agreed that as participants they voluntarily helped others during program planning. Twelve participants agreed, and two participants were undecided. Two participants disagreed.

- One of the eighteen team participants strongly agreed that as a participant he/she gave constructive criticism to colleagues during program planning that greatly strengthened their plan. Eight participants agreed, three were undecided, and six disagreed.
- Eleven of the eighteen team participants strongly agreed that they supported the utilization of program management planning process reports at program reviews. Six participants agreed, and one participant was undecided.
- Twelve of the eighteen team participants strongly agreed that they intended to execute the program in accordance with the performance measurement baseline. Six participants agreed.

2.4.1.3. Participant Multiple-Choice Questionnaire—Ten of the eighteen team participants reported that every applicable functional organization was depicted hierarchically in the program organization chart. Eight participants reported that most applicable functional organizations were depicted hierarchically in the program organization chart.

- Two of the eighteen team participants reported that they frequently were able to offer help or constructive criticism to other program personnel or other programs. Nine participants reported that they sometimes were able to offer help or constructive criticism to other program personnel or other programs, and five participants reported that they infrequently were able to. Two participants reported that they infrequently were able to offer help or constructive criticism and were seldom called upon to do so.

2.4.1.4. Researcher Observation—The researcher observed that the participants
sporadically helped others during program planning and never criticized others’ work. The researcher was undecided as to whether the program planning participants demonstrated any constructive competitiveness.

The researcher observed that the team participants appropriately contributed during program planning, generally shared their work with others, and generally discussed the merits of program planning during non-work times.

2.4.2. Summary and Analysis — Program management planning process outcome four identified three behaviors that, when exhibited, would indicate that this outcome had been satisfied. Outcome four was: Program personnel promote the use of the program management planning process.

Behavioral evidence was that:

1. Program personnel utilize program management planning process reports at program reviews.
2. Program personnel organize their activities in accordance with the cost, schedule, and technical performance measurement baseline as defined by the program management planning process.
3. Program personnel act as consultants to other start-up programs.

This outcome was developed as a follow-on to the third outcome. The concept was that if the team participants recognized the value of the program management planning process, then one might expect them to promote its use.

Data indicated that the team participants recognized as the most useful products those that the facilitator felt to be most critical to the successful implementation of a program’s cost, schedule, and technical performance measurement baseline. This was key because central to promoting the use of the planning process is the recognition that the process’s most critical products are preferred over alternative methodologies for creating a performance measurement baseline.

Data indicated that a predominance of team participants:

1. Voluntarily helped others during program planning.
2. Offered constructive criticism to colleagues during program planning that greatly strengthened their plan.
3. Supported the utilization of program management planning process reports at program reviews.
4. Intended to execute the program in accordance with the performance measurement baseline.
5. Offered help to other program planning participants on other programs.
Data indicated that the team participants routinely offered help when called on to do so. Researcher observation confirmed the promoting role played by the team participants and indicated that they were willing to help others and seemed authentically interested in the promotion of the planning process.

Active promotion of the program management planning process by the team participants beyond that described was not discernible from the data.

2.5. Summary of Findings

The data reported above have resulted in a number of summary findings. These findings are organized by outcome.

2.5.1. Program Management Planning Process Outcome #1 — The findings related to the first outcome were as follows:

1. The team participants defined the work to be performed (see #5 below).
2. The team participants adequately scheduled the work to be performed.
3. The team participants adequately allocated resources to the work to be performed.
4. The team participants adequately generated a time-phased budget.
5. The team participants may not have defined the work to be accomplished adequately. Although some requirements identification, analysis, and allocation were performed, and verification methods were identified, this activity was not performed as thoroughly as required by the program management planning process or system engineering processes.
6. The team participants did not refer to particular industry-specific guidelines when extending the program's work breakdown structure. The work breakdown structure for the program represented the existing understanding of the team participants, but without the guidance provided by these additional guidelines the degree of correctness or quality may be suspect.
7. Risk management and technical performance measurement were not performed adequately. This put the program at risk as undocumented high-risk events materialized after this study's completion. When high-risk events materialized the program was without a contingency plan to mitigate their effects.

2.5.2. Program Management Planning Process Outcome #2 — The findings related to the second outcome were as follows:

1. The team participants identified resources for each activity in the detailed schedules.
2. The team participants tied the effort to perform the activity in the detailed schedule to the actual activity of the detailed schedule within the scheduling tool.

3. The team participants assigned earned value performance techniques to the work defined in the detailed schedules.

4. Cost account managers for a given functional organization were not routinely assigned by the team participant representing that functional organization. In many cases the cost account managers were assigned by project accounting.

5. Cost accounts for a given functional organization were not routinely decided upon by the team participant representing that functional organization. In many cases the cost accounts were decided upon by project accounting.

6. The probability or seriousness of program risks were not all calculated or documented, potentially subjecting the program to future cost, schedule, or technical performance problems.

2.5.3. Program Management Planning Process Outcome #3 — The findings related to the third outcome were as follows:

1. The team participants positively acknowledged the formal framework for planning provided by the program management planning process.

2. The team participants positively acknowledged the consistency in functional organization planning provided by the program management planning process.

3. The team participants used data from the program management planning process to identify where program problems might reside.

4. The team participants used data from the program management planning process to quantify the extent of the identified program problems.

2.5.4. Program Management Planning Process Outcome #4 — The findings related to the fourth outcome were as follows:

1. The team participants voluntarily helped others during program planning.

2. The team participants offered constructive criticism to colleagues during program planning that greatly strengthened their plan.

3. The team participants supported the utilization of program management planning process reports at program reviews.
4. The team participants intended to execute the program in accordance with the performance measurement baseline.
5. The team participants offered help to other program planning participants on other programs.

3. Conclusions, Implications, and Recommendations

The data presented in section 2 were collected to make judgments about the outcomes of the program management planning process and were used in answering the questions this study addresses. Below is a discussion of the conclusions and implications drawn from these findings.

3.1. Research Question #1

How adequate will the cost, schedule, and technical performance measurement baseline be as a result of following this program management planning process?

3.1.1. Conclusion — On the whole, data indicated that all of the activities of the program management planning process were performed and their culminating products produced.

Key to evaluating the planning process was an understanding of the adequacy of the performance measurement baseline. In fact, an underlying premise of this study is that this planning process might serve as a model that contains essential elements of all program planning and that it therefore can be modified or tailored to accommodate the specifics of a given program in other situations. The first question is therefore central to this underlying premise. Should this program management planning process support the development of an adequate performance measurement baseline then it might accommodate the specifics of any given program.

Data indicated that this planning process does in fact provide an adequate cost, schedule, and technical performance measurement baseline and therefore could be used, when modified for the specifics of a given program, as a model for other programs.

3.1.2. Supporting Discussion — This question is concerned with whether or not the activities of the program management planning process were performed and their subsequent culminating products produced. The quality of the cost, schedule, and technical performance measurement baseline will be addressed in the second question.

The activities of the program management planning process culminate in eleven products:
1. Planning organization chart
2. Requirements database
3. Master program schedule
4. Intermediate schedule
5. Detailed schedules
6. Extended contract work breakdown structure
7. Work breakdown structure dictionary
8. Human resource plan
9. Program organization chart
10. Cost account plans
11. Responsibility assignment matrix

These products were not completely developed before the initiation of the next product. This subject will be addressed in the fifth question (see section 3.5).

3.1.2.1. Planning Organization Chart and Activities—The activity culminating in the production of the planning organization chart identifies and organizes the required planning resources for the program. The program's planning personnel are the individuals responsible for establishing the program's integrated cost, schedule, and technical performance measurement baseline. These personnel may (and should) be responsible for the subsequent execution of the program in accordance with the program's performance measurement baseline. Data indicated that a hierarchical depiction of the program planning team's personnel and management structure was created in the form of a planning organization chart.

3.1.2.2. Requirements Database and Activities—The activities culminating in the production of the requirements database are referred to as a whole as requirements management. Requirements management involves identification, analysis, allocation, verification, and traceability of stated and derived program requirements. Generating a requirements database necessitates that stated and derived program requirements be identified, analyzed, and allocated to system design elements when they are placed in the requirements database and that some basic information be associated with each requirement to provide subsequent traceability to lower-level design activities. One measure of effective program planning and successful execution is the thoroughness of the steps involved in identifying, analyzing, and allocating contractually stated and derived requirements.

Data indicated that the contract statement of work, specification, and provisions were used as sources for program-stated and -derived requirements. Functional organization processes were not sought out as a source for program-derived requirements. Requirements were not categorized as technical, cost, schedule, pro-
grammatic, or supportability, except in a few cases. In the few cases where requirements were categorized, team participants were predominantly undecided as to whether they were categorized accurately.

Data indicated that there was some identification, analysis, allocation, verification, and traceability of requirements but requirements identification was not as thorough as required by the system engineering processes and some requirements could have been overlooked. This problem would indicate that a tighter link between the planning process and the system engineering process is required. The planning process training did not address the activities required for proper requirements management. Requirements management training as performed by the system engineering functional organization was to be synchronized and performed in conjunction with the planning process training. A lack of synchronization may have contributed to insufficient requirements management.

A more detailed discussion of requirements management and its implications is presented below in section 3.2.

3.1.2.3. Master, Intermediate, and Detailed Schedules and Activities—Schedules provide the time frame for resource allocation and establish a baseline for current status and forecasts of completion dates of scheduled activities. Management of these activities begins with the master program schedule, incorporates the intermediate schedule, and culminates in the detailed schedules. The intermediate schedule and detailed schedules are typically depicted as an interdependency network, which depicts the interrelationships among the numerous program activities.

The detailed schedules expand each intermediate schedule summary/subproject into multiple activities to the extent necessary or desired and add schedule events that satisfy the requirements of the intermediate schedule. The detailed schedules depict horizontal dependencies and are used on a daily basis by the cost account managers to manage their work.

Data indicated that the master program schedule accurately reflected all contract deliveries and customer reviews. At this level, summaries of all program activities were depicted. The intermediate schedule was depicted one hierarchical level below the master program schedule and all start and completion dates of tasks were adequately indicated. The intermediate schedule included the start and completion dates of all summary activities. The detailed schedules were depicted one hierarchical level below the intermediate schedule. In the detailed schedules each activity was uniquely distinguishable from another. Each activity was assigned to a single functional organization. The duration of each activity was depicted, as was the predecessor and successor relationships.

3.1.2.4. Extended Contract Work Breakdown Structure and Dictionary—The extended
contract work breakdown structure is more commonly referred to simply as the work breakdown structure (WBS).

The work breakdown structure provided by the customer may be extended to reflect the program's current understanding of the work and its organization. Accompanying the work breakdown structure are dictionaries that describe the work to be performed, as depicted in the currently extended work breakdown structure.

Extending the work breakdown structure and creating dictionaries is the first step in planning the costs of the program. Cost planning is concerned with defining the relationships among the elements of work to be performed under the contract, allocating budget to the elements of work, defining who is responsible for performing the work, and selecting preliminary cost accounts.

With the establishment of the cost account, actual costs can be compared to budgeted costs. The cost account is a control point for cost, schedule, and technical performance planning, work execution, and performance measurement.

There are two basic elements in the creation of a work breakdown structure and attendant dictionary: a hierarchical depiction of the work to be performed and its organization, and a detailed description of the work.

Data indicated that a work breakdown structure and attendant dictionary were generated but when the program planning personnel extended their work breakdown structure they neglected to consult certain industry-specific guidelines, so the degree of correctness may be suspect. As a program progresses, the effort involved in changing the work breakdown structure and the resulting effect on associated documents increase, therefore increasing the program's costs and possibly extending the program's schedule.

A more detailed discussion on work breakdown structures and their implications is presented in section 3.2.

3.1.2.5. Human Resource Plan and Activities—The objective of this activity is to formulate a concise, meaningful, and practical program-level strategy for managing human resources most effectively and successfully.

Resource planning requires that resources be identified for and assigned to each detailed schedule activity. The human resource plan, then, is an automated time-phased report by activity, work breakdown structure element, or program that is generated by the program's scheduler. Developing the human resource plan is an iterative process, updated when the cost accounts have been determined.

Data indicated that the activities required to produce a human resource plan were performed and the plan was successfully and adequately produced. A more detailed discussion of resource loading is presented in section 3.2.

3.1.2.6. Program Organization Chart and Activities—During program planning
two different types of organizations exist: the planning organization and the program organization. The planning personnel are responsible for establishing the program’s cost, schedule, and technical performance measurement baseline. The program personnel are responsible for execution of the program in accordance with the program’s created and approved performance measurement baseline.

The program organization chart shows all personnel assigned to the program. The program responsibility assignment matrix is the intersection of the program organization personnel (to the cost account level) with those work breakdown structure elements identified as cost accounts.

Data indicated that the program organization chart depicted work assigned to the most appropriate functional organizations and that each functional organization required by the program was hierarchically depicted in the chart.

3.1.2.7. Cost Account Plans and Activities—The last activity in the program management planning process is the generation of cost account plans. Generating cost account plans involves the detailed planning of the contract statement of work, budget, and schedule via work packages and planning packages. Successfully completing the generation of cost account plans concludes the planning phase of the program management planning process and therefore establishes the program’s cost, schedule, and technical performance measurement baseline.

Each cost account is time-phased and planned prior to starting work. The cost account time-phased budget is the budgeted cost for work scheduled, which represents the budget at completion for the cost account.

The documents used to generate cost account plans contain targets for the cost account manager to use in planning the cost account. These targets provide an initial constraint and are converted to baseline values. If any target is not achieved during cost account planning, negotiations with the program manager must occur. Once cost account planning has met the targets, documents will be updated to include the cost account planning.

Each cost account work breakdown structure dictionary, budget, and schedule is planned in detail into work packages and planning packages and time-phased by the cost account manager. In determining the budgeted cost for work scheduled, the cost account manager considers past experience in similar work, engineering standards, industry standards, and other bottom-up estimating techniques.

Data indicated that the team participants predominantly agreed strongly that the cost accounts were all adequately identified, were one level below the contract reporting level, were defined in such a manner that a single functional organization could assume responsibility for each cost account, and were all adequately depicted in the responsibility assignment matrix.
3.1.2.8. Responsibility Assignment Matrix and Activities—The purpose of the responsibility assignment matrix is twofold: to associate program (not planning) individuals with the work to be performed and to initially assign target costs to groupings of work identified as cost accounts. Generating the responsibility assignment matrix is performed after the work breakdown structure and dictionaries are completed.

Data indicated that the responsibility assignment matrix and associated activities were successfully created and performed. In the responsibility assignment matrix each cost account had been assigned a responsible individual who had been identified with his/her respective functional organization. Dollars were depicted at the intersection of the cost accounts and the individuals responsible for the cost accounts.

3.2. Research Question #2

What is the quality of the performance measurement baseline resulting from following the program management planning process?

3.2.1. Conclusion—Overall, the performance measurement baseline for this program was satisfactory but it was subject to short-term obsolescence and may have been created without sufficient attention being paid to potentially significant cost, schedule, or technical program drivers. To fully appreciate the complexity in determining the quality of the performance measurement baseline each of the areas contributing to the overall quality of the performance measurement baseline must be discussed.

Our first question was important because it determined whether the essential elements of proper program planning were present in this planning process and whether the process was sufficiently succinct that an adequate cost, schedule, and technical performance measurement baseline could be produced. Our conclusion was that this planning process did possess the essential elements of program planning and could be used on other programs.

The second question examines the quality of the performance measurement baseline, which needs to be discussed if this program management planning process is to be adequately evaluated.

3.2.2. Supporting Discussion—The quality of the cost, schedule, and technical performance measurement baseline can be determined by looking at six factors:

1. Requirements management
2. Creation of the work breakdown structure
3. Risk management and technical performance measurement
4. Cost account manager assignment
5. Seriousness of program risks
6. Performance measurement baseline integration

3.2.2.1. Requirements Management—As discussed in a previous chapter, requirements management involves five steps: requirements identification, requirements analysis, requirements allocation, a means for verification, and requirements traceability.

This program management planning process did not explicitly state the activities associated with proper requirements management but instead referred to the system engineering process, which was outside the program management planning process.

As discussed in section 3.1.2.2, requirements identification was not as thorough as required by the system engineering processes, indicating that a tighter link between the program management planning process and the system engineering process is required.

3.2.2.2. Creation of the Work Breakdown Structure—The work breakdown structure is typically mandated by the customer down to level three. Further breaking down of the work is done by the contractor. If the contractor decides to further break down the work there are certain guidance documents available that support a methodological breakdown. As discussed in section 3.1.2.4, program planners neglected to consult the appropriate document, subjecting the program to possible delays and increased costs.

3.2.2.3. Risk Management and Technical Performance Measurement—Another quality issue has to do with what consideration was given to program risk and the subsequent measurement of technical performance and data indicating that the team participants were not convinced that risk management or technical performance measurement had been performed adequately.

Once integrated, risk management and technical performance measurement allow for detailed tracking of key technical parameters, which in turn will clarify the technical progress of the system under development. Risk management is concerned with the identification of program risks in terms of probability and seriousness of impact and of subsequent corrective action should such risks materialize.

The guiding principle is to first identify program-stated and -derived requirements. Once these requirements have been tentatively identified, then potential risks may be determined within the context of the total requirement set. Potential risks are categorized based on their probability of impact and subsequent seriousness should the risk materialize. Figure A.2 depicts a matrix for program risks.
Formal risk mitigation is the execution of the applicable corrective action for the materialized risk. Any significant risk requires the execution of such plans. Moderate risks require that a closer look be taken to determine the advisability of executing the appropriate corrective action. Negligible risk can be averted with normal program management techniques such as open communication.

Some risks, especially significant risks, require close tracking in order to determine progress. Once a risk has been determined to necessitate tracking, then technical performance measurement comes into play. Technical performance measurement simply requires that a key parameter (technical performance parameter) of each risk be identified and time-phased so that tracking may occur over time, and one can compare the planned performance measure to the actual performance measure. This concept is best explained through an example. Suppose there is a requirement for software to execute at an operational level in four seconds—that is, that four seconds elapse from the time the operator hits a key on the keyboard until the time the data are fully displayed on the terminal. Suppose further that the software currently is anticipated to execute in eight seconds. The appropriate time-phased plan would require the software to execute in four seconds at the end of the scheduled development time. Figure A.3 depicts this scenario.

The current planned value of the technical performance parameter of this risk element progresses steadily from an unacceptable value of eight seconds to the four seconds required by the contract. At four key points throughout the project’s life cycle, the parameter is measured to determine its actual value to date. Should this value exceed the established thresholds then corrective action would be required. The system design review, preliminary design review, critical design review, and

<table>
<thead>
<tr>
<th>PROBABILITY</th>
<th>HIGH</th>
<th>MEDIUM</th>
<th>LOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGNIFICANT RISK</td>
<td>FORMAL RISK Mitigation required</td>
<td>FORMAL RISK Mitigation should be considered</td>
<td></td>
</tr>
<tr>
<td>MODERATE RISK</td>
<td>MODERATE RISK</td>
<td>NEGLIGIBLE RISK</td>
<td></td>
</tr>
<tr>
<td>NEGLIGIBLE RISK</td>
<td>MANAGE RISK through routine processes</td>
<td></td>
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Figure A.2. Probability and seriousness of risk
test readiness review are sequential technical reviews that are part of this project’s
software development. Data points are established just prior to each of these re-
views for taking measurements.

In practice the head software engineer, the system engineer, and the program
manager would agree on thresholds above and below the planned values. These
thresholds would serve as guidelines of acceptability. Should the actual perfor-
mance measured at a predetermined point not be within the established guidelines
then corrective action would be required. This tracking of technical performance
parameters of risk elements couples risk management with technical performance
measurement and satisfies the requirements for tracking a project’s technical
progress. Through normal monthly status reports on cost, schedule, and technical
performance measurement baseline, the progress of the program, and the software
specifically, can then be monitored for required corrective action.

As stated above, team participants were not convinced that risk management
or technical performance measurement had been performed adequately. In fact,
sixteen of the eighteen team participants were either undecided or disagreed that
all significant risks had been identified.

The processes, methodologies, and techniques were in place for the imple-
mentation of risk management and technical performance measurement as de-
scribed above. They were, however, part of the system engineering processes. As
was the case with requirements management (see section 3.1.2.2), this problem in-
dicates that there was inadequate coordination between the program management

![Technical Performance Parameter Time-Phased Plan](image-url)
planning process and the system engineering process. The program management planning process training did not address proper risk management and technical performance measurement, and although the system engineering functional organization did, training was not properly synchronized.

3.2.2.4. Cost Account Manager Assignment—Ten of the eighteen team participants were not involved in determining the number of cost account managers. These participants represented their respective functional organizations and should have been involved in determining the number of cost account managers.

Each cost account is time-phased and planned prior to starting work. Cost accounts are functionally separated into smaller elements of work known as work packages, collections of tasks within a cost account. Work packages are detailed short-term jobs or purchased materials that constitute the basic building blocks in planning, controlling, and measuring contract performance. A work package describes the work to be performed, schedules the expenditure of resources by the appropriate functional organization, and serves as a vehicle for monitoring and reporting progress and accomplishment of work.

Planning packages are collections of work identified within a cost account that are not scheduled to begin in the near term, which is defined by the organization and used as a constant for all programs within the organization. As time nears, planning packages are converted into work packages for purposes of execution. The work identified in a planning package is typically far enough in the future that the level of effort to perform the work, or perhaps even the work itself, is not readily definable.

Because the cost account manager, who is responsible for planning the cost account and all related work packages and planning packages, requires an in-depth understanding of the work to be performed, he/she should have more than a casual understanding of the functional organization for which he/she is managing the work. The cost account manager should therefore be assigned by the functional organization for which the work is intended. The number of cost account managers depends on work risk, cost, duration, level of effort, and availability.

Although the cost accounts, work packages, and cost account managers should theoretically have been determined by the functional organization that assumed the responsibility for the work, ten team participants were not involved in determining the number of cost account managers, and ten participants reported that their cost accounts had been determined by project accounting. Seventeen team participants nonetheless strongly agreed that all required cost accounts had been identified. Most team participants felt the quantity of cost accounts and their associated work was satisfactory, which was not the expected result.

One explanation for this apparent difference between theory and practice may
reside in the experience of the program’s management team and project accounting. If these functional organizations have sufficient experience and insight into the work to be performed on the program, then they can satisfactorily assign cost accounts, work packages, and cost account managers.

3.2.2.5. **Seriousness of Identified Program Risks**—None of the eighteen team participants were able to address the seriousness of the developmental risks identified or the probability of their impact

Unidentified program risks or inadequate assessment of risks can have significant cost and schedule implications. Risk management was discussed in detail in section 3.2.2.3 above.

Applicability of these data is manifested by determining the quality of the integrated cost, schedule, and technical performance measurement baseline. Not being aware of the seriousness of risks or the probability of their impact, or not having program risks identified, is a quality issue related to the integration of the technical aspects of the program.

3.2.2.6. **Performance Measurement Baseline Integration**—The program under study assigned its resources, with the detailed activities, in the scheduling tool. The intent was to later move these resources automatically into the cost tool for pricing. This was an acceptable approach for the program.

The operative term for this discussion is “integration.” There are varying degrees of integration, each having an impact on the program. First, cost and schedule integration means that the human resources to perform the work are explicitly associated with the detailed work as depicted in the detailed schedules. This association is what constitutes integration. Resources are tightly coupled to the work in such a manner that the work cannot change without a simultaneous change in resources. In this way, the cost of performing the remaining work is always readily identifiable: it is the sum of the remaining resources associated with such work.

From the perspective of implementation the schedules are created and maintained in a scheduling tool while the costs of the associated resources are ultimately maintained in a cost (or budgeting) tool. Two basic techniques exist for making the schedule and costs integration possible. First, resources are assigned in the scheduling tool with their associated detailed activities. Then, on a periodic basis, these resources are transferred to the cost tool to ultimately calculate price, which is composed of additional costs, such as overhead and cost of money, because price and additional costs cannot be generated in the scheduling tool. This method of assigning resources in the scheduling tool and later moving those resources to the cost tool for pricing offers the most theoretically sound approach for assuring that the resources for performing the work are tied to the work to be performed.
Alternatively, it is possible to assign the resources directly in the cost tool in such a way that they are representative of the work to be performed. This type of integration offers less assurance that the resources do in fact represent the work to be performed than if those resources were assigned directly in the schedule along with their respective detailed activities. However, there may be less work involved in assigning the resources directly in the cost tool than assigning them in the scheduling tool and moving them at a later time into the cost tool. The costs associated with the tighter coupling of the two tools may be greater than the risks associated with maintaining resources separately from their corresponding detailed activities.

Integration therefore changes from automatic to manual based on the decision to assign resources in the scheduling tool or directly in the cost tool but does so at an additional cost for the automatic integration. This cost needs to be weighed in light of a number of factors.

Factors that will help determine whether the cost of the automatic method is outweighed by the benefit include the size of the program, the number of program management office personnel and cost account managers, and the ease of automatic transfer from the schedule tool to the cost tool. For example, if a program is relatively small and there are few cost account managers, then automatic integration may be cost-prohibitive regardless of the theoretical benefits.

The last issue related to integration involves the technical aspects of the program. Specifically, integration of the technical aspects is handled through the identification of program risk and the subsequent measurement of technical performance. See section 3.2.2.3 for a complete discussion of risk management and the integration of technical aspects.

3.3. Research Question #3

To what extent do the team participants perceive their efforts in creating a performance measurement baseline as justified?

3.3.1. Conclusion—Data indicated that the team participants believed that the program management planning process added sufficient value over alternative methodologies, meriting its continued use. Team participants believed that the benefits of the planning process outweighed its perceived additional efforts.

This question helps us judge whether the team participants accept the program management planning process. Even if the planning process were adequate and provided the essential elements for proper program planning, if the team participants did not like the process or felt that the cost of implementing the process was greater than the perceived benefits, then it is highly unlikely that the planning process would be satisfactorily implemented.
3.3.2. Supporting Discussion — To determine the team participants’ opinions of the planning process, questions were asked in the data collection instruments that extracted information on their perception of the added value of following the planning process. Additional questions were asked to determine whether or not the team participants believed the planning process added sufficient value that they would promote its use outside of their immediate programs. If the team participants believed that the program management planning process added value to their existing procedures for creating a performance measurement baseline then it would more readily be adhered to and a more thorough implementation of a performance measurement baseline would be created.

Data indicated that the team participants did feel that the program management planning process added value over their previous performance measurement baseline methodologies as noted by the following:

1. All eighteen team participants identified an increase in formality and consistency as two of the primary differences between their previous methodology for developing a performance measurement baseline and the methodology employed under the program management planning process.
2. Six team participants added sequencing of product development as a difference between their previous methodology and that employed under the planning process.
3. All eighteen team participants identified new competencies that they acquired as a result of program management planning training.
4. All eighteen team participants cited an increased awareness and appreciation for the order of product development as a reinforcement for their existing competencies.
5. Seventeen team participants either agreed or strongly agreed that they supported the utilization of program management planning process reports at program reviews.

One piece of data collected from the participant interview questionnaire stated that fifteen of the eighteen team participants identified the detailed schedules as one of the least useful products of the process. This is a troublesome finding: team participants accurately and adequately developed the detailed schedules, which were intended to be used solely by individuals at the cost account level and below and are the key to understanding interrelated program activities, the place where resources are assigned for purposes of costing. How could the detailed schedules be perceived as least useful, given their importance in proper program planning and execution?
I believe the answer to this question may lie in a cultural phenomenon. Before implementation of the program management planning process the team participants developed and maintained their own schedules on their own computers. With implementation of the program management planning process the scheduling function was assumed by a central individual, the program scheduler (or project scheduler). The cost account managers and all lower-level personnel were released from the responsibility of maintaining their own schedules. They did, however, retain responsibility for development of their schedules and further assumed the additional responsibility of working with the newly appointed program scheduler. With the scheduling function centralized, program management felt that the schedules had a higher likelihood of being internally consistent, that is, a more accurate depiction of the interrelatedness of the activities in the detailed schedules.

The central issue is one of control. Who best should control the schedules and associated maintenance? While it appears that the best theoretical approach might be centralization, the cost as perceived by the involved individuals was the loss of their personal control.

At this point in the discussion we must address the human nature of change. This particular organization had been experiencing rather significant downsizing in recent years. Team participants as well as personnel involved in the execution of programs had been asked to assume more responsibility, and therefore stress, because of this downsizing. Under these conditions it is human nature to want to revert to known processes, procedures, and methodologies. Under times of intense stress, it helps to feel a sense of control. We can therefore speculate that team participants felt the detailed schedules were one of the least useful products because of their loss of control under the new planning process coupled with their inherent need to be more controlling with the increase in responsibility and subsequent stress.

Once we established that team personnel recognized the value of the planning process we sought to determine whether we could expect them to promote its use outside this particular program.

Data indicated that the team participants recognized as the most useful products of the planning process those that the facilitator felt to be most critical to the successful implementation of a program's cost, schedule, and technical performance measurement baseline. This is key because central to promoting the use of the program management planning process is the recognition that the process's most critical products are superior to alternative methodologies for creating a performance measurement baseline.

Data indicated that a predominance of team participants:

1. Voluntarily helped others during program planning,
2. Offered constructive criticism to colleagues during program planning, which greatly strengthened their plan,
3. Supported the utilization of planning process reports at program reviews,
4. Intended to execute the program in accordance with the performance measurement baseline, and
5. Offered help to participants on other programs.

The questionnaires demonstrate that team participants routinely offered help when called on to do so. Researcher observation confirmed the promoting role played by the team participants, suggesting that the team participants were willing to help others and seemed authentically interested in the promotion of the program management planning process. Other, proactive promotion of the planning process was not discernible from the data.

Data indicated that the team participants believed that the program management planning process added sufficient value over alternative methodologies to merit its continued use. The benefits of the program management planning process thus outweighed its perceived additional efforts.

3.4. Research Question #4

Is the methodology employed in this study generalizable to other studies of planning processes?

3.4.1. Conclusion — On the whole, the methodology employed proved to be acceptable for this study and generalizable for use on other programs using this planning process.

This question addresses whether the methodology of this study could be used to evaluate other programs using this program management planning process or a derivative of it. In fact, it goes one step further in that it addresses the applicability of this methodology in evaluating other planning processes.

3.4.2. Supporting Discussion — To answer this question more specifically, each step of the methodology employed in this study must be addressed. The steps employed, each step’s applicability, and the generalizability of each step is discussed below.

1. A program was selected for use in implementing the program management planning process. The program had to be an awarded contract, a bid and proposal, or an internal research and development effort.

The program selected for this study was an awarded contract. A pre-contract award would have provided for a more careful implementation
and thorough analysis. Time considerations after contract award promote a higher probability of scrimping on the planning process steps, resulting in less dependable data for analysis. To overcome this potential limitation sufficient post-contract award time for implementation of the program management planning process was allowed.

This step is generalizable if sufficient time is allotted for implementing the program management planning process. A bid and proposal effort would not have allowed for full implementation of the planning process, as the entire contract could not be sufficiently planned without a definitized contract (which is only available on contract award). Time constraints associated with submitting a proposal would not allow for a full implementation.

2. The planning model was broken into the four logical components representing the various activities of the program management planning process: program organization planning, schedule planning, cost planning, and performance planning.

The value of this step is more for the researcher than the participants. Breaking the planning process into logical components allows for a compartmentalized development of data-collection instruments. Since the activities associated with each of these logical components are visited asynchronously, team participants do not recognize the value of such an organization. Further, the planning process is organized by activities such that the creation of logical components is transparent and of little perceived value to the team participants.

This step of the methodology is generalizable within the constraints of the planning model used.

3. Individuals representing different functional organizations were selected to implement their specific aspects of each of the logical components of the planning process.

This step is certainly generalizable to other programs within this same organization. The program management planning process requires that each functional organization perform activities specific to it. This step, however, assumes that the organization is divided into discrete entities readily identified as functional organizations. Perhaps a single functional organization exists that is capable of planning for all other functional organizations, and then it would not be necessary to identify representatives from the many applicable functional organizations to perform the program's planning.

4. Individuals representing each functional organization implementing their
specific functional organization’s part of each logical component were required to coordinate with the individuals implementing the other components.

This cross-fertilization of personnel provided for a continuous thorough evaluation of the products that passed from one activity of the planning process to the next. If there are many team participants it is imperative that a consistent performance measurement baseline be developed and that open communication exists among the representatives of the many functional organizations.

This step of the methodology is generalizable to any planning effort having multiple participants representing one or more functional organizations.

5. Questionnaires were completed and interviews conducted at the conclusion of each logical component listed above. These questionnaires and interviews provided the data from which analysis was performed to determine the effectiveness of the program management planning process. Additionally, participation and personal observation were used.

This step of the methodology is not generalizable in its current form. In fact, as discussed above, a logical component did not end prior to the initiation of the next logical component. Activities were executed producing an interim version of a product. This interim product allowed the next logical component to begin. Each of the activities was revisited as new data made existing products obsolete.

Therefore questionnaires had to be completed and interviews conducted as the entire planning effort neared completion. This approach, as it turns out, was satisfactory because the team participants had a better appreciation for the collective value of the planning activities and attendant products as a result of following the planning process. The team participants gained a global perspective of the planning process and could make more informed judgments.

Additionally, as part of the methodology, a committee of stakeholders was formed representing organizational interests and the specific program. This committee assisted in determining the goals and objectives of the program management planning process. The program’s goals and objectives thus became the focus for creating data-gathering instruments. The committee of stakeholders played an integral role in the entire evaluation process. This step is generalizable to other studies of this nature.

3.5. Research Question #5

Relative to integrated linear and integrated nonlinear models of planning processes what does this study reveal?
3.5.1. Conclusion — The findings of this study support the proposition that integrated nonlinear planning models are really macromodels and that integrated linear models are really micromodels. They are not separate models; rather, the integrated linear model is a subset of the higher-level integrated nonlinear model.

This question adds to the body of knowledge pertaining to program planning models. Program planning in general is a part of adult and community education as well as other social, political, and educational disciplines. Additionally, this program management planning process is a planning model, and as such, investigating its relationship to other types of planning models would be an expected part of this study.

3.5.2. Supporting Discussion — As discussed in a previous chapter, there are four basic combinations for a program-planning format: a nonintegrated linear model, a nonintegrated nonlinear model, an integrated nonlinear model, and an integrated linear model. The proposition that integrated nonlinear planning models are macromodels and integrated linear models are micromodels has already been discussed at length in a previous chapter.

What, then, do the data of this study reveal? The program management planning process identifies a series of activities, with each activity producing a culminating product of some degree of completeness. There exists a sequentiality of the numerous activities of the program management planning process. For example, a program planning team could not generate the master program schedule or the work breakdown structure and dictionaries if the requirements had not been identified. Human resources could not be assigned until the work had been decided upon and scheduled; hence the human resource plan comes after the detailed schedules have been generated.

From this perspective, then, the program management planning process is an integrated linear model. Note the cyclical nature, however, of the activities and products. Even though we generate a work breakdown structure or responsibility assignment matrix, they are only preliminary. These and other products cannot be entirely completed until further discussions and subsequent activities are performed. In other words, a final version of these documents can only be produced after some revisiting of previously executed activities.

This nonlinear aspect of the program management planning process means that various activities will be at different stages of development. This is true even though each activity must go through a logical natural progression, as depicted in linear models. The inherent sequentiality of the planning process is at the microlevel and must be adhered to by each of the lower-level activities, while the cyclical outer process provides us with the macroview we call nonlinear program planning. The outer/macro process provides the framework that allows for the cycling to take
place. The final version of end products, however, cannot be generated until the sequential activities have been completed.

3.6. Recommendations

There are a number of areas that would benefit from further research:

1. The findings of this study are limited to a specific situation. There is no prior documented account with which to compare the findings of this study. One area for further research, therefore, would be to perform this same type of study on either this program management planning process or another that requires comparable activities and end products. The findings of additional studies may begin to provide common themes from which we may make further determinable, constructive changes.

2. Other planning processes should be studied for programs with varying characteristics. With this information perhaps we can suggest that cost-plus programs of less than $2 million, or fixed-price programs between $6 million and $10 million, should or should not have certain activities performed. Questions also arise concerning which products provide how much benefit. For example, under which conditions is it beneficial to assign human resources in the scheduling tool versus assigning them directly in the cost tool?

3. Additional studies may provide some insight about where the cost of automatic integration outweighs the benefits, or if this is ever the case. Perhaps automatic integration of the cost and schedule functions by assigning resources in the scheduling tool and later transferring them to the cost tool for pricing is not only the theoretically best approach but in fact the best practical approach. Additional research could help to make that determination.

4. An additional avenue would be to study a program’s execution, analysis, and adjustment phases, thus providing another perspective on the value of the products and the accuracy of the original baseline.

5. A historical study could delineate programs by type and complexities and determine which characteristics identify routinely high-risk programs. For example, do most cost-plus software development programs between $8 million and $50 million experience overruns? Do high-risk programs have development methodologies for performing their software, hardware, or systems engineering work? Are all development programs at risk as compared to all production programs? Does program cost really make a difference or is the difference in the development practices? If we could make
some determinations as to which programs possessed the highest risks, then we could focus on improving those types of programs.

6. After determining which types of programs possess the highest risks for cost, schedule, or technical lack of performance, a study could investigate whether those programs, through following a documented program management planning process, perform the same, better, or worse than before.

3.7. Conclusion

The ultimate question, then, is should this program management planning process be included as a component of the curriculum in the education of program managers? Based on this study, we can answer this question with an unequivocal yes.

There is much work to be done if we expect to make positive changes in the way in which we manage programs in complex industries. Following a basic decision-making process for an entire industry may be a good point to start: defining the problems, identifying alternative solutions, selecting a solution, implementing a solution, and monitoring the effect. As simplistic as this process may sound we have not yet collected sufficient evidence to determine what the real problems may be. Certainly we have identified targets for change but on the whole we have been unable, or not committed enough, to categorize the numerous independent and dependent variables with sufficient clarity to make informed changes at a macro level, across business areas within companies or across companies themselves. Perhaps this is too lofty a goal or too theoretical in its intent and perhaps not practical in implementation. But only through continuously documenting applicable studies can we slowly evolve to a consistent perspective on how to handle programs of any type, let alone high-risk programs.
Appendix B

Outcomes and Behaviors

The following outcomes were viewed as potential favorable results of the program management planning process and the specific behaviors were identified as acceptable evidence of those outcomes.

1. Program personnel create a cost, schedule, and technical performance measurement baseline.
   Behavioral evidence:
   a. Program personnel define the work to be accomplished.
   b. Program personnel schedule the work to be performed.
   c. Program personnel allocate resources to the work to be accomplished.
   d. Program personnel generate a time-phased budget.

2. Program personnel integrate cost, schedule, and technical functions.
   Behavioral evidence:
   a. Program personnel identify resources for each detailed schedule activity (labor grade, functional organization, commitment level).
   b. Program personnel ensure that the efforts to perform the activities are tied to the activities identified in the detailed schedules.
   c. Program personnel assign earned value (performance credit) techniques to work defined.

3. Program personnel recognize the added value of the program management planning process.
   Behavioral evidence:
   a. Program personnel positively acknowledge the formal framework for planning provided by the planning process.
b. Program personnel positively acknowledge the consistency in functional organization planning provided by the planning process.
c. When there is a problem during planning, program personnel utilize planning process data to identify where the problem exists.
d. When there is a problem during planning, program personnel utilize planning process data to quantify the extent of the problem.

4. Program personnel promote the use of the program management planning process.
Behavioral evidence:
a. Program personnel utilize planning process reports at program reviews.
b. Program personnel organize their activities in accordance with the cost, schedule, and technical performance measurement baseline as defined by the planning process.
c. Program personnel act as consultants to other start-up programs.
Appendix C

Participant Interview Questionnaire

1. Which documents did your functional organization use to extract its stated and/or derived requirements?
2. Please describe the methodology and tools used to assign requirements to specific functional organizations.
3. Please describe the organization and sequencing of the work to be performed.
4. Please describe the documents that were consulted prior to the organization of the work.
5. To what level of detail were tasks identified that depict the defined work?
6. Please describe the scheduling technique employed.
7. Relative to horizontal integration of scheduled networked tasks, what is the highest utilized interfacing technique: finish-start, start-start, or finish-finish?
8. Please describe the costing strategy employed for the effort applicable to your functional organization.
9. Please describe the methodology employed in determining the cost accounts and work packages.
10. How did you determine the number of cost account managers for your functional organization?
11. Please describe the seriousness and probability of impact of the development risks on your functional organization.
12. Please describe the reporting relationship of the functional organizations to the program manager within the program organization.
13. What criteria did your functional organization use in identifying the program documents it required?
14. Which products of the planning process did you find to be most useful?
15. Which products of the planning process did you find to be least useful?
16. Please describe the sequencing and product differences between the way your functional organization previously developed the program baseline and the way your functional organization develops it now.
17. Did the program management training reinforce your existing competencies in program baseline development?
18. In what ways did the training reinforce your existing competencies?
19. Please give an example of instances where you were called upon to help others during program planning.
20. In what ways were you able to help others in performing their tasks?
Appendix D

Facilitator Interview Questionnaire

1. Which portions of the program management training did you find demanded a greater emphasis?
   a. What evidence did you use to determine the need for greater emphasis?
   b. What did you do to meet the need for greater emphasis?
   c. How well did the enhanced emphasis work?
2. Which portions of the training do you feel are the most critical?
   a. Why do you feel these portions are the most critical?
   b. In what ways were these critical portions enhanced to emphasize their importance?
   c. How well did the enhancement work?
3. Which portions of the training do you feel would have the least impact on the development of a proper program management baseline?
   a. Why do you feel these portions would have the least impact?
   b. How were these portions presented differently to emphasize their relative impact?
   c. Do you believe their relative impact was adequately conveyed?
4. What do you feel was the participants’ level of understanding prior to the training?
   a. What evidence did you use to determine their level of understanding?
   b. How was the training modified to accommodate the various levels?
   c. Do you think the multi-leveled training was effective for all?
   d. Why do you feel the multi-leveled training was effective for all?
5. In what ways do you feel the participants exhibited a theoretical knowledge of the subject matter?
6. How would you change the mix of participants in the training that was presented?
   a. What evidence did you use to determine that the mix needed changing?
   b. How would the mix affect the training order?
Appendix E

Participant Five-Point Questionnaire

Cost Planning

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1. The contract statement of work provided a vital source for program requirements.
2. The contract specification provided a vital source for program requirements.
3. Other functional organizations provided a source for program requirements.
4. All elements of the work breakdown structure were expanded to at least one level below the formal government reporting level.
5. All work breakdown structure elements at level three or below have costs assigned to them.
6. All work breakdown structure elements below level three have their costs summarized at a level-three element.
7. All required cost accounts have been identified.
8. All cost accounts are at least one level below the reporting level.
9. Cost accounts have been defined such that a single functional organization can be assigned the cost account responsibility.
10. Every cost account has a responsible functional organization.
A matrix depicting the functional organization to cost accounts mapping has been created.

Schedule Planning

11. 1 2 3 4 5

12. 1 2 3 4 5 The master program schedule reflects the contract deliveries.
13. 1 2 3 4 5 The master program schedule reflects the customer reviews.
14. 1 2 3 4 5 The master program schedule reflects summaries of all program activities.
15. 1 2 3 4 5 The master program schedule reflects management reserve.
16. 1 2 3 4 5 The intermediate schedule depicts a level hierarchically lower than the master program schedule.
17. 1 2 3 4 5 The intermediate schedule depicts all start/complete dates of tasks.
18. 1 2 3 4 5 The intermediate schedule depicts durations for all summaries.
19. 1 2 3 4 5 The detailed schedules depict a level hierarchically lower than the intermediate schedule.
20. 1 2 3 4 5 Each activity in the detailed schedules is distinguishable from every other activity in the detailed schedules.
21. 1 2 3 4 5 Each activity in the detailed schedules can be assigned to a unique functional organization.
22. 1 2 3 4 5 The detailed schedules depict the duration of each activity.
23. 1 2 3 4 5 The detailed schedules depict the predecessor relationship for each activity.
24. 1 2 3 4 5 The detailed schedules depict the successor relationship for each activity.

Performance Planning

25. 1 2 3 4 5 All requirements have been accurately categorized as either technical, cost, schedule, programmatic, or supportability.
26. Each identified requirement is assigned to a work breakdown structure element.

27. Each significant risk has been identified.

28. Each significant risk has had performance parameters assigned to it.

29. Each significant risk is objectively measurable.

**Program Organization Planning**

30. Each element of work is assigned to the most appropriate functional organization.

31. Each functional organization is depicted in a hierarchical organization chart.

32. All program documentation has been identified.

33. A needs mapping exists between program documentation and functional organizations.

**Promoting the Planning Process**

34. As a participant, I voluntarily helped others during program planning.

35. As a participant, I gave constructive criticism to colleagues during program planning that greatly strengthened their plans.

36. I support the utilization of planning process reports at program reviews.

37. I intend to execute the program in accordance with the performance measurement baseline.
Appendix F

Participant Multiple-Choice Questionnaire

1. Relative to identifying the requirements for purposes of organizing the work, I believe that:
   a. All contract documents (statement of work, specification, contract provisions) were thoroughly scanned.
   b. All contract documents were minimally scanned.
   c. Some contract documents were scanned more thoroughly than others.
   d. Not all contract documents were scanned.

2. Relative to the assignment of costs to work breakdown structure elements, I believe that:
   a. All costs were allocated appropriately based on sound evidence.
   b. Costs are allocated appropriately in most cases.
   c. Costs do not appear to consider the actual effort of the work to be performed.
   d. When implemented most cost estimates will require major revisions.

3. Relative to the assignment of work to the responsible functional organizations or individuals, I believe that:
   a. All work has been properly assigned to the appropriate functional organizations.
   b. Generally, most work appears to be assigned appropriately.
   c. Most work is inappropriately assigned.
   d. Some work is not assigned at all.

4. Relative to the master program schedule, I believe that:
   a. It accurately reflects all contract deliveries, customer reviews, program activity summaries, and management reserve.
b. It reflects most contract deliveries, customer reviews, program activity summaries, and management reserve.

c. It reflects few of the contract deliveries, customer reviews, program activity summaries, and management reserve.

d. It is inadequate in that it has missed a significant number of contract deliveries, customer reviews, or program activity summaries.

5. Relative to the intermediate schedule, I believe that:

a. In all cases it depicts a level hierarchically lower than the master program schedule, start and complete dates of tasks, and durations for summaries.

b. In most cases it depicts a level hierarchically lower than the master program schedule, start and complete dates of tasks, and durations for summaries.

c. In some cases it depicts a level hierarchically lower than the master program schedule, start and complete dates of tasks, and durations for summaries.

d. In few cases it depicts a level hierarchically lower than the master program schedule, start and complete dates of tasks, or durations for summaries.

6. Relative to the detailed schedules, I believe that:

a. In all cases they depict the predecessor and successor relationships for each task.

b. In most cases they depict the predecessor and successor relationships for each task.

c. In some cases they depict the predecessor and successor relationships for each task.

d. In few cases they depict the predecessor and successor relationships for each task.

7. Relative to the categorization of requirements, I believe that:

a. Requirements are appropriately assigned to one or more of the categories of technical, cost, schedule, programmatic, or supportability.

b. Requirements in general are appropriately assigned to one or more of the categories of technical, cost, schedule, programmatic, or supportability.

c. A number of requirements, but not all, are appropriately assigned to one or more of the categories of technical, cost, schedule, programmatic, or supportability.

d. Requirements in most all cases are inappropriately assigned to one or more of the categories of technical, cost, schedule, programmatic, or supportability.
8. Relative to the identification of program risks, I believe that:
   a. Every anticipated identified risk has been documented.
   b. Most identified risks have been documented.
   c. Some identified risks have been documented.
   d. Few identified risks have been documented.

9. Relative to the program organization chart, I believe that:
   a. Every applicable functional organization is depicted hierarchically in the program organization chart.
   b. Most applicable functional organizations are depicted hierarchically in the program organization chart.
   c. Some applicable functional organizations are depicted hierarchically in the program organization chart.
   d. Few applicable functional organizations are depicted hierarchically in the program organization chart.

10. Relative to actually performing the program planning, I believe that:
    a. I frequently was able to offer help or constructive criticism to other program personnel or other programs.
    b. I sometimes was able to offer help or constructive criticism to other program personnel or other programs.
    c. I infrequently was able to offer help or constructive criticism to other program personnel or other programs.
    d. I infrequently was able to offer help or constructive criticism to other program personnel or other programs and was seldom called upon to do so.

11. Relative to actually performing the program planning, I believe that:
    a. The program management training provided significant value over what I already knew in performing the planning activity more efficiently or effectively.
    b. The program management training provided some value over what I already knew in performing the planning activity more efficiently or effectively.
    c. The program management training provided little value over what I already knew in performing the planning activity more efficiently or effectively.
    d. The program management training provided no additional value over what I already knew in performing the planning activity more efficiently or effectively.
Appendix G

Researcher Observation Form

1. Used contract statement of work, specification, and/or contract provisions for extracting program stated or derived requirements:

   No utilization of documents ( ) ( ) ( ) ( ) ( ) Continuous utilization of documents

2. Used higher-level schedules for purposes of generating lower-level schedules:

   No utilization of higher-level schedules ( ) ( ) ( ) ( ) ( ) Continuous use of higher-level schedules

3. Frequency of documentation of program risk:

   Never documented identified program risks ( ) ( ) ( ) ( ) ( ) Continuously documented identified program risks

4. Relative to promoting the use of the program management planning process, participants:

   Never helped others during program planning ( ) ( ) ( ) ( ) ( ) Continuously helped others during program planning
   Never criticized others’ work ( ) ( ) ( ) ( ) ( ) Continuously offered constructive criticism of others’ work
   Never demonstrated competitiveness ( ) ( ) ( ) ( ) ( ) Continuously demonstrated constructive competitiveness
5. Relative to demonstrating enthusiasm for program planning, participants:

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<th>Inappropriately interfered with program planning</th>
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<td>Never shared their work with others</td>
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<td>Never discussed the merits of planning during breaks</td>
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Appendix H

Data Collection Instrument Mapping

This appendix provides a mapping of data collection instrument questions (multiple-choice, Likert scale, and interview) to behaviors deemed as acceptable evidence that planning process outcomes were satisfactory. This mapping indicates the primary behavior for which the question is directed and helps the reader locate the data in section 2 of Appendix A.

This mapping does not imply that a particular question is singularly applicable to the behavior indicated. Nearly all questions provide some form of supplemental information applicable to other behaviors. The mapping is a depiction of primary applicability.
### Mapping of Data Collection Instruments to Program Management Planning Process Outcomes and Behaviors

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### Mapping of Data Collection Instruments to Program Management Planning Process Outcomes and Behaviors

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Appendix I

Participant Five-Point Questionnaire Data

The numbers under the categories of Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), and Strongly Disagree (SD) represent the number of program planning team participants responding in that way to that particular question. There were eighteen program planning team participants in this study.

### Cost Planning

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- The contract statement of work provided a vital source for program requirements.

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- The contract specification provided a vital source for program requirements.

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- Other functional organizations provided a source for program requirements.

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- All elements of the work breakdown structure were expanded to at least one level below the formal government reporting level.

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- All work breakdown structure elements at level three or below have costs assigned to them.

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- All work breakdown structure elements below level three have their costs summarized at a level-three element.

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- All required cost accounts have been identified.

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- All cost accounts are at least one level below the reporting level.
9. 17 1 0 0 0 Cost accounts have been defined such that a single functional organization can be assigned the cost account responsibility.

10. 18 0 0 0 0 Every cost account has a responsible functional organization.

11. 18 0 0 0 0 A matrix depicting the functional organization to cost account mapping has been created.

Schedule Planning

12. 13 5 0 0 0 The master program schedule reflects the contract deliveries.
13. 13 4 1 0 0 The master program schedule reflects the customer reviews.
14. 12 4 2 0 0 The master program schedule reflects summaries of all program activities.
15. 0 4 10 4 0 The master program schedule reflects management reserve.
16. 15 3 0 0 0 The intermediate schedule depicts a level hierarchically lower than the master program schedule.
17. 15 3 0 0 0 The intermediate schedule depicts all start/complete dates of tasks.
18. 16 2 0 0 0 The intermediate schedule depicts durations for all summaries.
19. 18 0 0 0 0 The detailed schedules depict a level hierarchically lower than the intermediate schedule.
20. 7 10 1 0 0 Each activity in the detailed schedules is distinguishable from every other activity in the detailed schedules.
21. 5 10 3 0 0 Each activity in the detailed schedules can be assigned to a unique functional organization.
22. 18 0 0 0 0 The detailed schedules depict the duration of each activity.
23. 18 0 0 0 0 The detailed schedules depict the predecessor relationship for each activity.
24. 18 0 0 0 0 The detailed schedules depict the successor relationship for each activity.
Performance Planning

SA A U D SD
25. 0 2 12 3 1 All requirements have been accurately categorized as either technical, cost, schedule, programmatic, or supportability.
26. 0 3 10 5 0 Each identified requirement maps to a work breakdown structure element.
27. 0 2 5 10 1 Each significant risk has been identified.
28. 0 0 5 5 8 Each significant risk has had performance parameters assigned to it.
29. 0 3 2 5 8 Each significant risk is objectively measurable.

Program Organization Planning

SA A U D SD
30. 7 11 0 0 0 Each element of work is assigned to the most appropriate functional organization.
31. 9 9 0 0 0 Each functional organization is depicted in a hierarchical organization chart.
32. 17 1 0 0 0 All program documentation has been identified.
33. 0 0 12 4 2 A needs mapping exists between program documentation and functional organizations.

Promoting the Planning Process

SA A U D SD
34. 2 12 2 2 0 As a participant, I voluntarily helped others during program planning.
35. 1 8 3 6 0 As a participant, I gave constructive criticism to colleagues during program planning that greatly strengthened their plans.
36. 11 6 1 0 0 I support the utilization of planning process reports at program reviews.
37. 12 6 0 0 0 I intend to execute the program in accordance with the performance measurement baseline.
Appendix J

Participant Multiple-Choice Questionnaire Data

The numbers in parentheses after each multiple-choice option represent the number of program planning team participants responding to that option for that particular question. There were eighteen program planning team participants in this study.

1. Relative to identifying the requirements for purposes of organizing the work, I believe that:
   a. (2) all contract documents (statement of work, specification, contract provisions) were thoroughly scanned.
   b. (2) all contract documents were minimally scanned.
   c. (14) some contract documents were scanned more thoroughly than others.
   d. (0) not all contract documents were scanned.
2. Relative to the assignment of costs to work breakdown structure elements, I believe that:
   a. (0) all costs were allocated appropriately based on sound evidence.
   b. (12) costs were allocated appropriately in most cases.
   c. (0) costs do not appear to have considered the actual effort of the work to be performed.
   d. (6) when implemented, most cost estimates required major revisions.
3. Relative to the mapping of work to be performed to the responsible functional organizations or individuals, I believe that:
   a. (1) all identified work was properly assigned to the appropriate functional organizations.
b. (16) generally, most work was assigned appropriately

c. (0) most work was inappropriately assigned.

d. (1) some work was not assigned at all.

4. Relative to the master program schedule, I believe that:

a. (2) it accurately reflected all contract deliveries, customer reviews, program activity summaries, and management reserve.

b. (16) it reflected most contract deliveries, customer reviews, program activity summaries, and management reserve.

c. (0) it reflected few of the contract deliveries, customer reviews, program activity summaries, and management reserve.

d. (0) it was inadequate in that it missed a significant number of contract deliveries, customer reviews, or program activity summaries.

5. Relative to the intermediate schedule, I believe that:

a. (18) in all cases it depicted a level hierarchically lower than the master program schedule, start and complete dates of tasks, and durations for summaries.

b. (0) in most cases it depicted a level hierarchically lower than the master program schedule, start and complete dates of tasks, and durations for summaries.

c. (0) in some cases it depicted a level hierarchically lower than the master program schedule, start and complete dates of tasks, and durations for summaries.

d. (0) in few cases it depicted a level hierarchically lower than the master program schedule, start and complete dates of tasks, or durations for summaries.

6. Relative to detailed schedules, I believe that:

a. (3) in all cases they depicted the predecessor and successor relationships for each task.

b. (13) in most cases they depicted the predecessor and successor relationships for each task.

c. (2) in some cases they depicted the predecessor and successor relationships for each task.

d. (0) in few cases they depicted the predecessor and successor relationships for each task.

7. Relative to the categorization of requirements, I believe that:

a. (1) requirements were appropriately assigned to one or more of the categories of technical, cost, schedule, programmatic, or supportability.
b. (0) requirements in general were appropriately assigned to one or more of the categories of technical, cost, schedule, programmatic, or supportability.

c. (15) a number of requirements, but not all, were appropriately assigned to one or more of the categories of technical, cost, schedule, programmatic, or supportability.

d. (2) requirements in most all cases were inappropriately assigned to one or more of the categories of technical, cost, schedule, programmatic, or supportability.

8. Relative to the identification of program risks, I believe that:
   a. (0) every anticipated identified risk was documented.
   b. (2) most identified risks were documented.
   c. (2) some identified risks were documented.
   d. (14) few identified risks were documented.

9. Relative to the program organization chart, I believe that:
   a. (10) every applicable functional organization was depicted hierarchically in the program organization chart.
   b. (8) most applicable functional organizations were depicted hierarchically in the program organization chart.
   c. (0) some applicable functional organizations were depicted hierarchically in the program organization chart.
   d. (0) few applicable functional organizations were depicted hierarchically in the program organization chart.

10. Relative to actually performing the program planning, I believe that:
    a. (2) I frequently was able to offer help or constructive criticism to other program personnel or other programs.
    b. (9) I sometimes was able to offer help or constructive criticism to other program personnel or other programs.
    c. (5) I infrequently was able to offer help or constructive criticism to other program personnel or other programs.
    d. (2) I infrequently was able to offer help or constructive criticism to other program personnel or other programs and was seldom called upon to do so.

11. Relative to actually performing the program planning, I believe that:
    a. (1) the program management training provided significant value over what I already knew in performing the planning activity more efficiently or effectively.
b. (16) the program management training provided some value over what I already knew in performing the planning activity more efficiently or effectively.

c. (0) the program management training provided little value over what I already knew in performing the planning activity more efficiently or effectively.

d. (1) the program management training provided no additional value over what I already knew in performing the planning activity more efficiently or effectively.
Appendix K

Researcher Observation Form Data

The “x” represents the researcher’s opinion as a result of observation during the program planning team's implementation of the program management planning process.

1. Used contract statement of work, specification, and/or contract provisions for extracting program stated or derived requirements:

   No utilization of documents ( ) (x) ( ) ( ) ( ) Continuous utilization of documents

2. Used higher-level schedules for purposes of generating lower-level schedules:

   No utilization of higher-level ( ) ( ) ( ) ( ) (x) Continuous use of higher-level schedules

3. Frequency of documentation of program risk:

   Never documented identified ( ) (x) ( ) ( ) ( ) Continuously documented identified program risks

4. Relative to promoting the use of the program management planning process, participants:

   Never helped others during ( ) ( ) (x) ( ) Continuously helped others during program planning
5. Relative to demonstrating enthusiasm for program planning, participants:

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<th>Statement</th>
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<td>Continuously demonstrated constructive competitiveness</td>
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Inappropriately interfered with program planning

Never shared their work with others

Never discussed the merits of planning during breaks

Appropriately contributed during planning

Continuously shared their work with others

Constructively discussed the merits of planning during breaks
Glossary

0/100 (earned-value technique). The earned-value technique for work packages having a planned duration of one accounting period where the BCWP earned for starting work is 0% of BAC and the BCWP earned for completing the planned work is 100% of BAC.

25/75 (earned-value technique). The earned-value technique for work packages having a planned duration of two accounting periods where the BCWP earned for starting work is 25% of BAC and the BCWP earned for completing the planned work is 75% of BAC.

40/60 (earned-value technique). The earned-value technique for work packages having a planned duration of two accounting periods where the BCWP earned for starting work is 40% of BAC and the BCWP earned for completing the planned work is 60% of BAC.

50/50 (earned-value technique). The earned-value technique for work packages having a planned duration of two accounting periods where the BCWP earned for starting work is 50% of BAC and the BCWP earned for completing the planned work is 50% of BAC.

Action item list. A product of the documentation and communication process that documents all action items generated in a specific program area including action item identification, progress, closure (solution), and archiving. The action item list is an attachment to the appropriate meeting minutes.

Activity. (1) A discrete element of work or a task in a project that occurs over time and consumes resources. (2) A work package, planning package, or task. (3) A class of scheduling objects that includes activities, summaries, hammocks, and subprojects.
Activity-on-node. An activity-oriented scheduling method that demonstrates the critical path. Also called the precedence diagram method for scheduling.

Actual cost of work performed (ACWP). The costs actually incurred and recorded in accomplishing the work performed within a given time period.

Actual direct cost. Those costs identified specifically with a contract that are based upon the contractor’s cost identification and accumulation system. (See also Direct cost.)

Adjustment. See Program adjustment.

Aliasing. A technique used to relate functional CWBS elements to product CWBS elements for the purpose of collecting costs on a product basis.

Analysis. See Program analysis.

Applied direct costs. The amounts recognized in the time period associated with the consumption of labor, material, and other direct resources without regard to the date of commitment or the date of payment.

Apportioned effort (earned-value technique). The earned-value technique for work packages measuring work related in direct proportion to work measured by one or more other work packages, where the apportioned value of BCWP earned is based on the BCWP earned by the other applicable work package(s). As an example, WP #1’s BCWS for period #1 is $1000. WP #2’s BCWS is $100, as it is budgeted to cost 10% of WP #1’s effort planned for period #1. Assume only 50% of WP #1’s planned work ($1000 \times 50\% = $500) is completed during period #1, then BCWP earned by WP #2 would be 10% of 500, or $50.

Asset number. The company-assigned identification number assigned to equipment for inventory and tracking purposes.

At-completion variance. See Variance at completion.

Authorized unpriced work. Work authorized in writing by the buyer’s contracting officer that has not been negotiated.

Authorized work. Effort that is required in the performance of a definitized contract, or effort authorized in writing by the buyer’s contracting officer prior to having a definitized contract.

Balanced set. Typically refers to the complete set of parts and/or subassemblies required by the bill of material to manufacture a single end item. However, “balanced set” may also be used when referring to a subassembly, as opposed to an end item.

Baseline. See Program baseline; Performance measurement baseline; Contract baseline.
**Base material cost (BMC).** Prior to contract negotiations, it is the anticipated vendor's price for material, usually based on a quote obtained by purchasing from the vendor, or an advertised price (e.g., catalog price). Following contract negotiations, it is the negotiated material cost minus management reserve.

**Bid manager.** The person responsible for managing proposal preparation, delivery, and post-submission activities.

**Budget at completion (BAC).** The total budgeted cost for work scheduled.

**Budgeted cost for work performed (BCWP).** Credit earned for work completed at the program or work-package level. (1) For a program: the sum of the budgets for completed work packages and completed portions of open work packages, plus the appropriate portion of the budgets for level of effort and apportioned effort. (2) For a work package: a value (dollars or person-hours) that is earned during each accounting period by accomplishing scheduled work and is all or part of the budget at completion for the work scheduled as determined by the work package's earned-value technique established prior to the start of work.

**Budgeted cost for work scheduled (BCWS).** Budget for planned work at the program or work package level. (1) For a program: the sum, by accounting period, of the budgets for all work packages and planning packages. (2) For a work package or planning package: the budgeted cost of the work planned for completion during each accounting period.

**Build/version.** An event that depicts a predetermined state of development for a hardware configuration item and/or computer software configuration item.

**Build/version schedule.** An intermediate-level supplemental schedule depicting only those activities required to complete a build, or a new version, of a configuration item.

**Burden (labor).** The sum of all indirect cost incurred within a specific labor pool (e.g., design engineering, assembly shop, etc.).

**Burden rate.** A standard percentage of total direct cost incurred within a specific labor pool that is periodically determined by the accounting functional organization and is used when bidding/estimating contracts to compensate for all indirect expense incurred by the labor pool.

**Charge number.** A job order number assigned by the accounting functional organization to a cost account to collect and report actual costs.

**Change order.** See Contract change order.

**Company investment.** (1) Internally contracted work completed with company funds. (2) Any contractual effort funded from company profit in accordance with a
contract’s cost sharing provisions. Investment is normally funded via an approved internal request for expenditure.

**Company organization.** The organization that illustrates the arrangement of jobs and positions from the president to each employee.

**Configuration item.** (1) An aggregation of hardware and/or computer software, or any of its discrete portions, that satisfies an end use and is designated by the customer or the company for configuration management. (2) Any item required for logistic support designated for separate procurement.

**Configuration item schedule.** An intermediate-level supplemental schedule depicting only those activities required to complete a build or a new version of a configuration item.

**Connection (schedule).** A sequential workflow link (dependency) between activities that is used to calculate the activity’s early and late schedule.

**Constraint (schedule).** A date limitation imposed on the start and/or finish of an activity or event. Events having constraints are frequently called targeted or fixed events.

**Contract baseline.** A baseline formed by the paper or papers that collectively contain the parties’ agreements concerning the work that is to be performed, including: a specification and/or statement of work; contract deliverables, line items, and data; delivery schedules; price (ceiling, target, or both) for fixed-price contracts or cost (target, ceiling, or both) for cost-reimbursement contracts; all specifications and standards incorporated by reference; when so stipulated by the contract, the contractor’s proposal; any other documents that form the basis for the agreement; and an order of precedence for contract documents. The contract baseline is established by the definitized contract.

**Contract budget base.** The value of all negotiated contract costs plus the estimated cost of authorized unpriced work.

**Contract change order.** A written order signed by the buyer’s contracting officer directing the contractor to make a change that the contract’s changes clause authorizes the contracting officer to order without the contractor’s consent.

**Contract data requirements list.** A list of various types of data to be prepared by the contractor in accordance with contract requirements and delivered to the buyer.

**Contract line item number (CLIN).** A unique number defined by the contract and assigned to each contract deliverable.

**Contract manager.** The contract management functional manager assigned to the communications management function responsible for managing external formal
documentation and communication except management and delivery of the contract data requirements list.

**Contract reporting level.** The CWBS level, agreed to by the customer and contractor, at which formal cost performance reporting to the customer is required. The contract reporting level is normally level three (i.e., CWBS Element AAA, AAB, etc.).

**Contract target cost.** (1) The negotiated cost for the original definitized contract and all contractual changes that have been definitized, excluding the estimated cost of any authorized unpriced changes. The contract target cost equals the value of the budget at completion plus management reserve when there is no authorized unpriced work. (2) The cost specified in incentive contracts that is compared to total allowable contract cost to arrive at a difference that is used to adjust negotiated profit or fee, based on the contract’s incentive formula.

**Contract target price.** The negotiated price of the contract (contract target cost plus profit or fee).

**Contract work breakdown structure (CWBS).** The complete work breakdown structure for a contract provided by the customer in the contract or developed by the contractor in accordance with industry guidelines and the contract statement of work. This document must be accompanied by the CWBS dictionary.

**Contract work breakdown structure cost reporting level schedule.** An intermediate-level supplemental schedule that depicts the program level at which costs are being reported to the customer.

**Control identification number.** See Job order number.

**Cost account.** (1) An intersection of the extended contract work breakdown structure and organizational structure at which budget, statement of work (technical performance), schedule, and functional responsibility for work is assigned by the program manager to a cost account manager. (2) The management control point at which actual costs of work performed can be accumulated and compared to budgeted costs for work scheduled and work performed. Cost, schedule, and technical performance variances are monitored and reported.

**Cost account authorization document.** A form used by the program management office to formally authorize work. It must include, as a minimum, the cost account job order number, statement of work, scheduled start and completion dates, budget, and manager’s name. It must be approved by the program manager and functional manager and be agreed on by the cost account manager.
Cost account identifier. Typically the same identifier as the extended CWBS element, normally at the fourth level (e.g., AABA, AABC, etc.), which intersects with a program organization to form the basis for the cost account.

Cost account plan. A product of the cost account planning process that provides a summary of the time-phased work allocated to a cost account in terms of budget and schedule. It includes summary information, work/planning packages, an earned-value milestones description list, and a material analysis sheet for material cost accounts. Cost account plans are program baseline documents.

Cost account plan worksheet. A form that is used during cost account planning to transmit detailed work package/planning package data between the planner (cost account manager or functional organization planning resource) and the cost manager.

Cost account planning. The program management planning process used for developing the cost account plans and the spend plan. Cost account supplemental schedules are approved in this process.

Cost account supplemental schedule. A product of the schedule planning process (but approved in the cost account planning process) that is below the intermediate schedule and depicts a cost account's summary schedule, work package schedules, planning package schedules, interface events, and other applicable milestones. Cost account supplemental schedules are program baseline documents.

Cost breakdown structure. A product of the cost planning process that assigns budget (initially target budget) to each extended CWBS element; provides identification of cost accounts; identifies where charge numbers for direct charges will be required; and assigns budget (initially target budget) allocated to general and administration, cost of money, undistributed budget, performance measurement baseline, management reserve, contract budget base, current target cost; and authorized unpriced work. The cost breakdown structure is a program baseline document.

Cost management. The program management office function responsible for managing and maintaining program-level work definition and program cost data using an approved software tool and the cost requirements performance management function.

Cost objective. A contract, organizational division, function, or other work unit for which cost data are desired and for which provision is made to accumulate and measure the cost of processes, products, jobs, etc.

Cost of capital assets under construction. An imputed cost determined by applying a cost-of-money rate to the investment in tangible and intangible capital assets while they are being constructed, fabricated, or developed for the contractor's own use.

Cost of money. The earned interest of money had the money been in a bank.
**Cost of money rate.** (1) The arithmetic mean of the interest rates specified by the secretary of the treasury pursuant to Public Law 92-41 (85 Stat 97). (2) Where the cost of money must be determined on a prospective basis it is based on the most recent available rate published by the secretary of the treasury.

**Cost performance report.** A standard form, submitted monthly to the customer, having five reporting formats: (1) WBS, (2) functional categories, (3) baseline, (4) manpower loading, and (5) problem analysis. Formats 1 (WBS) and 2 (functional categories) show current period, cumulative-to-date, and at-completion status.

**Cost planning.** The program management planning process used for developing the extended CWBS and dictionary, the extended CWBS/CLIN matrix, and the cost breakdown structure.

**Cost/schedule control system criteria (C/SCSC).** A methodology described in Department of Defense Instructions 5000.1 and 5000.2 and the C/SCSC Joint Implementation Guide, which is imposed as a requirement for government contracts above specified dollar-values and is composed of earned-value management, on-site implementation review, and extensive progress reporting.

**Cost variance.** The difference between BCWP and ACWP.

**Critical path.** Any path through a schedule having a float equal to or less than zero.

**Current target cost.** See Contract target cost.

**CWBS dictionary.** A document that includes, for each CWBS element, the name and definition of the product(s)/service(s) being developed/manufactured/provided. This document must identify the elements used for cost reporting to the customer and must accompany the CWBS.

**CWBS template.** Generic CWBS structures, developed by functional organizations, that are used as a basis to develop a program-specific CWBS when a CWBS is not specified in the contract.

**Data item (database).** The smallest unit of data stored in a database. Data items are defined within process product standards.

**Data item (contract data requirements list).** An individual document identified as a deliverable item in the contract data requirements list.

**Data manager.** The data management functional manager assigned to the communications management function who is responsible for management and delivery of the data items specified in the contract data requirements list, which is part of external formal documentation and communication.

**Definitized contract.** A negotiated and signed agreement that completely defines in writing the funding, delivery schedule, and technical performance requirements
for all research and development, supplies, and/or services to be furnished by the contractor. The definitized contract establishes the contract baseline.

**Dependency (schedule).** See Connection.

**Design engineering.** Functional organizations existing within company divisions consisting of hardware engineering, software engineering, and drafting.

**Detailed schedules.** A product of the schedule planning process that is the lowest level of the schedule hierarchy and depicts activities and events and their interdependencies. The detailed schedule may be presented as a Gantt chart or an interdependency network. Resources are applied to, and status is entered into, these schedules. Detailed schedules are program baseline documents.

**Direct cost.** Any costs that can be identified specifically with a particular final cost objective. *(See also Actual direct cost.)*

**Discrete effort.** A task that has a specific end product or end result.

**Discrete milestone.** A milestone which has a definite scheduled occurrence in time signaling the finish of an activity such as “release drawings,” “submit contract data requirements list data item,” and/or signaling the start of a new activity. Synonymous with the term objective indicator.

**Documentation and communication.** The program management process used for managing and maintaining all written program documentation and communications and for generating the program management library and various products, including program directives, meeting minutes, program events calendar, action item lists, management presentations, telecons, and trip reports.

**Earned-value management.** A methodology for program management that is composed of tracking cost and dollarized schedule at specific management points called cost accounts. Tracking requires establishing and maintaining a performance measurement baseline, comparing performance to this baseline, and implementing corrective action with formal reporting for deviation from the baseline that exceed specified thresholds.

**Earned-value milestone.** A discrete milestone used to earn credit for work performed (BCWP). The value of BCWP allocated to an earned-value milestone (milestone weight) reflects both the amount of work that must be performed to achieve the milestone and the value of BCWP, expressed as a percentage of budget at completion and earned as a result of achieving the milestone.

**Earned-value milestones description list.** The part of the cost account plan that provides the list of earned-value milestones and their descriptions for every work package in a cost account.
**Earned-value milestone description worksheet.** A form that is used during cost account planning to transmit earned-value milestone information for each work package between the planner (cost account manager or functional organization planning resource) and the cost manager.

**Earned-value technique.** One of ten methods of establishing BCWP during each accounting period based on budget at completion and the amount of scheduled work completed for a work package.

**Element (CWBS, extended CWBS).** A work unit identified by a unique designator. Each element has an associated dictionary with all contract/internal work requirements identified. Elements may be summary-level, cost accounts, or work/planning packages.

**Element of cost.** Direct cost for labor, material, other direct costs, and travel.

**Estimate at completion.** Actual direct cost to date plus the estimate of costs for authorized work remaining.

**Estimate-to-complete (ETC).** An estimate of actual direct cost to complete the remaining authorized work.

**Event (schedule).** (1) A objective or milestone often associated with the start or finish of a project or phase of work or an important hand-off point between tasks. (2) An occurrence or milestone represented in a graphic. (3) An occurrence at a point in time, often associated with the start or completion of a key activity. Events do not consume time or resources.

**Event description list.** A product of the schedule planning process that identifies each schedule event (milestone) in the master program schedule and intermediate schedule by name and provides a description of how the event is accomplished. The event description list is a program baseline document.

**Execution.** See Program execution.

**Extended cost.** (1) The material cost determined by the monthly quantity multiplied by the unit price. (2) The total cost for a particular item of material (i.e., unit cost × total number of units).

**Extended CWBS.** A product of the cost planning process that is the contractor’s extension of the CWBS to the lowest level required for management control. The contractor will generally expand the CWBS by partitioning CWBS elements into smaller and more specific units of work, such as units separated by functional area or by time. In conjunction with the extended CWBS dictionary, the extended CWBS is a program baseline document.
Extended CWBS/CLIN matrix. A product of the cost planning process that provides a detailed cross-reference between each extended CWBS element and the contract line item number (CLIN) that funds the work described in the extended CWBS element. The extended CWBS/CLIN matrix is a program baseline document.

Extended CWBS dictionary. A product of the cost planning process that is coupled with the extended CWBS and that includes, for each extended CWBS element, the name, definition, and completion criteria of the product(s)/service(s) being developed/manufactured/provided; risk (cost/schedule/performance); applicable elements of cost (e.g., labor, material, subcontractor, other direct costs); and, for applicable elements, work/planning package descriptions, in product/service-oriented terms (lowest elements only). In conjunction with the extended CWBS, the extended CWBS dictionary is a program baseline document.

External formal documentation and communication. Any documentation or communication transmitted by the buyer’s or seller’s contracting officer that results in complying with contract requirements or changes to the contract baseline.

External informal documentation and communication. Any documentation or communication not requiring compliance with, or a change to, the contract.

Facilities capital cost of money. An imputed cost determined by applying a cost-of-money rate to facilities capital employed in contract performance.

Final cost objective. A cost objective that has allocated to it both direct and indirect costs and, in the contractor’s accumulation system, is one of the final accumulation points.

Finish float. The number of workdays the finish of an activity can slip before it causes another activity to slip.

Finish-to-finish connection. A workflow dependency that states that the successor activity cannot finish until its predecessor activity has finished.

Finish-to-start connection. A workflow dependency that states that the successor activity cannot start until its predecessor activity has finished.

Fixed event. An event with an imposed date limitation.

Float (schedule). (1) Free float is the number of workdays an activity can slip before it causes another activity to slip. (2) The difference between an activity’s earliest finish date and latest finish date, i.e. spare time. Float is also referred to as slack time. See also Finish float and Start float.

Formal documentation and communication. Any documentation or communication resulting in compliance with, or a change to, the contract baseline and/or program baseline (including the performance measurement baseline).
Formal reprogramming. A replanning of the effort remaining on the contract that requires prior written customer approval, is based on a new budget allocation, and exceeds the contract budget base. The excess budget is referred to as the operating budget.

Freeze period. A period, typically the current and subsequent reporting periods, during which customer approval is required prior to changing the budgeted cost for work scheduled for any work that is part of the performance measurement baseline.

Functional discipline work breakdown structure. A template developed by each functional discipline describing the way that the functional discipline performs its work.

Functional manager. The person responsible for managing a functional organization.

Functional organization. An organization associated with a specific functional discipline, including contract management (administration), quality assurance, subcontract management (administration), system engineering, design engineering, operations, purchasing, configuration management, data management, specialty engineering, etc.

Functional organization by process (schedule perspective). An intermediate-level supplemental schedule that depicts the intermediate schedule specific to one functional organization.

Functional organization planning resources. Resources from functional organizations, assigned to planning organization functions other than the program management office, that execute the program management planning process.

Gantt chart. A time-scaled chart that represents activities as bars and depicts relative durations of activities without depicting workflow dependencies.

Gantt/milestone chart. A Gantt chart that also depicts program milestones.

General and administration expense. (1) As defined in the program management cost management tool, an aggregate of indirect expenses that includes corporate general and administration, division general and administration, bid and proposal, and independent research and development. It is allocated only to final cost objectives. (2) Expenses representing the cost of management and administration of a business area that are grouped into a separate indirect cost pool and allocated only to final cost objectives.

General and administration rate. (1) As defined in the program management cost management tool: a standard percentage of total burdened direct cost, periodically determined by the corporate accounting functional organization, that is used when
bidding/estimating contracts to compensate for corporate general and administration, division general and administration, bid and proposal, and independent research and development expenses. (2) A standard percentage of total burdened direct cost, periodically determined by the corporate accounting functional organization, that is used when bidding/estimating contracts to compensate for general and administration expense.

**High risk.** See Significant risk.

**High-value material.** Those material items that constitute 80% of the program's material cost but only represent ~20% of the total quantity of material items.

**Holding account.** An inventory account outside the performance measurement system where actual material costs are accrued until material is released to build, at which time the actual cost of released material is transferred to the proper cost account.

**Horizontal integration.** The development of workflow dependencies among all schedule elements so that the impact of the expansion, compression, delay, or acceleration of one schedule element is reflected in all affected elements.

**Horizontal traceability.** The ability to trace workflow dependencies among all schedule elements so that any impact due to expansion, compression, delay, or acceleration of one element can be identified and located.

**Human resource plan.** A product of the resource planning process that details a program's human resource requirements and provides a program-level summary for schedule and cost of human resources. The human resource plan is a program baseline document.

**Incremental cost.** Cost depicted over time or at specified times.

**Incremental funding period.** That portion of a program performance period funded by the contract when total contract funding is not authorized at the time of contract award.

**Incremental funding requirement (incremental contract funding).** The provision (or recording) of budgetary resources for a program or project based on obligations estimated to be incurred within a fiscal year when such budgetary resources will cover only a portion of the obligations to be incurred in completing the program or project as programmed. This situation differs from full funding, where budgetary resources are provided or recorded for the total estimated obligations for a program or project in the initial year of funding.

**Indirect costs.** Costs that, because of their occurrence for common or joint cost objectives, are not readily subject to treatment as direct costs. (See also Overhead.)
Informal documentation and communication. Any documentation or communication not resulting in compliance with, or a change to, the contract baseline and/or program baseline (including performance measurement baseline).

Instant contract. The negotiated contract, including all change orders or supplemental agreements, existing at any particular instant during the life of the contract.

Interdependency network. See Network diagram/chart.

Interface event. (1) A schedule activity that provides a link between two levels of schedule hierarchy. (2) An event that demonstrates interaction between levels of schedule hierarchy. An interface event is a single entity that resides in two different places (the subproject in which it was created and the subproject’s parent node). Interface events are used to identify hand-off points between subprojects as well as the start and finish of a subproject. Interface events remember their schedule when project files are separated and automatically link together again when united in the same project file.

Intermediate schedule. A product of the schedules planning process existing one level below the master program schedule that depicts significant events and activities required to meet master program schedule milestones; depicts key internal milestones, including receipt of critical material and long-lead items; depicts transmittal of buyer-furnished equipment, information, or material to subcontractors and/or receipt of subcontractor deliverables; contains interrelated activities or summarizations of lower-level schedules (e.g., cost account supplemental schedules); provides horizontal integration for lower-level schedules; and is vertically integrated with the master program schedule and all lower-level schedules. For small programs the master program schedule and intermediate schedule can be the same schedule. Large programs may have more than one intermediate schedule. The intermediate schedule is a program baseline document.

Internal formal documentation and communication. Any documentation or communication resulting in compliance with, or a change to, the program baseline.

Internal informal documentation and communication. Any documentation or communication not requiring compliance with, or a change to, the program baseline.

Internal milestones. Any milestone not contractually stated or derived that is required to give management visibility to critical or significant events.

Internal replanning. Replanning actions required to incorporate a change in scope that are performed by cost account managers at the direction of the program manager for the remaining effort within the contract budget base.

Internal requirement. Includes, but is not limited to, requirements stated in directives from the business area director, program management process standards,
company standard practice instructions, company engineering standards, or other
departmental procedures or processes.

**Internal requirements from functional organizations.** Any requirements stated or
derived as a result of performing functional organization processes and procedures.

**Inventory control plan.** A part of the procurement plan in the material manage-
ment plan that includes inventory handling details, location information, quanti-
ties, tracking and rotation data, and costs.

**Job order number.** A number assigned by the accounting functional organization
to collect and report actual costs. (See also Charge number.)

**Latest revised estimate.** See Estimate at completion.

**Ledger variance (material).** A conversion factor that is unique to each material item
and is used to convert standard cost to actual cost when material is transferred from
a holding account to a cost account. Ledger variance is computed by dividing the
actual cost of the item based on the most recent buy by the item's standard cost.

**Level of effort.** Effort of a general nature (e.g., liaison, coordination, follow-up,
etc.) that does not produce definite end products or results (e.g., contract data re-
quirements list, hardware assembly, software module, test results, etc.).

**Low risk.** See Negligible risk.

**Low run-rate material (LRRM).** Engineering materials for systems or modules that
exceed a quantity build of six or more. The determining factor is that it will not be
built in a production environment (i.e., with flow charts, paced lines, etc.). BCWS-
LRRM is time-phased based on the point of issue, in balanced sets, using cost from
the negotiated cost proposal minus any management reserve. BCWP-LRRM is
earned when material is issued from the holding account to the assembly activity.
ACWP-LRRM is based on “standard cost” plus “ledger variance.”

**Make/buy analysis plan.** A part of the material management plan that details
which parts and assemblies will be manufactured by the company or purchased
from a vendor or subcontractor.

**Management presentations.** A product of the documentation and communica-
tion process that documents a presentation related to the program and is given to
internal management.

**Management reserve (MR).** An amount of the total allocated budget withheld by
the program manager for management control purposes rather than being design-
nated for the accomplishment of a specific task or set of tasks. Management reserve
is within the scope of the contract but it is not part of the performance measure-
Management baseline (i.e., not within the scope of any cost account). Management reserve is synonymous with management reserve budget.

**Manufacturing cost.** Direct cost plus applicable burden (e.g., labor burden, procurement and transportation, etc.). Manufacturing cost does not include general and administrative, cost of money, or profit/fee.

**Master program schedule.** A product of the schedule planning process that provides the top-level summary of all program contractual effort, significant events, and/or milestones, including hardware/software deliveries, major customer reviews/decision points, and buyer-furnished equipment, information, and material delivery dates. The master program schedule dictates the time frames for the development of all lower-level schedules. The master program schedule is a program baseline document.

**Material.** (1) A direct charge resource that includes all assets purchased for a program from sources outside of the company, interdivisional purchases, and internal transfers. (2) Buyer-furnished material used in the fabrication of a contract end item.

**Material acceptance plan.** A part of the material management plan that details how material will be accepted by the company prior to being sent to stock.

**Material analysis sheet.** Part of the cost account plan used by the cost account manager during planning to establish the budgeted cost for work scheduled, during execution to alert the cost account manager to potential schedule variance, and to record the data required to calculate and monitor material usage variance, price variance, and cost variance at both item and cost account levels. For nonrecurring material only, the material analysis sheet is also used to establish the value of budgeted cost for work performed that is earned when material is received.

**Material attrition.** See Material shrink.

**Material cost variance.** The sum of material usage variance and material price.

**Material disposition plan.** A part of the material management plan that details how material that is no longer required will be disposed of.

**Material price variance.** The difference for a material item between the committed or actual unit price and the budgeted unit price. Material price variance is synonymous with price variance.

**Material shrink.** Production or development material that ends up as material scrap. Production material is scrapped for various reasons, e.g., defective vendor material, obsolete material, excess material, manufacturing scrap, floor loss, etc. De-
velopment material may be scrapped as a result of obsolescence, screening, burn-in, destructive testing, stress testing, etc.

**Material shrink rate.** (1) In production, a standard percentage of purchased material costs, periodically determined by the accounting functional organization for each business area, that is applied to production material bids to cover the required material overbuy necessary to account for material that ends up as material scrap. (2) In development, an engineering estimate of additional material items that are added to development material bids to account for anticipated losses due to obsolete material, screening, burn-in, destructive testing, stress testing, etc.

**Material usage variance.** The difference between the actual quantity used and the quantity budgeted. Usage variance in terms of actual consumption is derived from an item-by-item comparison of the company’s purchase order written report with the cost account material analysis sheet. Material usage variance is synonymous with usage variance.

**Milestone.** See Event.

**Milestone weights (earned-value technique).** (1) The earned-value technique for a long-term effort (more than 2 months) where earned-value (BCWP) is reported based on accomplishment of milestones that have been assigned a predetermined value of BCWP (milestone weight). (2) The values assigned to earned-value milestones that reflect a predetermined amount of work that must be completed to achieve the milestone (BCWS) and the value of BCWP earned as a result of achieving the milestone. (3) The percentages of work package/planning package budget at completion assigned to the earned-value milestones.

**Milestone weights with percent complete (earned-value technique).** An earned-value technique that can be used when a series of measurable units of work are essentially equal in value. Milestones must be scheduled in each month within which measurable units are performed. BCWS for each milestone is equal to the percentage of the total units planned for completion at each milestone occurrence multiplied by BAC (e.g., milestone #1 = 10 of 100 units, or 10%, are planned for completion; BAC = $1,000; therefore, BCWS = 10% of $1,000 = $100). BCWP for each milestone is earned based on “the percentage of total units actually completed by the milestone date” multiplied by BAC (e.g., milestone #1 = 9 of 100 units, or 9%, actually completed; BAC = $1,000; therefore BCWP = $90).

**Moderate risk.** A risk that can potentially cause some disruption of schedule, increase in cost, degradation of performance, or some combination thereof that special management emphasis and close monitoring will probably be able to overcome. Moderate risks have low/high, medium/medium, low/medium, or high/high probability of occurrence/seriousness of impact.
Glossary

**Multifunctional organizational effort.** Effort within a cost account that is to be completed by more than one functional organization.

**Negligible risk.** Risk that has little potential to cause disruption of schedule, increase in cost, or degradation of performance. Normal effort and normal monitoring will probably be able to overcome difficulties. Negligible risks have a low or medium probability of occurrence and a low seriousness of impact.

**Negotiated contract cost.** The cost negotiated by the parties for cost plus fixed fee, cost plus incentive fee, or fixed price incentive fee contracts.

**Network diagram/chart.** A schedule that shows a grouping of discrete elements of work or tasks as bars in a time-scaled format with workflow connections.

**Nonrecurring material (NRM).** Material used in a nonmanufacturing environment to develop an end item, its associated tools and test equipment; or to build five or fewer end items (e.g., prototype systems or modules). BCWS-NRM is planned using the material analysis sheet and is time-phased based on anticipated receipt dates. BCWP-NRM is earned in the reporting period during which the material is physically received. ACWP-NRM is actual cost accrued during the reporting period during which the material is physically received.

**Operating budget.** The total budget in excess of the contract budget base (applicable only to reprogramming).

**Operations.** A functional organization consisting of material logistics, manufacturing, manufacturing engineering, tooling, test equipment, hybrid microelectronics, and facilities maintenance.

**Organization.** A social entity that is goal-directed and has a deliberately structured activity system and an identifiable boundary.

**Organizational structure.** The formal pattern, illustrated in chart form, of how people and jobs are grouped (arranged) in an organization.

**Original budget.** The budget established at or near the time the contract was signed based on the negotiated contract cost.

**Other direct cost.** Includes direct costs for travel, outside engineering, equipment rental/lease and maintenance, facilities rental/lease, computer-aided design and manufacturing, etc. Rented/leased equipment/facilities may be used in support of only one contract.

**Overhead.** Indirect labor and material, supplies and services costs, and other charges that cannot be consistently identified with individual projects.

**Parts control plan.** A part of the material management plan that details all aspects of component selection.
Percent complete (earned-value technique). The earned-value technique whereby the budgeted cost of work performed is earned monthly based on a formula, established prior to work authorization, that incorporates objective factors for determining the percentage of the total effort completed (e.g., BCWP = number of drawing completed ÷ the number of drawing budgeted × budget at completion). Monthly budgeted cost of work scheduled is calculated using the same formula, with the exception that “number of drawings completed” is replaced by “number of drawings planned to be completed.”

Performance management. The program management function responsible for requirements identification, requirements mapping to the CWBS and extended CWBS, and performance measurement planning and execution. Requirements are separated into five perspectives: technical, supportability, programmatic, cost, and schedule.

Performance measurement baseline. (1) The baseline for all work authorized by the contract. This includes the contract work breakdown structure and its attendant dictionary; the responsibility assignment matrix; the budget baseline log; and all approved cost account plans. Cost account plans and their associated work/planning packages define the work to be performed in terms of planned budget, schedule, and technical performance requirements. (2) The time-phased budget plan against which contract performance is measured. The performance measurement baseline is formed by the budgets assigned to scheduled cost accounts and the applicable indirect budgets. It equals the total allocated budget less management reserve.

Performance planning. The program management planning process used for developing the requirements breakdown structure and the technical, programmatic, and supportability performance measurement plan.

Performing organization. A defined unit within the company’s organizational structure that applies the resources to perform the work.

Planned-value profile. A value profile spanning an objective’s performance period that defines projected, time-phased, demonstrable values for the performance objective that are attainable with planned resources. A planned-value profile is used for performance management (technical, supportability, and programmatic).

Planning authorization document. A document approved by the business area manager that defines the program planning scope and authorizes the program manager to expend funds to perform the program management planning process. During the bid phase this document is the bid request document.

Planning distribution matrix. A product of the program organization planning process consisting of a cross-reference of the planning organization functions and
the planning documents available/produced. The planning distribution matrix forms a distribution list for all documents required/used during a program’s planning phase.

**Planning organization.** (1) A product of the program organization planning process that consists of an organization comprised of program management office resources and all functional organization planning resources assigned to plan a program, or portion thereof, in accordance with the program management planning process. (2) The organization that executes the program management planning process.

**Planning organization resource requirements.** A product of the program organization planning process that consists of human resources required for the planning process. The document includes both functional organization planning resources and program management office resources.

**Planning package.** Part of the cost account plan that provides a logical aggregation of work within a cost account, normally the long-term effort, that can be identified and budgeted in early baseline planning but is not yet defined into one or more work package(s).

**Planning package descriptions.** Planning package descriptions are part of the extended CWBS dictionary. Descriptions state engineering or manufacturing approaches contemplated to accomplish tasks, produce products, provide services, or purchase materials in accordance with all requirements assigned to the planning package.

**Precedence diagram method.** A network scheduling technique that depicts activities (or tasks) on nodes.

**Predecessor.** Any scheduling object (e.g., node, milestone, activity, subproject, etc.) controlling the start or finish of another scheduling object by virtue of the connection between the objects.

**Price variance.** See Material price variance.

**Prime costs.** Any costs that can be identified specifically with a particular final cost objective. (See also Direct cost.)

**Process control data.** Data collected at process control points and used to measure the effectiveness of the process and the resultant products.

**Process control point.** Strategic points within a process where process control data are collected.
Process product standard (product standard). Documents created, derived, manipulated, or modified as a result of performing a specified process. Product standards include detailed content and format requirements.

Procurement and transportation expenses. Expenses representing a business area’s cost of procuring material and/or subcontractor services or products. They are grouped into a separate indirect cost pool and allocated only to final cost objectives.

Procurement and transportation rate. A standard percentage of total direct cost for material or a subcontract, periodically determined by the accounting functional organization for each business area, that is used when bidding/estimating contracts to compensate for procurement and transportation expense.

Procurement plan. A part of the material management plan that details how material will be procured, provides schedule and cost information, and includes an inventory control plan.

Procuring activity/agency. The command in which the procuring contracting office is located. It may include the program office, related functional support offices, and procurement offices.

Program. (1) An activity that has a definite starting point, clearly defined objectives, a definite ending point, and requires resources to execute. (2) A specific activity or phase for a product that is clearly delineated by the type of funding applied: independent research & development, bid & proposal, contract, or company investment. (3) A set of activities in the life of a specific product’s development and deployment. (This definition is broader than the scope of this program management planning process.)

Program adjustment. One of four major activities in the program management process. Possible corrective actions for over-threshold conditions identified during program analysis are examined and decisions are made to select corrective action plan(s).

Program administration management. The program management function responsible for all program-level administration, process metrics data collection, the programmatic requirements performance management, and cost account management of the program management office.

Program analysis. One of four major activities in the program management process. Cost, schedule, and performance data collected during program execution are compared to the program baseline and over-threshold conditions are identified.

Program baseline. (1) The complete planning baseline derived from the internal requirements and the contract baseline. (2) The baseline that includes all planning
products. (3) The program baseline that includes the performance measurement baseline.

**Program directive.** A product of the documentation and communication process that is issued by the program manager and provides special program instructions and/or procedures that are not specified in the contract or the program management process standards and guides. Program directives are program baseline documents.

**Program events calendar.** A product of the documentation and communication process that provides a 28-day calendar of upcoming program and significant non-program events.

**Program execution.** One of four major activities in the program management process. Deliverables are produced and cost, schedule, and performance data are collected.

**Program management.** (1) The program function responsible for (a) managing all program facets and their attendant risks during all program phases in accordance with the business area director, the contract, company program management processes, company engineering standards and guides, and company standard practice instructions; (b) approving all external and internal formal documentation and communication. (2) The professional discipline concerned with the function of program management.

**Program management library.** A repository for all program external and internal formal documentation and communication. The program management library is generated in the documentation and communication process.

**Program management office.** The group of functions and corresponding personnel that are responsible for program-level planning, execution, analysis, adjustment, administration, etc. It includes program management, cost management, schedule management, secretarial, program administration management, risk management, resource management, and communications management.

**Program management organization.** See Program organization.

**Program manager.** The person responsible for performing the program management function.

**Program office.** See Program management office.

**Program organization.** (1) A product of the program organization planning process that is depicted in an organizational chart format and consists of all functions and associated personnel responsible for executing the program. The program organization is a program baseline document. (2) All personnel assigned, directly or indirectly, to a program, up to and including the program manager.
**Program organization distribution matrix.** A product of the program organization planning process that is a cross-reference of program organization functions and program documents and that forms a distribution list for those documents during the execution phase of a program.

**Program organization planning.** The program management planning process used for developing the planning organization resource requirements, planning organization, planning distribution matrix, program organization, program organization distribution matrix, and responsibility assignment matrix.

**Program planning.** One of the four activities in the program management process. It is composed of program organization planning, performance planning, cost planning, schedule planning, resource planning, and cost account planning. Completion of the program planning activity produces the program baseline.

**Program risk.** The probability of not achieving a program’s cost, schedule, technical performance, supportability, and/or programmatic requirements.

**Programmatic risk.** Risks associated with obtaining and using applicable resources that are outside of the program’s direct control but can affect the program’s direction (e.g., manufacturing, environmental facilities, test facilities, etc.).

**Project.** See Program.

**Project accountant.** The person assigned to the cost management function who is responsible for managing and maintaining program-level work definition and program cost data, and cost requirements performance management.

**Project tree (schedule).** A graphic representation of the project structure that shows how subproject networks relate to one another hierarchically and that is used to change network views.

**Project tree chart.** The schedule breakdown structure (schedule hierarchy).

**Pseudo-asset number.** An artificial asset number assigned to work/planning package assets during planning prior to asset assignment. It is used to identify where each asset is used when more than one of an asset type is involved and is replaced by the actual asset number when the assignment is made.

**Pseudo-name.** An artificial name assigned to work/planning package human resources during planning prior to assignment. It is used to identify where each resource is used when more than one resource of a specific type is involved and is replaced by the actual name when the assignment is made.

**Release order notification.** The primary work authorization document used within the company to authorize a program manager to expend company resources to perform contract or company-funded activities.
Reporting periods. Periods that normally run concurrent with accounting periods except where specified differently by the contract. Cost performance and cost/schedule status reports are normally due to the customer 25 days after the end of each accounting period.

Reprogramming. See Formal reprogramming.

Resource code. A two-character code defined by the company standard resource code (resource deck) used in the human resource plan to represent resource description, labor grade (range of salary costs), and element of cost (labor, material, other direct costs, and travel).

Resource deck. A cost tool database created from accounting data by the program management office that is comprised of rate tables, a burden template, and an element-of-cost table.

Resource management. A program management office function responsible for the management of program-level human, material, equipment, and facility resources.

Resource manager. The person assigned to the resource management function responsible for the management of program-level human, material, equipment, and facility resources.

Resource planning. The program management planning process used for developing the human resource plan, equipment/facility plan, and material management plan.

Responsibility assignment matrix. A product of the program organization planning process that is depicted in a matrix format and consists of intersections of the program organization structure with cost breakdown structure elements (extended CWBS depicting cost account budgets) at the cost account level. The intersection identifies the cost account manager responsible for the management of the cost account. When budget information on the cost breakdown structure appears on the responsibility assignment matrix it is called a costed responsibility assignment matrix. The responsibility assignment matrix is a program baseline document.

Risk. (1) The combination of the probability of an event occurring and the seriousness of the impact (consequence) of the event. (2) The condition of having outcomes with known probabilities of occurrence, not certainty of occurrence. (3) A measurable probability of consequence associated with a set of conditions or actions. Often risk has a negative connotation and action must be taken to avoid failure.

Risk abatement. Mitigation of risk through timely implementation of management actions consistent with the chosen risk-handling method.
**Risk analysis.** (1) An examination of the change in consequences caused by changes in the risk-input variables. (2) An examination of risk areas or events to determine options and the probable consequences for each event in the analysis.

**Risk assessment.** (1) The process of examining all aspects of a program to identify areas of risk and their corresponding potential impact. (2) The process of subjectively determining the probability that a specific interplay of performance, schedule, and cost, as an objective, will or will not be attained along the planned course of action.

**Risk assumption.** A conscious decision to accept the consequences of the risk occurring.

**Risk avoidance.** The non-selection of an option because of potentially unfavorable results or the selection of an option because of its lower risk.

**Risk control.** The process of continually monitoring and correcting the condition of the program.

**Risk drivers.** The technical, programmatic, and supportability risk factors.

**Risk handling.** Any action or inaction taken to address risk issues identified and evaluated during the risk assessment and risk analysis efforts.

**Risk handling methods.** Avoidance, assumption, control, and transfer.

**Risk identification.** An organized thorough approach to seek out the real risks associated with the program and document them in straightforward statements. The basic risk identification question is: What are the events or facts that may reasonably occur which will prevent the achievement of program goals?

**Risk management.** (1) Relates to the various processes used to manage risk. (2) All actions taken to identify, assess, and eliminate or reduce risk to an acceptable level in selected areas (e.g., cost, schedule, technical, producibility, etc.) and the total program.

**Risk prioritization.** The process of organizing and stratifying risks based on a risk rating scheme and risk quantification data.

**Risk quantification.** The process of taking quantitative risk information and transforming it into quantitative risk estimates in terms of probability of occurrence and potential impact to cost, schedule, or performance (technical, supportability, or programmatic) based on the advice of experts.

**Risk transfer.** The sharing of risk through joint ventures, make-versus-buy decisions, or contractual agreements (prime or subcontract), such as performance incentives, cost sharing, warranties, etc.
Rolling wave planning. A planning technique using a combination of work packages and planning packages whereby all short-term (normally the next 120 days) work is defined in detail by work packages, with the remaining long-term work defined by planning packages. As time progresses planning packages are progressively converted to, and superseded by, work packages (the rolling wave).

Schedule acceleration. See Schedule reserve.

Schedule element. Another term for the activity class of scheduling objects (e.g., activities, milestones, subprojects, etc.).

Schedule management. The program management office function responsible for constructing, maintaining, and statusing program-level schedules (master program schedule, intermediate schedule, and detailed schedules), with cost account manager assistance, and the schedule requirements performance management function.

Schedule manager. The person assigned to the schedule management function, responsible for constructing, maintaining, and statusing program-level schedules and schedule requirements performance management. Typically referred to as the program planner.

Schedule perspectives. Intermediate-level supplemental schedules created to view schedule data from various perspectives, such as build/version, functional organization by process, configuration item, CWBS cost reporting level, or cost account.

Schedule planning. The program management planning process used for developing the master program schedule, intermediate schedule, detailed schedules, and cost account supplemental schedules.

Schedule reserve. Time that is retained for later use by the program manager and is obtained by accelerating contractual dates in the master program schedule.

Schedule risk. The risk to a program in not meeting a milestones (e.g., schedule growth).

Schedule variance. The difference between budgeted cost for work performed and budgeted cost for work scheduled.

Shrink rate. See Material shrink rate.

Significant risk. Risk that is likely to cause significant disruption of schedule, increase in cost, or degradation of performance, or any combination thereof, although special management emphasis and close monitoring occur. Significant risks have high/high, high/medium, or medium/high probability of occurrence/seriousness of impact.

Significant variances. Those differences between planned and actual performance that require further review, analysis, or action. Appropriate thresholds are estab-
lished as to the magnitude of variances that, when exceeded, require variance analysis reports.

**Skill code.** A code used by various functional organizations that provides information on an individual’s experience, field of expertise, and education.

**Specialty engineering.** A term generally associated with one or more of the following types of organizations: reliability engineering, maintainability engineering, testability engineering, environmental engineering, component engineering, integrated logistics support, electromagnetic engineering, human factors engineering, and system safety engineering.

**Spend plan.** A product of the cost account planning process that is a periodically revised document and provides the time-phased expenditure estimate (ACWPCum-to-date + ETC), fees, and price at the program level.

**Standard cost (material).** The weighted value, at the piece part level, determined by purchasing, and based on a maximum of the five most recent buys during the previous 24 months.

**Start float.** The number of workdays the start of an activity can slip before it causes another activity to slip, assuming the activity’s duration is held constant.

**Start-to-start connection.** A workflow dependency that states that the successor activity cannot start until its predecessor activity has started.

**Subcontract management plan.** A part of the material management plan that details how subcontractors will be selected and managed.

**Subcontract work breakdown structure.** The subcontractor’s work breakdown structure is relatable to the prime contractor’s extended CWBS and defines all of the subcontractor’s contractual efforts and cost reporting requirements.

**Subproject.** An activity-type scheduling object used to summarize a group of activities performed by one functional group (e.g., software engineering) or within a cost account. Subprojects are schedule-driven by interface events, which are used to integrate detailed work and other subprojects.

**Substantial risk.** See Significant risk.

**Successor.** Any scheduling object (e.g., node, milestone, activity, subproject, etc.) whose start or finish is controlled by virtue of its connection to other objects.

**Summary-level extended CWBS element.** An extended CWBS element, above the cost account level, that identifies sub-elements where work is defined rather than detailing work to be performed. Detailed work definitions should only appear in the lowest-level extended CWBS elements.
Summary planning budget. Budget that cannot be immediately identified with a cost account but may be identified with a summary-level extended CWBS element.

Supplemental schedule. A summary view of schedules that accurately reflects schedule detail contained in more than one node of the project tree. Supplemental schedules are frequently used to depict contract data requirements list delivery schedules, functional organization schedules, extended CWBS-oriented schedules, and cost account schedules. Supplemental schedules cannot be statused.

Supportability risk. Risk associated with fielding and maintaining systems or products that are currently being developed or have been developed and are being deployed.

System engineering. The functional organization responsible for system requirements analysis, requirements allocation, system design, and for the technical and supportability requirements.

System engineering manager. The system engineering functional manager assigned to the performance management function, responsible for the technical and supportability requirements.

Target budget. A budget for a cost account established during cost planning by the program manager that the cost account manager is expected to meet, or better, during cost account planning.

Targeted event. An event with an imposed date limitation.

Target profit/fee. The excess of the amount realized from sales of goods over the cost thereof in a given transaction or over a given period. Profit is the term used with fixed-price contracts. Fee is used with cost-reimbursement contracts.

Technical risk. The risk associated with evolving a new design to provide a greater level of performance than previously demonstrated, or the same or a lesser level of performance subject to one or more new constraints.

Top-down planning. A method of planning schedule, cost, and performance that begins with the top level and systematically subdivides requirements, products, and/or work into increasing levels of detail.

Total allocated budget. The sum of all budgets allocated to the contract. Total allocated budget consists of the performance measurement baseline (all direct costs plus burden, cost of money, general and administrative expenses, undistributed budget) and all management reserve. The total allocated budget should reconcile directly with the contract budget base. Any differences will be documented as to amount and cause. In the case of reprogramming, the total allocated budget is the sum of the contract budget base and the operating budget.
**Total cost.** The sum of manufacturing cost (i.e., direct costs plus burden), cost of money, general and administrative expenses, undistributed budget, and management reserve.

**TPS milestone.** A technical, programmatic, and supportability milestone identified by the parameter’s planned-value profile, at which time the value of the parameter is measured and/or analyzed. Where a TPS milestone exists within a cost account, the earned-value milestone for that event shall be identical to the TPS milestone; i.e., the earned-value milestone description shall be identical to the TPS milestone description.

**TPS variance.** The difference between the measured and/or analyzed parameter value and the parameter’s planned-value profile value at the TPS milestone, the time at which the parameter is being measured/analyzed.

**Undistributed budget.** Authorized budget applicable to contract effort that has not been distributed to cost accounts.

**Usage variance.** See Material usage variance.

**Variance.** See Cost variance; Material (cost, price, and usage) variances; Schedule variance; Significant variance; Technical, programmatic, and supportability variance; Variance at completion.

**Variance analysis report.** A report prepared by the cost account manager and submitted to the program manager whenever a cost, schedule, or performance (technical, supportability, or programmatic) variance occurs. The report states the cause of the variance, impact to the cost account, and provides a corrective action plan that includes expected recovery dates.

**Variance at completion.** The difference between budget at completion and estimate at completion.

**Variance threshold.** (1) Thresholds for cost or schedule variances are expressed two ways: plus or minus a percent, and plus or minus a dollar amount (e.g., ± 10% and ± $5000). (2) Thresholds for technical, programmatic, and supportability variances are expressed as “maximum” and/or “minimum” parameter values. (3) More than one threshold for an item may be established by the program manager or cost account manager. A lower threshold can be an informal indicator that a problem may be developing. When the highest threshold is exceeded, a variance analysis must be performed and a formal variance analysis report must be submitted to the program manager.

**Vertical integration.** The development of relationships between all levels of schedule information to ensure that each level of the schedule supports the program ob-
jectives of the top-level schedule and correctly reflects the status of the detail in the lowest level(s) of the schedule.

**Vertical traceability.** The ability to trace the relationships among all levels of schedule information to ensure that each level of the schedule supports the program objectives of the top level and correctly reflects the status of the detail in the lowest level(s) of the schedule.

**Work breakdown structure (WBS).** A product-oriented family tree, composed of hardware, software, services, and data, that completely defines the project/program. A work breakdown structure displays and defines the product(s) to be developed or produced, or services to be provided, and relates the elements of work to be accomplished to each other and to the end item. (See also Contract work breakdown structure, Extended contract work breakdown structure, and Subcontract work breakdown structure.)

**Work package (WP).** Part of the cost account plan that is a detailed short-span job or material item identified by the contractor for accomplishing work required to complete the contract. A work package has an assigned earned-value technique.

**Work package descriptions.** Work package descriptions are part of the extended CWBS dictionary. Descriptions state engineering or manufacturing approaches contemplated to accomplish tasks, produce products, provide services, or purchase materials in accordance with all requirements assigned to the work package.
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