CHAPTER 1

An Overview of Project Management

What's all the fuss about, anyway? Since the first edition of this book was published, in 1997, the Project Management Institute (PMI®) has grown from a few thousand members to nearly 450,000 in 2011. For those of you who don't know, PMI is the professional organization for people who manage projects. You can get more information from the institute's website, *www.pmi.org*. In addition to providing a variety of member services, a major objective of PMI is to advance project management as a profession. To do so, it has established a certification process whereby qualifying individuals receive the Project Management Professional (PMP®) designation. To do so, such individuals must have work experience (approximately five thousand hours) and pass an online exam that is based on the *Project Management Body of Knowledge*, or the *PMBOK® Guide*.

A professional association? Just for project management? Isn't project management just a variant on general management?

Yes and no. There are a lot of similarities, but there are enough differences to justify treating project management as a discipline separate from general management. For one thing, projects are more schedule-intensive than most of the activities that

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general managers handle. And the people in a project team often don't report directly to the project manager, whereas they do report to most general managers.

So just what is project management, and, for that matter, what is a project? PMI defines a project as "a temporary endeavor undertaken to produce a unique product, service, or result" (*PMBOK® Guide*, Project Management Institute, 2008, p. 5). This means that a project is done only one time. If it is repetitive, it's not a project. A project should have definite starting and ending points (time), a budget (cost), a clearly defined scope—or magnitude—of work to be done, and specific performance requirements that must be met. I say "should" because seldom does a project conform to the desired definition. These constraints on a project, by the way, are referred to throughout this book as the PCTS targets.

PMI defines a project as ". . . a temporary endeavor undertaken to produce a unique product, service, or result."

Dr. J. M. Juran, the quality guru, also defines a *project* as a problem scheduled for solution. I like this definition because it reminds me that every project is conducted to solve some kind of problem for a company. However, I must caution that the word "problem" typically has a negative meaning, and projects deal with both positive and negative kinds of problems. For example, developing a new product is a problem, but a positive one, while an environmental cleanup project deals with a negative kind of problem.

A project is a problem scheduled for solution.

—J. M. Juran

Project Failures

In fact, the Standish Group (*www.standishgroup.com*) has found that only about 17 percent of all software projects done in the

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United States meet the original PCTS targets, 50 percent must have the targets changed—meaning they are usually late or overspent and must have their performance requirements reduced—and the remaining 33 percent are actually canceled. One year, U.S. companies spent more than $250 billion on software development nationwide, so this means that $80 billion was completely lost on canceled projects. What is truly astonishing is that 83 percent of all software projects get into trouble!

Now, lest you think I am picking on software companies, let me say that these statistics apply to many different kinds of projects. Product development, for example, shares similar dismal rates of failure, waste, and cancellation. Experts on product development estimate that about 30 percent of the cost to develop a new product is rework. That means that one of every three engineers assigned to a project is working full time just redoing what two other engineers did wrong in the first place!

I also have a colleague, Bob Dudley, who has been involved in construction projects for thirty-five years. He tells me that these jobs also tend to have about 30 percent rework, a fact that I found difficult to believe, because I have always thought of construction as being fairly well defined and thus easier to control than might be the case for research projects, for example. Nevertheless, several colleagues of mine confirm Bob's statistics.

The reason for these failures is consistently found to be inadequate project planning. People adopt a ready-fire-aim approach in an effort to get a job done really fast and end up spending far more time than necessary by reworking errors, recovering from diversions down "blind alleys," and so on.

I am frequently asked how to justify formal project management to senior managers in companies, and I always cite these statistics. However, they want to know whether using good project management really reduces the failures and the rework, and I can only say you will have to try it and see for yourself. If you can achieve levels of rework of only a few percent using a seat-of-the-pants approach to managing projects, then keep doing what you're doing! However, I don't believe you will find this to be true.

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The question I would ask is whether general management makes a difference. If we locked up all the managers in a company for a couple of months, would business continue at the same levels of performance, or would those levels decline? If they decline, then we could argue that management must have been doing something positive, and vice versa. I doubt that many general managers would want to say that what they do doesn't matter. However, we all know that there are effective and ineffective general managers, and this is true of project managers, as well.

Project management is application of knowledge, skills, tools, and techniques to project activities to achieve project requirements. Project management is accomplished through the application and integration of the project management processes of initiating, planning, executing, monitoring and controlling, and closing.

What Is Project Management?

The *PMBOK® Guide* definition of *project management* is "application of knowledge, skills, tools, and techniques to project activities to meet the project requirements. Project management is accomplished through the application and integration of the 42 logically grouped project management processes comprising the 5 Process Groups: initiating, planning, executing, monitoring and controlling, and closing" (*PMBOK® Guide*, Project Management Institute, 2008, p. 6). Project requirements include the PCTS targets mentioned previously. The various processes of initiating, planning, and so on are addressed later in this chapter, and the bulk of this book is devoted to explaining how these processes are accomplished.

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It would be better if the *PMBOK® Guide* specified that a project manager should *facilitate* planning. One mistake made by inexperienced project managers is to plan the project for the team. Not only do they get no buy-in to their plan, but that plan is usually full of holes. Managers can't think of everything, their estimates of task durations are wrong, and the entire thing falls apart after the project is started. The first rule of project management is that the people who must do the work should help plan it.

The first rule of project management is that the people who must do the work should help plan it.

The role of the project manager is that of an enabler. Her job is to help the team get the work completed, to "run interference" for the team, to get scarce resources that team members need, and to buffer them from outside forces that would disrupt the work. She is not a project czar. She should be—above everything—a *leader*, in the true sense of the word.

The best definition of leadership that I have found is the one by Vance Packard, in his book *The Pyramid Climbers*. He says, "Leadership is the art of getting others to *want* to do something that you believe should be done." The operative word here is "want." Dictators get others to do things that they want done. So do guards who supervise prison work teams. But a leader gets people to want to do the work, and that is a significant difference.

"Leadership is the art of getting others to want to do something that you believe should be done."

—Vance Packard

The planning, scheduling, and control of work represent the management or administrative part of the job. But, without leadership, projects tend to just satisfy bare minimum requirements. With leadership, they can exceed those bare minimums. I offer a comprehensive application of project leadership techniques in Chapter 13.

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It Is Not Just Scheduling!

One of the common misconceptions about project management is that it is just scheduling. At last report, Microsoft had sold a huge number of copies of Microsoft Project®, yet the project failure rate remains high. Scheduling is certainly a major tool used to manage projects, but it is not nearly as important as developing a shared understanding of what the project is supposed to accomplish or constructing a good work breakdown structure (WBS) to identify all the work to be done (I discuss the WBS in Chapter 6). In fact, without practicing good project management, the only thing a detailed schedule is going to do is allow you to document your failures with great precision!

I do want to make one point about scheduling software. It doesn't matter too much which package you select, as they all have strong and weak points. However, the tendency is to give people the software and expect them to learn how to use it without any training. This simply does not work. The features of scheduling software are such that most people don't learn the subtleties by themselves. They don't have the time, because they are trying to do their regular jobs, and not everyone is good at self-paced learning. You wouldn't hire a green person to run a complex machine in a factory and put him to work without training, because you know he will destroy something or injure himself. So why do it with software?

One-Person Projects

When is managing a project not project management? When only one person is involved.

A lot of people are sent to my seminars to learn how to manage projects, but they are the only person working on their projects. Now it is true that a one-person job can be called a project, because it has a definite starting point, target, end date, specific performance requirements, defined scope of work, and a budget. However, when no one else is working on the project (including outside vendors), there is no need for a critical path schedule. A critical

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path schedule is one that has a number of parallel paths, and one of them is longer than the others and determines how long it will take to complete the job or, ultimately, whether the given end date can be met. When you're working on a job by yourself, there aren't any parallel paths—unless you are ambidextrous!

One-person projects do require good self-management, or good time management, but all you need is a good to-do list, which comes from a task listing. However, unless you are coordinating the work of other people, you aren't practicing true project management.

The Big Trap—Working Project Managers

It is common to have individuals serve as project managers and require also that they do part of the actual work in the project. This is a certain prescription for problems. If it is a true team, consisting of several people, the project manager inevitably finds herself torn between managing and getting her part of the work done. Naturally, the work must take precedence, or the schedule will slip, so she opts to do the work. That means that the managing does not get done. She hopes it will take care of itself, but it never does. After all, if the team could manage itself, there would be no need for a project manager in the first place (remember our argument about whether project management matters?).

Unfortunately, when the time comes for her performance evaluation, she will be told that her managing needs improving. Actually, she just needs to be allowed to practice management in the first place.

Yes, for very small teams—perhaps up to three or four people—a project manager can do some of the work. But, as team sizes increase, it becomes impossible to work and manage both, because you are constantly being pulled away from the work by the needs of your team members.

One of the reasons for this situation is that organizations don't fully understand what project management is all about, and they think that it is possible for individuals to do both. The result is that nearly everyone in the company is trying to manage projects, and,

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as is true in every discipline, some of them will be good at it and others will have no aptitude whatsoever. I have found that a far better approach is to select a few individuals who have the aptitude and desire to be project managers and let them manage a number of small projects. This frees "technical" people (to use the term broadly) to do technical work without having to worry about administrative issues and allows project managers to get really good at their jobs.

It is outside the scope of this book to discuss how to select project managers, but, for the interested reader, the topic is covered in a book by Wysocki and Lewis titled *The World-Class Project Manager* (Perseus, 2001).

You Can't Have It All!

One of the common causes of project failures is that the project sponsor demands that the project manager must finish the job by a certain time, within budget, and at a given magnitude or scope, while achieving specific performance levels. In other words, the sponsor dictates all four of the project constraints. This doesn't work.

The relationship among the PCTS constraints can be written as follows:

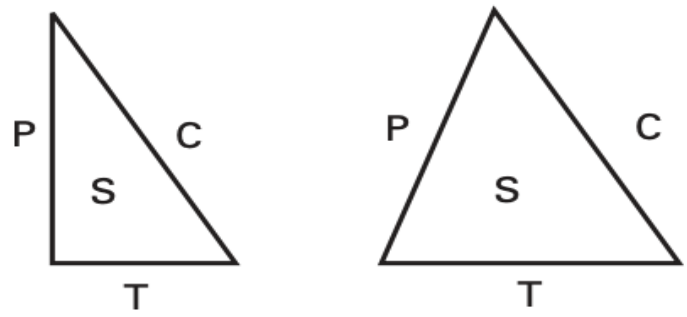
$$C = f(P, T, S)$$

In words, this says, "Cost is a function of Performance, Time, and Scope." Graphically, I like to show it as a triangle, in which P, C, and T are the sides and S is the area. This is shown in Figure 1-1.

In geometry, we know that if we are given values for the sides of a triangle, we can compute the area. Or, if we know the area and the length of two sides, we can compute the length of the remaining side. This translates into a very practical rule of project management: The sponsor can assign values to any three variables, but the project manager must determine the remaining one.

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Figure 1-1. Triangles showing the relationship between P, C, T, and S.



So let's assume that the sponsor requires certain performance, time, and scope from the project. It is the project manager's job to determine what it will cost to achieve those results. However, I always caution project managers that they should have a paramedic standing by when they give the cost figure to the sponsor because she will probably have a stroke or heart attack, and the paramedic will have to revive her.

Invariably, the sponsor exclaims, "How can it cost that much?" She had a figure in mind, and your number will always exceed her figure. And she may say, "If it's going to cost that much, we can't justify doing the job." Exactly! And that is the decision she should make. But she is certain to try to get the project manager to commit to a lower number, and, if you do, then you only set up yourself—and her—to take a big fall later on.

It is your *obligation* to give the sponsor a valid cost so that she can make a valid decision about whether or not the project should be done. If you allow yourself to be intimidated into committing to a lower number, it is just going to be a disaster later on, and you are far better off taking your lumps now than being hanged later on.

Of course, there is another possibility. If she says she can afford only so much for the job, then you can offer to reduce the scope. If the job is viable at that scope level, then the project can be done. Otherwise, it is prudent to forget this project and do something else that can make profits for the company. As someone has said,

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there is a higher probability that things will accidentally go wrong in a project than that they will accidently go right. In terms of cost estimates, this means that there is always a higher likelihood that the budget will be overrun than that the project will come in below budget. This is just another way of stating Murphy's law, that "whatever can go wrong will go wrong."

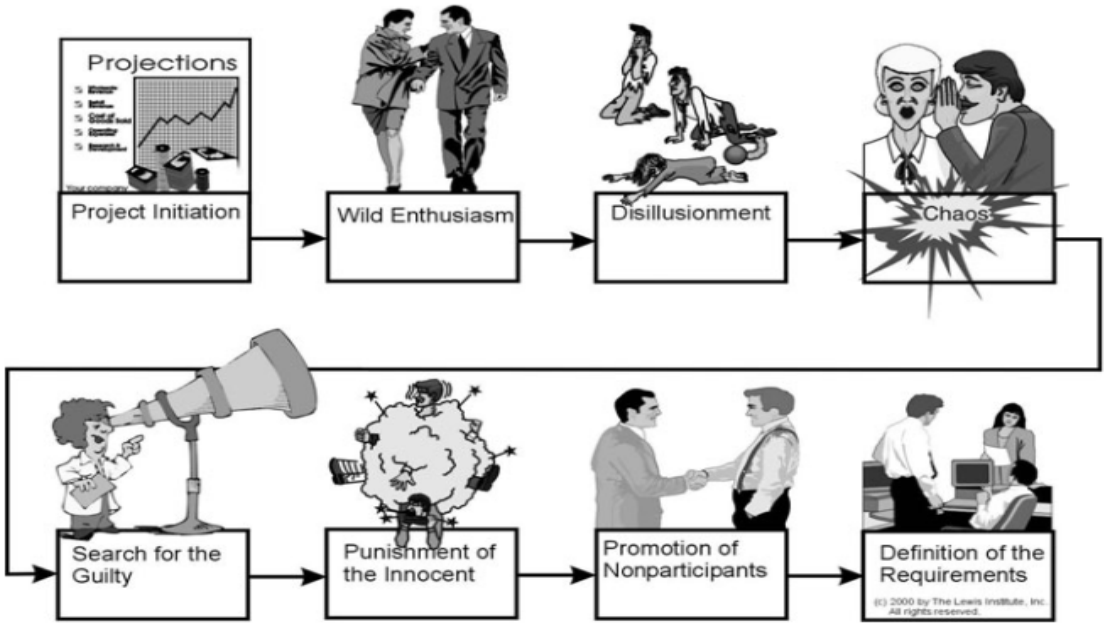
There is a higher probability that things will accidentally go wrong in a project than that they will accidentally go right.

The Phases of a Project

There are many different models for the phases a project goes through during its life cycle. One of these captures the all-too-frequent nature of projects that are not managed well and is shown in Figure 1-2.

I have shown this diagram to people all over the world, and they invariably laugh and say, "Yes, that's the way it works."

Figure 1-2. Life cycle of a troubled project.



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I suppose the comfort I can take is that we Americans are not the only ones who have the problem, but the bad news is that there are a lot of dysfunctional projects if everyone recognizes the model.

At the simplest level, a project has a beginning, middle, and end. I prefer the life-cycle model shown in Figure 1-3, but there are other versions that are equally valid. In my model, you will notice that every project begins as a concept, which is always "fuzzy," and that the project team must formalize the definition of the job before doing any work. However, because of our ready-fire-aim mentality, we often start working on the job without ensuring that we have a proper definition or that the mission and vision for the job are shared by everyone. This invariably leads to major problems as the project progresses. This is illustrated by the example that follows.

Definition Phase

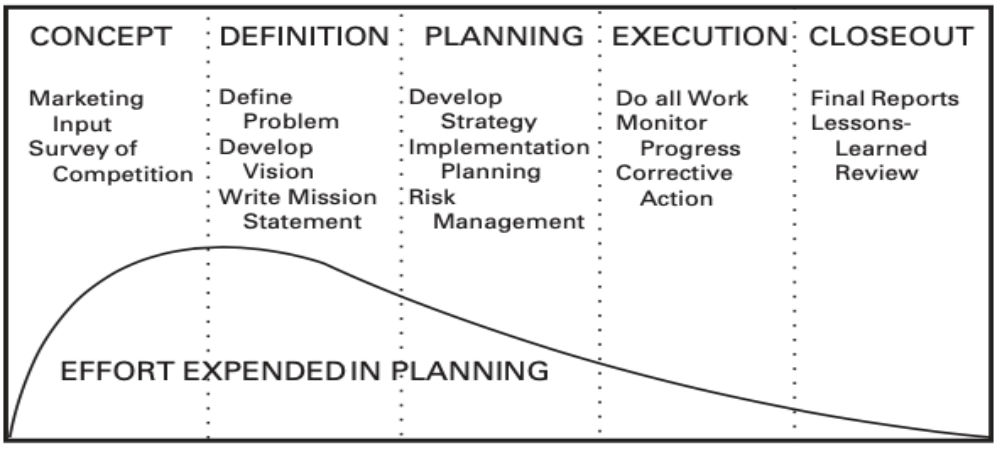
Some years ago, a project manager in one of my client companies called me and said, "I've just had a conference call with key members of my project team, and I realized that we don't agree on what the project is supposed to accomplish."

I assured him that this was common.

"What should I do?" he asked.

I told him that he had no choice but to get the team members

Figure 1-3. Appropriate project life cycle.



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all going in the same direction by clarifying the mission of the project. He asked me to facilitate a meeting to do this.

At the meeting, I stood in front of a flip chart and began by saying, "Let's write a problem statement." Someone immediately countered by saying, "We don't need to do that. We all know what the problem is."

I was unmoved by this comment. I said, "Well, if that is true, it's just a formality and will only take a few minutes, and it would help me if we wrote it down, so someone help me get started."

I'm going to be a little facetious to illustrate what happened next. Someone said, "The," and I wrote the word on the chart, and someone else said, "I don't agree with that!"

Three hours later, we finally finished writing a problem statement.

The project manager was right. The team did not agree on what the problem was, much less how to solve it. This is fundamental—and is so often true that I begin to think we have a defective gene in all of us that prohibits us from insisting that we have a good definition of the problem before we start the work. Remember, project management is solving a problem on a large scale, and the way you define a problem determines how you will solve it. If you have the wrong definition, you may come up with the right solution—to the wrong problem!

In fact, I have become convinced that projects seldom fail at the end. Rather, they fail at the definition stage. I call these projects *headless-chicken projects* because they are like the chicken that has had its head chopped off and runs around spewing blood everywhere before it finally falls over and is "officially" dead. Projects work the same way. They spew blood all over the place, until someone finally says, "I think that project is dead," and indeed it is. But it was actually dead when we chopped off its head in the beginning—it just took a while for everyone to realize it.

Once the project is defined, you can plan how to do the work. There are three components to the plan: strategy, tactics, and logistics. Strategy is the overall approach or "game plan" that will be followed to do the work. An example of strategy was related to me by a friend who is into military history.

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Strategy

During World War II, defense contractors were under great pressure to build weaponry at an intense level. To accelerate construction of ships and planes in particular, many new assembly methods were invented. Avondale shipyards, for example, worked on the method of building ships. The traditional way had always been to build the ship in an upright position. However, ships built from steel required welding in the bottom, or keel area of the boat, and this was very difficult to do. Avondale decided to build its ships upside down, to make the welding easier, and then turn them over to complete the structures above the top deck. This strategy was so effective that Avondale could build boats faster, cheaper, and of higher quality than their competitors, and the strategy is still being used today, nearly seventy years later.

Implementation Planning

This phase includes tactics and logistics. If you are going to build boats upside down, you must work out the details of how it will be done. A fixture must be constructed that will hold the boat and allow it to be turned over without being damaged. This is called "working out the tactics." It also includes the sequence in which the work will be done, who will do what, and how long each step will take.

Logistics deal with making sure the team has the materials and other supplies needed to do their jobs. Ordinarily we think about providing teams with the raw materials they need, but if the project is in a location where they can't get food, work will soon come to a grinding halt. So provisions must be made for the team to be fed—and possibly housed.

Execution and Control

Once the plan has been developed and approved, the team can begin work. This is the *execution* phase, but it also includes control, because, while the plan is being implemented, progress is monitored to ensure that the work is progressing according to the plan. When deviations from the plan occur, corrective action is

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taken to get the project back on track, or, if this is not possible, the plan is changed and approved, and the revised plan becomes the new baseline against which progress is tracked.

Closeout

When all the work has been completed, the *closeout* phase requires that a review of the project be conducted. The purpose is to learn lessons from this job that can be applied to future ones. Two questions are asked: "What did we do well?" and "What do we want to improve next time?"

Notice that we don't ask what was done wrong. This question tends to make people defensive, and they try to hide things that may result in their being punished. In fact, a lessons-learned review should never be conducted in a blame-and-punishment mode. If you are trying to conduct an inquisition, that's different. The purpose of an inquisition is usually to find who is responsible for major disasters and punish them. Lessons-learned sessions should be exactly what the words imply.

I have learned during the past few years that very few organizations do regular lessons-learned reviews of their projects. There is a reluctance to "open a can of worms." And there is a desire to get on with the next job. The problem is that you are almost sure to repeat the mistakes made on the previous project if no one knows about them or has an understanding of how they happened so that they can determine how to prevent them. But, perhaps most important, you can't even take advantage of the good things you did if you don't know about them.

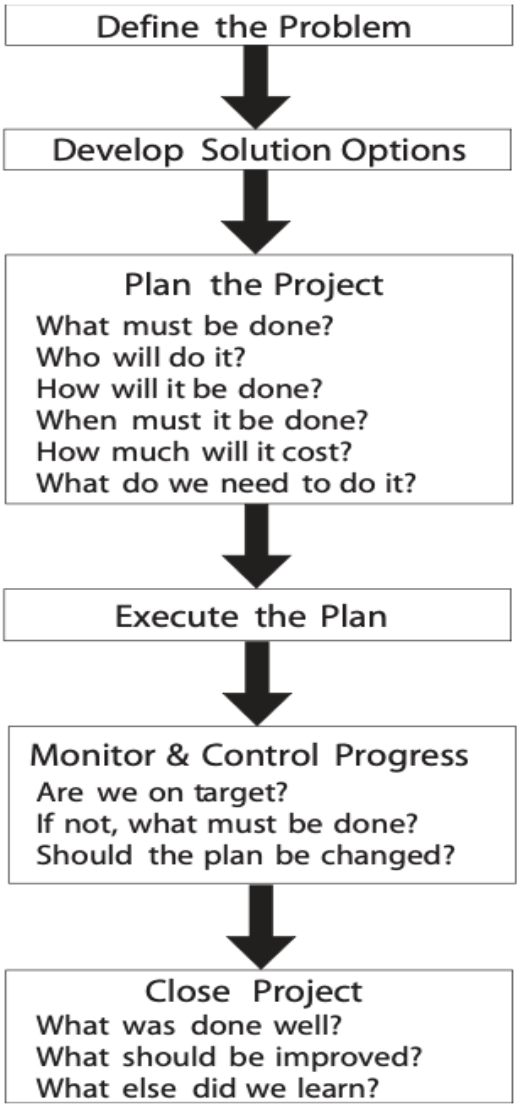
It has been said that the organizations that survive and thrive in the future will be those that learn faster than their competitors. This seems especially true for projects.

The Steps in Managing a Project

The actual steps to manage a project are straightforward. Accomplishing them may not be. The model in Figure 1-4 illustrates the steps.

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Figure 1-4. The steps in managing a project.



Subsequent chapters of this book elaborate on how each step is accomplished. For now, here is a brief description of the actions involved.

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Define the Problem

As was discussed previously, you need to identify the problem to be solved by the project. It helps to visualize the desired end result. What will be different? What will you see, hear, taste, touch, or smell? (Use sensory evidence if things can't be quantified.) What client need is being satisfied by the project?

Develop Solution Options

How many different ways might you go about solving the problem? Brainstorm solution alternatives (you can do this alone or as a group). Of the available alternatives, which do you think will best solve the problem? Is it more or less costly than other suitable choices? Will it result in a complete or only a partial fix?

Plan the Project

Planning is answering questions: what must be done, by whom, for how much, how, when, and so on. Naturally, answering these questions often requires a crystal ball. We discuss these steps in more detail in Chapters 2 through 4.

Execute the Plan

Obvious. Once the plan is drafted, it must be implemented. Interestingly, we sometimes find people going to great effort to put together a plan, then failing to follow it. If a plan is not followed, there is not much point in planning, is there?

Monitor and Control Progress

Plans are developed so that you can achieve your end result successfully. Unless progress is monitored, you cannot be sure you will succeed. It would be like having a roadmap to a destination but not monitoring the highway signs along the way.

Of course, if a deviation from the plan is discovered, you must ask what must be done to get back on track, or—if that seems impossible—how the plan should be modified to reflect new realities.

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Close the Project

Once the destination has been reached, the project is finished, but there is a final step that should be taken. Some people call it an audit, others a postmortem (sounds a bit morbid, doesn't it?). Whatever you call it, the point is to learn something from what you just did. Note the way the questions are phrased: What was done well? What should be improved? What else did we learn? We can always improve on what we have done. However, asking "What did we do wrong?" is likely to make people a bit defensive, so the focus should be on improvement, not on placing blame. More on this later.

The Project Management Body of Knowledge (PMBOK®)

The Project Management Institute has attempted to determine a minimum body of knowledge that is needed by a project manager in order for him or her to be effective. As I mentioned earlier when I defined project management, there are five processes defined by the *PMBOK® Guide*, together with nine general areas of knowledge, and I will give brief summaries of them. If you want a complete document, you can get one by visiting the PMI website: *www.pmi.org*.

Project Processes

A *process* is a way of doing something. As previously mentioned, the *PMBOK® Guide* identifies five processes that are used to manage projects. Although some of them will be predominant at certain phases of a project, they may come into play at any time. Broadly speaking, however, they tend to be employed in the sequence listed as the project progresses. That is, initiating is done first, then planning, then executing, and so on. In the event that a project goes off course, replanning comes into play, and if a project is found to be in serious trouble, it may have to go all the way back to the initiating process to be restarted.

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Initiating

Once a decision has been made to do a project, it must be *initiated* or launched. There are a number of activities associated with this. One is for the project sponsor to create a project charter, which defines what is to be done to meet the requirements of project customers. This is a formal process that is often omitted in organizations. The charter should be used to authorize work on the project; define the authority, responsibility, and accountability of the project team; and establish scope boundaries for the job. When such a document is not produced, the team members may misinterpret what is required of them, and this can be very costly.

Planning

One of the major causes of project failures is poor *planning*. Actually, I am being kind. Most of the time the problem is caused by there being no planning! The team simply tries to "wing it," to do the work without doing any planning at all. As I have explained earlier in this chapter, many of us are task oriented, and we see planning as a waste of time, so we would rather just get on with the work. As we will see when we turn to controlling the project, failing to develop a plan means that there can be no actual control of the project. We are just kidding ourselves.

Executing

There are two aspects to the process of project *execution*. One is to execute the work that must be done to create the product of the project. This is properly called technical work, and a project is conducted to produce a product. Note that we are using the word "product" in a very broad sense. A product can be an actual tangible piece of hardware or a building. It can also be software or a service of some kind. It can also be a result—consider, for example a project to service an automobile that consists of changing the oil and rotating the tires. There is no tangible deliverable for such a project, but there is clearly a result that must be achieved, and if it is not done correctly the car may be damaged as a result.

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Executing also refers to implementing the project plan. It is amazing to find that teams often spend time planning a project, then abandon the plan as soon as they encounter some difficulty. Once they do this, they cannot have control of the work, since without a plan there is no control. The key is to either take corrective action to get back on track with the original plan or to revise the plan to show where the project is at present and continue forward from that point.

Monitoring and Controlling

Monitoring and *controlling* can actually be thought of as two separate processes, but because they go hand in hand, they are considered one activity. Control is exercised by comparing where project work is to where it is supposed to be, then taking action to correct for any deviations from target. Now the plan tells where the work should be. Without a plan, you don't know where you should be, so control is impossible, by definition.

Furthermore, knowing where you are is done by monitoring progress. An assessment of quantity and quality of work is made using whatever tools are available for the kind of work being done. The result of this assessment is compared to the planned level of work; if the actual level is ahead or behind of the plan, something will be done to bring progress back in line with the plan. Naturally, small deviations are always present and are ignored unless they exceed some pre-established threshold or show a trend toward drifting further off course.

Closing

In too many cases, once the product is produced to the customer's satisfaction, the project is considered finished, or *closed*. This should not be the case. A final lessons-learned review should be done before the project is considered complete. Failing to do a lessons-learned review means that future projects will likely suffer the same headaches encountered on the one just done.

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Knowledge Areas

As previously mentioned, the *PMBOK® Guide* identifies nine knowledge areas that project managers should be familiar with in order to be considered professionals. These are as follows.

Project Integration Management

Project integration management ensures that the project is properly planned, executed, and controlled, including the exercise of formal project change control. As the term implies, every activity must be coordinated or integrated with every other one in order to achieve the desired project outcomes.

Project Scope Management

Changes to project scope are often the factors that kill a project. *Project scope management* includes authorizing the job, developing a scope statement that will define the boundaries of the project, subdividing the work into manageable components with deliverables, verifying that the amount of work planned has been achieved, and specifying scope change control procedures.

Project Time Management

I consider this a bad choice of terms, as "time management" implies personal efforts to manage one's time. *Project time management* specifically refers to developing a schedule that can be met, then controlling work to ensure that this happens! It's that simple. Because everyone refers to this as scheduling, it should really be called *schedule management*. (I know, I may be booted out of PMI for such heresy!)

Project Cost Management

This is exactly what it sounds like. *Project cost management* involves estimating the cost of resources, including people, equipment, materials, and such things as travel and other support details. After this is done, costs are budgeted and tracked to keep the project within that budget.

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Project Quality Management

As I have commented earlier, one cause of project failure is that quality is overlooked or sacrificed so that a tight deadline can be met. It is not very helpful to complete a project on time, only to discover that the thing delivered won't work properly! *Project quality management* includes both quality assurance (planning to meet quality requirements) and quality control (steps taken to monitor results to see if they conform to requirements).

Project Human Resources Management

Project human resources management, often overlooked in projects, involves identifying the people needed to do the job; defining their roles, responsibilities, and reporting relationships; acquiring those people; and then managing them as the project is executed. Note that this topic does not refer to the actual day-to-day managing of people. The *PMBOK® Guide* mentions that these skills are necessary but does not attempt to document them. Given that these are the most important skills that a project manager must have, the *PMBOK® Guide* is deficient in omitting them.

Project Communications Management

As the title implies, *project communications management* involves planning, executing, and controlling the acquisition and dissemination of all information relevant to the needs of all project stakeholders. This information might include project status, accomplishments, and events that may affect other stakeholders or projects. Again, this topic does not deal with the actual process of communicating with someone. This topic is also mentioned but not included in the *PMBOK® Guide*.

Project Risk Management

Project risk management is the systematic process of identifying, quantifying, analyzing, and responding to project risk. It includes maximizing the probability and consequences of positive events and minimizing the probability and consequences of adverse events

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to project objectives. This is an extremely important aspect of project management that sometimes is overlooked by novice project managers.

Project Procurement Management

Procurement of necessary goods and services for the project is the logistics aspect of managing a job. *Project procurement management* involves deciding what must be procured, issuing requests for bids or quotations, selecting vendors, administering contracts, and closing them when the job is finished.

Key Points to Remember

- A project is a temporary endeavor undertaken to produce a unique product, service, or result.
- A project is also a problem scheduled for solution.
- Project management is application of knowledge, skills, tools, and techniques to project activities to meet project requirements. Project management is accomplished by applying the processes of initiating, planning, executing, monitoring and controlling, and closing.
- All projects are constrained by Performance, Time, Cost, and Scope requirements. Only three of these can have values assigned. The fourth must be determined by the project team.
- Projects tend to fail because the team does not take time to ensure that they have developed a proper definition of the problem being solved.
- The major phases of a project include concept, definition, planning, execution and control, and closeout.

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Questions for Review

1. Project management is not just:
   a. planning
   b. rework
   c. scheduling
   d. controlling

2. The problem with being a working project manager is that, in a conflict between working and managing:
   a. You don't know what priorities to set.
   b. Your boss will think you're slacking off.
   c. There will never be enough time to do both.
   d. The work will take precedence and managing will suffer.

3. The *PMBOK® Guide* refers to:
   a. The body of knowledge identified by PMI as needed by project managers to be effective.
   b. A test administered by PMI to certify project managers
   c. An acronym for a special kind of risk analysis, like FMEA (Failure Mode and Effects Analysis)
   d. None of the above

4. Project scope defines:
   a. A project manager's visibility to the end date.
   b. The magnitude or size of the job.
   c. How often a project has been changed.
   d. The limits of a project manager's authority.

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CHAPTER 2

The Role of the Project Manager

The role of project managers seems to be very misunderstood throughout the world. Because many project managers arrive at their position as a natural progression from their jobs as engineers, programmers, scientists, and other kinds of jobs, both they and their bosses see the job as a technical job. This simply isn't true.

If you remember that every project produces a product, service, or result, then there is a technical aspect to the job. However, it is a question of who is responsible for what, and project managers who must manage the project and handle technical issues are set up to fail from the beginning. I will explain this later on. For now, suffice it to say that the primary responsibility of the project manager is to ensure that all work is completed on time, within budget and scope, and at the correct performance level. That is,

The primary responsibility of the project manager is to ensure that all work is completed on time, within budget and scope, and at the correct performance level.

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she must see that the PCTS targets are met. Her primary role is to manage the project, not do the work!

What Is Managing?

The PMI definition of project management does not completely capture the true nature of project management. Remember, it says that "project management is application of knowledge, skills, tools, and techniques to project activities to meet the project requirements. Project management is accomplished through the application and integration of the 42 logically grouped project management processes comprising the 5 Process Groups: initiating, planning, executing, monitoring and controlling, and closing" (*PMBOK® Guide*, Project Management Institute, 2008, p. 6). That sounds nice on paper, but what is it that a person really does when he manages?

I don't know if it is really possible to convey what managing actually is. One reason is that project management is a *performing art*, and it is difficult to convey in words what an actor, athlete, or artist does. However, we can describe the various roles of a project manager, and that is the focus of this chapter. What should be clear is that you can't very well become something if you can't describe and define it, so this is a necessary exercise.

Definitions of Management

One common definition of management says that a manager gets work done by other people. Only a bit of thought is needed to realize how useless this definition is. Dictators get work done by other people, but I wouldn't call that management. Dr. Peter Drucker, whom many credit with being the "father" of management because he first made people realize that management was a profession, rather than a job, has said that a manager is supposed to make an unsolicited contribution to the organization. That is, a manager looks around to see what needs to be done to advance the cause of the organization and does it without asking

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permission or having to be told to do it. This is often called being proactive, as opposed to reactive, and it is.

But, most important, a manager can't do this unless she understands the mission and vision for the organization and takes initiative to help achieve these. And I believe this applies equally well to project managers. First, they must understand the mission and vision of the organization; then they must see how the project they are managing meshes with the organization's mission; then they must steer the project to ensure that the interests of the organization are met.

Project managers must understand the mission and vision of the organization first, then they must see how the project they are managing meshes with the organization's mission, and they must steer the project to ensure that the interests of the organization are met.

It's about People!

In addition, I said earlier that the job is not a technical job. It is about getting people to perform work that must be done to meet the objectives of the project. In that respect, the classical definition is correct, but Drucker has pointed out that the manager must get people to perform above the minimum acceptable performance level. The reason is that this minimum level is the survival level for the organization, and any company that just manages to survive will not do so for long. Eventually the competition will pass it by, and the organization will die.

So the first skills that a project manager needs are *people skills*. Herein lies the source of major problems for many project managers—and general managers, too, for that matter. I have found that most managers know more about getting performance from computers, machines, and money than they do about getting people to perform. There are many reasons for this, but chief among them is that nobody has ever taught them practical methods for dealing

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with people, and we simply aren't born knowing how. So far as I know, the geneticists have not yet found a people-skills gene that endows a person with these skills.

Furthermore, many project managers who have strong technical backgrounds find it difficult to deal with people effectively. They are "things oriented," not people oriented, and some will even go so far as to say that they hate this aspect of the job. My recommendation is that they forget about being project managers if this is true. You usually aren't very effective at something you hate doing, but, beyond that, why spend your life doing something you hate?

The Working Project Manager

In fact, one of the biggest traps for project managers is to be what is euphemistically called a *working project manager*. This means that the project manager is indeed responsible for performing technical work, in addition to managing the job. The problem with this is that when there is a conflict between managing and doing work—and there always is such a conflict—the work will take priority and the managing will be neglected. However, when it comes time for the manager's performance appraisal, he will be told that his technical work was okay, but the managing was inadequate. This is a double bind that should not exist.

Authority

The universal complaint from project managers is that they have a lot of responsibility but no authority. It is true, and it is not likely to change. It is the nature of the job, I'm afraid. However, you can't delegate responsibility without giving a person the authority commensurate with the responsibility you want him to take, so, while the project manager's authority might be limited, it cannot be zero.

A word to project managers, however. I learned early in my career as an engineer that you have as much authority as you are willing to take. I know that sounds strange. We see authority as something granted to us by the organization, but it turns out that

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those individuals who take authority for granted usually get it officially. Of course, I am not advocating that you violate any of the policies of the organization. That is not a proper use of authority. But when it comes to making decisions, rather than checking with your boss to see if something is okay, make the decision yourself, take action that is appropriate and does not violate policy, and then inform your boss what you have done. Many managers have told me that they wish their people would quit placing all decisions on their shoulders to make. And they wish their people would bring them solutions, rather than problems. In other words, your boss is looking for you to take some of the load and leave her free to do other things.

A Moment of Truth

Jan Carlzon was the youngest ever CEO of Scandinavian Airlines, and he successfully turned around the ailing airline. He did so in part by empowering all employees to do their jobs without having to ask permission for every action they felt they should take to meet customer needs. He pointed out that every interaction between an employee and a customer was a *moment of truth* in which the customer would evaluate the airline's service. If that service was good, then the customer would be likely to fly SAS again; conversely, if it wasn't good, the customer would be less likely to do so. As Carlzon pointed out, from the customer's point of view, the SAS employee *is* the airline.

Furthermore, Carlzon revised the standard organization chart, which is typically a triangle with the CEO at the apex and successive levels of managers cascading down below, eventuating to the front-line employees at the very bottom. This implies that there is more and more authority as you go from the bottom toward the apex at the top and that the people at the lowest level have almost no authority at all.

Carlzon simply inverted the triangle, placing the apex at the bottom and the front-line employees at the top. In doing so, he said that the job of managers is to make it possible for the front line to

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deliver the services that the customer expects. The manager is an *enabler* of employees. They are actually servants of employees, not their masters, when you look at it this way.

This is, to me, the essence of the project manager's role. Since you have very little authority anyway, consider that your job is to ensure that everyone in the project team has what he needs to do his job well. If you do, then most of your team will perform at appropriate levels.

Since you have very little authority anyway, consider the job to ensure that everyone in the project team has what they need to do their job well.

Leadership and Management

Finally, because the project manager's job is mostly about dealing with people, it is absolutely essential that you exercise leadership as well as management skills (see Chapter 13). I have defined management as making an unsolicited contribution to the organization. The definition of leadership that seems to me to best express the meaning of the word is this (from *The Pyramid Climbers*): "Leadership is the art of getting others to *want* to do something that you believe should be done." The operative word in the definition is "want."

As I said previously, dictators get people to do things. Leaders get them to *want* to do things. There is a big difference. As soon as the dictator turns her back, people quit working. When the leader turns her back, people continue working, because they are working willingly.

Clearly, a project manager needs to exercise leadership, since he lacks authority. But, most important, the dictator can control only those people within his immediate range of sight. The leader can get people to perform without having to closely supervise them. And this is necessary in projects.

However, a project manager must also exercise management

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skills. In fact, the two sets of skills must be integrated into the job of project management because management deals with the administrated aspects of the job—budgets, schedules, logistics, and so on—while leadership gets people to perform at optimum levels. If you exercise one set of skills to the exclusion of the other, the outcome will be far less effective than if you integrate the two skill sets.

Do You Want to Be a Project Manager?

Project management is not for everyone. I emphasized earlier that it is not a technical job. It is about getting people to perform work that must be done to meet the objectives of the project. So when I am asked what I consider to be the most important attributes for project managers to have, I always say that people skills are number one through three. Then, below that, comes everything else. If you can deal with people, you can either learn to do everything else or delegate it to someone who can do it. But being able to do everything else without being good at dealing with people just won't cut it.

So when I am asked what I consider to be the most important attributes for project managers to have, I always say that people skills are number one through three.

Now the question is, do you really want to be a project manager? Do you like having responsibility with very limited authority? Do you enjoy working to impossible deadlines, with limited resources and unforgiving stakeholders? Are you, in other words, a bit masochistic? If you are, then you will love being a project manager.

If you are the boss of project managers, these are things you should consider in selecting people for the job. Not everyone is cut out for the job.

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Key Points to Remember

- A project manager must understand the mission and vision of the organization first, see how the project they are managing meshes with the organization's mission, and then steer the project to ensure that the interests of the organization are met.
- The first skills a project manager needs are people skills.
- One of the biggest traps for project managers is to perform technical work in addition to managing the job, because, when there is a conflict between performing the two, the project manager cannot neglect the management aspects.
- Instead of asking for authority, make decisions yourself, take action that is appropriate and does not violate policy, and then inform your boss what you have done.
- The project manager's job is to ensure that everyone in the project team has what he needs to do his job well.
- A project manager must exercise both leadership and management skills.

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CHAPTER 3

Planning the Project

In Chapter 1, I talked about the high cost of project failures. Almost every study finds that failures are caused primarily by poor project management, especially the failure to plan properly. There are two barriers to good planning. The first is prevailing paradigms, and the second is the nature of human beings.

A paradigm is a belief about what the world is like. You can tell what people believe by watching what they do, because they always behave consistently with their deeply held beliefs. It is not necessarily what they say they believe but what they *really* believe that counts. Chris Argyris, in his book *Overcoming Organizational Defenses: Facilitating Organization Learning*, has called these beliefs one's *theory espoused* as opposed to one's *theory in practice*. To illustrate, a fellow who attended my seminar on the tools of project management later told me that, upon returning to work, he immediately convened a meeting of his project team to prepare a plan. His boss called him out of the conference room.

"What are you doing?" asked the boss.

"Planning our project," explained the fellow.

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"Oh, you don't have time for that nonsense," his boss told him. "Get them out of the conference room so they can get the job done!"

It is clear that his boss didn't believe in planning, which raises this question: Why did he send the fellow to a training program if he really didn't believe in what is taught? Go figure.

The second reason that people don't plan is that they find the activity painful. Some individuals, especially engineers and programmers, are concerned that they will be held to estimates of task durations that they have made using their best guesses. Because they have no historical data to draw on, this is all they can do. But they also know that such numbers are highly uncertain, and they are afraid that failure to meet established targets will get them in trouble. As one of my engineers told me once, "You can't schedule creativity."

I replied that this may be true, but we must pretend we can, because no one will fund the project unless we put down a time. Since then, I have changed my mind—you can schedule creativity, within limits. In fact, there is no better stimulus to creative thinking than a tight deadline. If you give people forever, they simply mess around and don't produce anything.

Nevertheless, we find that, when people are required to plan a project, they find the activity painful, and they resist the pain it causes. The net result is that they wind up on the pain curve numbered 1 in Figure 3-1. The net result of being on this curve is to experience a lot of pain, because the total pain experienced is represented by the area under the curve.

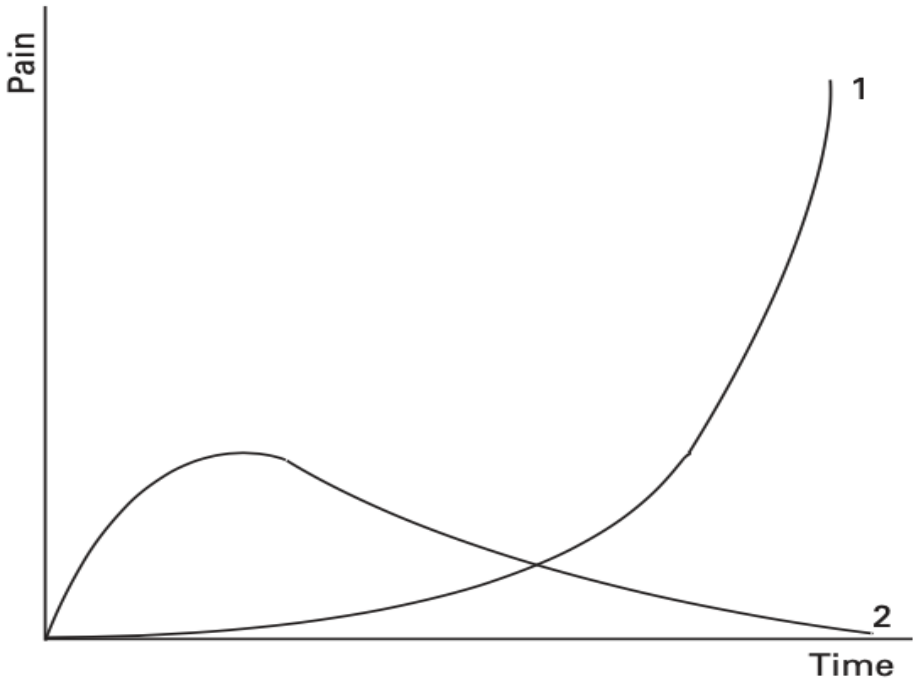
In curve 2 of the figure, there is a lot of pain early on, but it diminishes over time, and the total area under the curve is less than that under curve 1.

The Absolute Imperative of Planning

If you consider the major function of managing, it is to ensure that desired organization objectives are met. This is accomplished by exercising control over scarce resources. However, the word

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Figure 3-1. Two pain curves in a project over time.



control has two connotations, and we must be careful which one we intend.

One meaning of the word is "power and domination." In management, this is sometimes called the command-and-control approach, which in its worst form degenerates into the use of fear and intimidation to get things done. This method works when people have no other desirable options for employment or are not free to leave (as in the military or a prison). However, in a robust economy, very few employees tolerate such management for long.

The second meaning of control—and the one I advocate for managers—is highlighted in the idea that control is exer-

Control is exercised by comparing where you are to where you are supposed to be so that corrective action can be taken when there is a deviation.

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cised by comparing where you are to where you are supposed to be so that corrective action can be taken when there is a deviation. Notice that this is an information systems or guidance definition. Furthermore, note that two things are necessary for control to exist. First, you must have a plan that tells where you are supposed to be in the first place. If you have no plan, then, you cannot possibly have control. I think we need to remind ourselves of this almost every day, because it is so easy to forget when you are constantly being assaulted by demands to do this and that and a million other things.

No plan, no control!

Second, if you don't know where you are, you can't have control. Knowing where you are isn't as easy as it may seem, especially in doing knowledge work. For example, you say you expect to write ten thousand lines of code by today, and you've written eight thousand. Does that mean you're 80 percent of where you should be? Not necessarily. You may have found a more efficient way to write the code.

Predicting the future is easy. It's knowing what's going on now that's hard.

—Fritz R. S. Dressler

In any event, the major point to remember is that you cannot have control unless you have a plan, so planning is not optional.

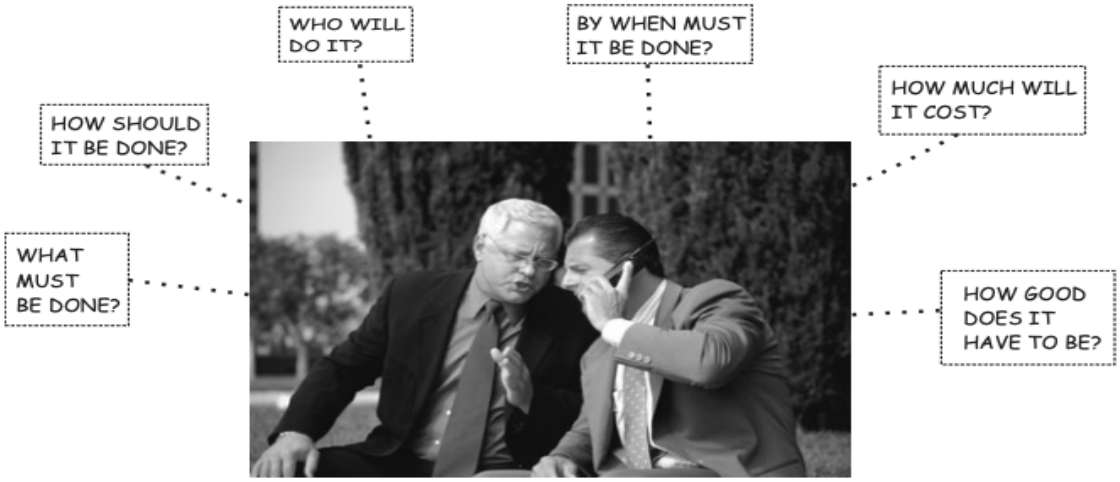
Another trap that causes people not to plan is to believe that they have no time to plan; they need to get the job done really fast! This is counterintuitive, but think about it—if you have forever to get something done, then you don't need a plan. It's when the deadline is tight that the plan becomes really important. As a simple example, imagine flying into Chicago and being late. You have a meeting across town in less than an hour. You've never been to Chicago, but when the rental car attendant asks if you need a map, you say, "I don't have time for a map. I've got to get to my meeting really fast!" Not very likely, is it?

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Planning Defined

Planning is quite simply answering the questions shown in Figure 3-2. They may be called the "who, what, when, why, how much, how long?" questions that you learned if you ever studied interviewing methods. It is that simple. And it is that hard. I say hard because answering some of these questions requires a crystal ball—especially questions like "How long will that take?" On tasks for which no history is available, this is a very hard question to answer. As my engineer said, "You can't schedule creativity."

Figure 3-2. Planning is answering questions.



Strategy, Tactics, and Logistics

To plan a project properly, you must attend to three kinds of activities that may have to be performed during the life of the job. These are strategy, tactics, and logistics.

Strategy refers to the overall method you will employ to do the job, sometimes referred to as a "game plan." As I related in Chapter 1, for thousands of years boats have been built with the keel down so that when one wishes to put the boat in the water, it is already right side up. This method worked fine until the

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1940s, when World War II placed tremendous pressure on shipyards to build military ships faster and ships were being built out of steel plate, rather than wood. Shipbuilders quickly found that it was extremely difficult to weld in the keel area. From the outside, you had problems getting under the ship, and inside you had to stand on your head to weld.

Avondale shipyards decided that it would be easier to build steel boats if ships were built upside down. The welding in the keel area now could be done from outside, standing above the ship, and to work on the inside one could stand upright. This strategy proved so effective that Avondale could build boats faster, cheaper, and of higher quality than its competitors, and the approach is still being used today.

Too often planners choose a project strategy because "it has always been done that way," rather than because it is best. You should always ask yourself, "What would be the best way to go about this?" before you proceed to do detailed implementation planning.

Implementation Planning

Once you have decided to build boats upside down, you must work out all of the details of how it will be done. Sometimes we say that we must be sure to dot all of the "i's" and cross all the "t's." This is where you answer those "who, what, when, and where" questions. In fact, it is implementation planning that many people think of when they talk about planning. However, a well-developed implementation plan for the wrong project strategy can only help you fail more efficiently.

Logistics

Military people can quickly tell you the benefit of attention to logistics. You can't fight a battle if people have no ammunition, food, clothing, or transportation. It is logistics that attends to these things. I once saw a project scheduling program (regrettably now defunct) that allowed construction managers to record when a certain quantity of bricks was delivered to their site; it

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then showed when they would run out, given a specific utilization rate. This would alert managers to schedule delivery of a new supply just before the existing stock was depleted.

I was also told about a road construction project in India that had very bad living conditions for the workers. The food was bad, sleeping conditions were poor, and the workers were suffering low morale. The project manager and his staff were all staying in a nice hotel in a nearby city. They finally realized the problem and moved to the site with the workers. Living conditions immediately improved, and so did worker morale. This is an example of the importance of a peripheral aspect of logistics.

Plan Ingredients

Following are the *minimum ingredients* that should be contained in a project plan. It is a good idea to keep these in a *centralized project database*. Initially, the *electronic file* will contain only the plan. As the project is managed, reports, changes, and other documents will be added, so that when the project is completed the *file* will contain a complete history of the project, which can be used by others as data for planning and managing their own projects.

Here are the items that make up the project plan:

- Problem statement.
- Project mission statement (see Chapter 4 for instructions on how to develop a mission statement).
- Project objectives (see discussion in Chapter 4).
- Project work requirements, including a list of all deliverables, such as reports, hardware, software, and so on. It is a good idea to have a deliverable at each major project milestone so that progress can be measured more easily.
- Exit criteria. Each milestone should have criteria established that will be used to determine whether the preceding phase of work is actually finished. If no deliverable is provided at a milestone, exit criteria become very important.

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- End-item specifications to be met. This means engineering specifications, architectural specs, building codes, government regulations, and so on.
- Work breakdown structure (WBS). This is an identification of all of the tasks that must be performed in order to achieve project objectives. A WBS is also a good graphic portrayal of *project scope* (see Chapter 6).
- Schedules (both milestone and working schedules should be provided; see Chapters 7 and 8).
- Required resources (people, equipment, materials, and facilities). These must be specified in conjunction with the schedule (see Chapters 7 and 8).
- Control system (see Chapters 9, 10, and 11).
- Major contributors. Use a linear responsibility chart (see Chapter 6).
- Risk areas with contingencies when possible (see Chapters 4 and 5).

Sign-Off of the Plan

Once the plan has been prepared, it should be submitted to *stakeholders* for their signatures.

Following are some comments about the meaning of a signature and suggestions for handling the process:

- A signature means that the individual is *committed* to his contribution, agrees with the scope of work to be done, and accepts the specs as valid. A signature on the part of a contributor does not mean a *guarantee* of

STAKEHOLDER: Anyone who has a vested interest in the project. These include contributors, customers, managers, and financial people.

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performance. It is a commitment. Because there are factors outside our control, few of us would like to guarantee our performance. However, most would be willing to make a commitment, meaning we promise to do our best to fulfill our obligations. If a signature is treated as a guarantee, either signers will refuse to sign or they will sign without feeling really committed to the agreement. Neither response is desirable.

The project plan should be reviewed and signed off in a meeting—not through interoffice mail!

- The plan should be signed in a *project plan review meeting*, not by mail. Circulating copies for signature by mail seldom works, as people may be too busy to read in depth and may miss important points that would be brought out in a signoff meeting.

- People should be encouraged to "shoot holes in the plan" during the review meeting, rather than wait until problems develop later on. Naturally, this does not mean that they should nitpick the plan. The objective is to ensure that the plan is workable—that is all.

Encourage people to spot problems during the sign-off meeting, not later.

Changing the Plan

It would be nice to think that a plan, once developed, would never change. However, that is unrealistic. No one has 20/20 foresight. Unforeseen problems are almost certain to arise. The important thing is to make changes in an orderly way, following a standard change procedure.

Make changes in an orderly way, following a standard change procedure.

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If no change control is exercised, the project may wind up over budget, behind schedule, and hopelessly inadequate, with no warning until it is too late. Here are suggestions for handling changes to the plan:

- Changes should be made only when a significant deviation occurs. A significant change is usually specified in terms of percent tolerances relative to the original targets.
- Change control is necessary to protect *everyone* from the effects of scope creep—changes to the project that result in additional work. If changes in scope are not identified and managed properly, the project may come in considerably over budget and/or behind schedule.
- Causes of changes should be documented for reference in planning future projects. The causes should be *factual*, not blame-and-punishment statements.

> **Any plan is bad which is not susceptible to change.**
>
> —Bartolommno de San Concordio (1475–1517)

A comprehensive process for managing project change is presented in Chapter 10.

Suggestions for Effective Planning

Here are some ideas to help you plan effectively:

- Plan to plan. It is always difficult to get people together to develop a plan. The planning session itself should be planned, or it may turn into a totally disorganized meeting of the type that plagues many organizations. This means that an agenda must be prepared, the meeting should be time limited to the degree possible, and people should be kept on track. If someone goes off on a tangent, the meeting facilitator should get the person back on track as quickly as possible. There are many excellent guides to

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running meetings (e.g., *Mining Group Gold* by Tom Kayser); the reader is referred to those.

Rule: The people who must do the work should participate in developing the plan.

▶ The people who must implement a plan should participate in preparing it. Otherwise, you risk having contributors who feel no sense of commitment to the plan; their estimates may be erroneous, and major tasks may be forgotten.

The first rule of planning is to be prepared to replan!

▶ The first rule of planning is to be prepared to replan. Unexpected obstacles will undoubtedly crop up and must be handled. This also means that you should not plan in too much detail if there is a likelihood that the plan will have to be changed, as this wastes time.

▶ Because unexpected obstacles will crop up, always conduct a risk analysis to anticipate the most likely ones (see Chapter 5). Develop Plan B just in case Plan A doesn't work. Why not just use Plan B in the first place? Because Plan A is better but has a few weaknesses. Plan B has weaknesses also, but they must be different from those in Plan A, or there is no use in considering Plan B a backup.

Identify project risks and develop contingencies to deal with them if they occur.

The simple way to do a risk analysis is to ask, "What could go wrong?" This should be done for the schedule, work performance, and other parts of the project plan. Sometimes, simply identifying risks can help avert them, but, if that cannot be done, at least you'll have a backup plan available. One caution: If you are dealing with very analytical people, they may go into *analysis paralysis* here. You are not trying to identify *every possible risk*—just those that are fairly likely.

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▶ Begin by looking at the *purpose* of doing whatever is to be done. Develop a problem statement. All actions in an organization should be taken to achieve a result, which is another way of saying "solve a problem." Be careful here to identify what the end user really needs to solve the problem. Sometimes we see projects in which the team thinks a solution is right for the client, but that solution is never used, resulting in significant waste to the organization.

▶ Use the Work Breakdown Structure (discussed in Chapter 6) to divide the work into smaller chunks for which you can develop accurate estimates for duration, cost, and resource requirements.

Consider the little mouse, how sagacious an animal it is which never entrusts its life to one hole only.

—Plautus (254–184 B.C.)

Project Planning Steps

The basic planning steps are as follows. Note that some of these topics are covered in the next chapter.

- ▶ Define the problem to be solved by the project.
- ▶ Develop a mission statement, followed by statements of major objectives.
- ▶ Develop a project strategy that will meet all project objectives.
- ▶ Write a scope statement to define project boundaries (what *will* and *will not* be done).
- ▶ Develop a Work Breakdown Structure (WBS).
- ▶ Using the WBS, estimate activity durations, resource requirements, and costs (as appropriate for your environment).

Be sure the project really satisfies the customer's needs, rather than being what the team thinks the customer should get!

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- Prepare the project master schedule and budget.
- Decide on the project organization structure—whether matrix or hierarchical (if you are free to choose).
- Create the project plan.
- Get the plan signed off by all project stakeholders.

Key Points to Remember

- If you have no plan, you have no control.
- The people who must execute a plan should participate in preparing it.
- Have the plan signed off in a meeting, not by sending it through the interoffice mail.
- Keep all project documentation in an electronic project file.
- Use exit criteria to determine when a milestone has actually been achieved.
- Require that changes to the project plan be approved before you make them.
- Risk management should be part of all project planning.
- A paradigm is a belief about what the world is like.
- Planning is answering the "who, what, when, how, how long, and how much" questions.
- Logistics refers to supplying people with materials and supplies they need to do their jobs.

Exercise

We have talked about strategy, tactics, and logistics. Which must be decided first? What is the function of tactics? When would you plan for logistics?

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CHAPTER 4

Developing a Mission, Vision, Goals, and Objectives for the Project

Before a project team does any work, it should spend time ensuring that it has a shared understanding of where it is going. The terms used to define that destination are "mission," "vision," "goals," and "objectives." And it is at this very early stage that projects tend to fail, because everyone takes for granted that "we all know what the mission is."

Defining the Problem

Every project solves a problem of some kind, but people are inclined to skip over the definition of the problem. This is a big mistake. The way you define a problem determines how you will solve it, so it is critical that a proper definition be developed. For example, too often a problem is defined in terms of a solution. A person may say, "I have a problem. My car has quit, and I have no way to get to work. How am I going to get my car repaired, because I have no money to do it?"

The problem has essentially been defined as "How do I repair

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my car?" The actual problem, however, at its most fundamental level, is that the person has no way to get to work—or so he says. But could he ride the bus, go with a coworker, or ride a bike until he has the money to have the car repaired? It is true that having no money to repair the car is a problem, but it is important to distinguish between the basic or core problem and those at another level.

I once heard a sales manager berate a salesman, saying, "The company has spent a lot of money developing this new product, and none of you are selling it. If you don't get out there and sell this product, I'm going to find myself some salespeople who can sell!"

It is clear how he has defined the problem—he has a group of salespeople who can't sell. However, given that none of them can sell the product, I am sure he is wrong. There is something wrong with the product or market, or the competition is killing them. You are very unlikely to have *all* bad salespeople!

Nevertheless, this manager has defined the problem in terms of people, and that is the way it must be solved. Imagine that he replaces all of the salespeople. He will still have the same problem, because he has not addressed the actual cause.

People sometimes define a problem as a goal. A goal in itself is not a problem. It is when there are obstacles that make it difficult to reach the goal that one has a problem. Given this definition of a problem, we can say that problem solving involves finding ways to deal with obstacles: They must be overcome, bypassed, or removed.

A problem is a gap between where you are and where you want to be, with obstacles existing that prevent easy movement to close the gap.

Confusion of Terms

Suppose a person tells you that she is taking a new job in a distant city, and she plans to move there. She immediately realizes that

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she must find a place to live. So she says, "I have a problem. I have to find a place to live."

You ask her what her mission is. "To find a place to live," she says.

And how about her vision? "To have a place to live," she answers, a little confused.

No wonder she is confused. All three statements sound alike! She needs to understand the difference between them if she is to solve this problem.

Remember, a problem is a gap. Suppose we were to ask her to tell us where she wants to be when her problem is solved. She would say, "I would have a place to live in the new city."

"And where are you now?" you ask.

"I have no place to live," she says.

Then the gap is between having a place and not having one. This can be stated simply as "I have no place to live." And, indeed, this is the problem she is trying to solve.

But—would just *any* place be okay? Of course not. She doesn't want to live under a bridge, although homeless people sometimes do. So if you ask her, "What kind of place are you looking for?" she can tell you.

"It needs to have three bedrooms, the house must be of a certain size, and I prefer a certain style," she says. This is her vision for the kind of place she wants to live in. That vision literally paints a picture in her mind, and, when she finds a place that comes close to that picture, she will have "arrived" at her destination. This is the function of vision—it defines "done."

Her mission, then, is to find a place that conforms to her vision. Another way to say this is that the mission of a project is always to achieve the vision. In doing so, it solves the stated problem. So you may want to diagram it as shown in Figure 4-1. Note that the vision has been spelled out as a list of things she must have, along with some that she wants to have and a few that would be nice to have if she could get them.

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Figure 4-1. Chevron showing mission, vision, and problem statement.



The Real World

Okay, now we know the differences among the mission, vision, and problem, but in the "real world" you never get them in this order. Your boss or project sponsor will say, "Here is your mission," without any mention of a problem statement. It is possible that some discussion of the sponsor's vision of the end result will take place, but even that may be fairly sketchy. So the first order of business for a project team is to develop these into a form that everyone will accept.

The major "political" problem you may encounter is that the sponsor will undoubtedly have given you a mission that is based on his definition of the problem to be solved. Sometimes his definition will be incorrect, and you will have to confront this. Otherwise, you will spend a lot of the organization's money, only to

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find that you have developed the right solution to the wrong problem.

The Real Mission of Every Project

I said earlier that the mission is always to achieve the vision. However, I should add that the vision you are trying to achieve is the one the customer holds. Another way to say this is that you are trying to satisfy the customer's needs. That is the primary objective. Your motive may be to make a profit in the process, but the mission is always to meet the needs of the customer. That means, of course, that you must know what those needs are, and sometimes this isn't easy, because even the customer isn't clear about them. So you have to translate or interpret as best you can. Your best safeguard is to keep the customer involved in the project from concept to completion so that there is a constant check on whether what you are doing will achieve the desired result.

The mission of the project can be written by answering two questions:

1. What are we going to do?
2. For whom are we going to do it?

In the previous edition of this book, it was suggested that you also state how you will go about meeting those customer needs, but this should not be part of the mission statement itself. The mission statement defines "what" you are doing; "how" you are going to do it is project strategy and should be dealt with separately.

Developing Project Objectives

Once a mission statement has been developed, you can write your project objectives. Note that objectives are much more specific than the mission statement itself and define results that must be achieved in order for the overall mission to be accomplished. Also, an objective defines the desired end result.

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I may want to finish this chapter by 10 o'clock this morning. That is my desired outcome or result—my objective. The way in which I achieve that objective is to perform a number of tasks. These might include typing text into my computer, reviewing some other literature on the topic about which I am writing, calling a colleague to ask a question for clarification, and printing out the chapter, proofing it, and entering some revisions into my computer.

Goal setting has traditionally been based on past performance. This practice has tended to perpetuate the sins of the past.

—J. M. Juran

The following acronym may help you remember the essential qualities that a statement of objectives must have. We say that an objective must be SMART, each letter standing for a condition as follows:

Specific

Measurable

Attainable

Realistic

Time limited

An objective specifies a desired end result to be achieved. A task is an activity performed to achieve that result. An objective is usually a noun, whereas a task is a verb.

Dr. W. Edwards Deming has raised some serious questions about the advisability of trying to quantify goals and objectives. He argued that there is no point in setting quotas for a manufacturing process to reach. If the system is stable, he argued, then there is no need to specify a goal, since you will get whatever the system can produce. A goal beyond the capability of the system can't be achieved.

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On the other hand, according to Deming, if the system is not stable (in the statistical sense of the word), then again there is no need to specify a quota, since there is no way to know what the capability of the system is.

In project work, we may know the capability of a person by looking at his or her past performance, but, unless you have a large number of samples, you have no way of knowing exactly what the person can do, since there is always variability in people's performance. Furthermore, it does no good to base a quota on what someone else has done. The quota must be valid for the person who is going to do the job this time.

We all know that some people are capable of more output than others. So defining the measurement and attainability aspects of goal or objective setting is very difficult. I go into this more in Chapter 6 when I discuss time estimating.

I have found the following two questions to be useful both in setting objectives and in monitoring progress toward those objectives:

1. What is our desired outcome? This is called the outcome frame. It helps keep you focused on the result you are trying to achieve, rather than on the effort being expended to get there.
2. How will we know when we achieve it? I call this the evidence question. This question is very useful for establishing exit criteria for objectives that cannot be quantified.

What follows are a couple of examples of objectives:

- Our objective is to develop a one-minute commercial to solicit contributions to WXYZ to air on local TV stations by June 5, 2012.
- Our objective is to raise $600,000 in funds from local viewers by September 18, 2012.

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The Nature of Objectives

Note that these examples of objectives do not say how they will be achieved. I consider an objective to be a statement that tells me what result is to be achieved. The "how" is problem solving, and I prefer to keep that open so that solutions can be brainstormed later. If the approach is written into the objective statement, it may lock a team into a method that is not really best for the project.

Assessing Project Risks

Once you have established your objectives, you can develop plans for how to achieve them. Unfortunately, the best plans sometimes don't work. One safeguard in managing projects is to think about the risks ahead that could sink the job. This can be done for critical objectives and for other parts of the plan.

The simplest way to conduct a risk analysis is to ask, "What could go wrong?" or "What could keep us from achieving our objective?" It is usually best to list the risks first, then think about contingencies for dealing with them. One way to look at risk is to divide a flip chart page in half, have the group brainstorm the risks, which you write down on the left side of the page, and then go back and list the contingencies—things you can do to manage the risks if they do materialize. An example of a risk analysis for a photography project is shown in Figure 4-2.

It is helpful to assess risks of failure of the following:

- The schedule
- The budget
- Project quality
- Customer satisfaction

One benefit of doing a risk analysis in this manner is that it may help you avert some risks. When you cannot avert a risk, you will at least have a backup plan. Unexpected risks can throw a project into a tailspin.

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Figure 4-2. Risk analysis example.

What could go wrong?	Contingency
1. Exposure wrong	Bracket the exposure
2. Shots unacceptable	Take extra photos
3. Film lost or damaged	Hand carry to client
4. Weather delays	Allow extra time

I mentioned this point previously, but it bears repeating: You are not trying to identify every possible risk, just some of the more likely ones. This point should be made to team members who are highly analytical or who perhaps have a tendency to be negative in general. Also, risk analysis always has a positive thrust—that is, you are asking, "If it happens, what will we do about it?" You don't want people to say, "Ain't it awful!"

Risk analysis should not lead to analysis paralysis!

In Chapter 5, I present detailed tools and techniques to address risk management in the project environment.

Key Points to Remember

- The way a problem is defined determines how you will solve it.
- A problem is a gap between where you are and where you want to be, with obstacles making it hard to reach the goal. A goal by itself is not a problem. Obstacles must exist for there to be a problem.
- Vision is what the final result will "look like." It defines "done."
- The mission is to achieve the vision. It answers the two questions "What are we going to do?" and "For whom are we going to do it?"

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- Objectives should be SMART.
- You can identify risks by asking, "What could go wrong?"

Exercise

Choose a project that you are going to do or perhaps have just started. Answer the questions that follow to the best of your ability. If you need to confer with others to answer some of them, fine. Remember, the people who have to follow the plan should participate in preparing it.

- What are you trying to achieve with the project? What need does it satisfy for your customer? Who exactly is going to actually use the project deliverable(s) when it is finished? (That is, who is your real customer?) What will distinguish your deliverable from those already available to the customer?
- Write a problem statement on the basis of your answers to the first question. What is the gap between where you are now and where you want to be? What obstacles prevent easy movement to close the gap?
- Write a mission statement, answering the two basic questions:
  1. What are we going to do?
  2. For whom are we going to do it?

Talk to your customer about these issues. Do not present your written statements to her. Instead, see whether you can get confirmation by asking open-ended questions. If you can't, you may have to revise what you have written.

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CHAPTER 5

Creating the Project Risk Plan

As mentioned in Chapter 1, risk management is the systematic process of identifying, analyzing, and responding to project risk. *Systematic* is a key word here, as many project managers attempt to deal with risks on an informal basis with little or no prior planning. Any project manager who operates in this manner is inviting failure, if not disaster. These are strong words, but appropriate for an important topic. A formal, comprehensive project risk plan allows the project manager to be proactive regarding the innumerable things that can and do go wrong with a project. Without this plan, you are forced to manage reactively when things go wrong—easily the most expensive approach. A systematic process adds discipline and efficiency when creating the plan. At the end of Chapter 4, a high-level overview of the risk process was

A formal, comprehensive project risk plan allows the project manager to be proactive regarding the innumerable things that can and do go wrong with a project.

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presented. Here we present a comprehensive approach to project risk management.

Defining Project Risks

Project risk management begins early in the life cycle. A clear understanding of the risks that face the project must be established. The sources of project risk are almost limitless, emphasizing the need for a well-thought-out, detailed plan. Typical examples include the loss of a key team member, weather emergencies, technical failures, and poor suppliers. This section introduces general concepts of risk and briefly discusses what should be done early in the process.

Many project managers wait too long to assess risk factors and delay the risk plan because they assume they don't know enough yet, that there are too many unknowns. This is a common trap that you should try to avoid. During the initiation phase of the project life cycle, an initial high-level assessment ought to be conducted. You and your team members should take a strategic approach to "what can go wrong" and begin laying the foundation for the detailed plan to follow. Without this foundation, projects often experience the negative impact of risks that become reality, risks that might have been prevented or mitigated through contingency planning. This is *reactive* behavior, and you must live in the *proactive* world to be successful as a project manager. Potential opportunities are sometimes referred to as positive risks, where the project manager strives to optimize the positive impact on project objectives.

Project risk management is "the process of conducting risk management planning, identification, analysis, response planning, and monitoring and control on a project."

As previously noted, project risk management is identified as one of the nine knowledge areas of the *PMBOK® Guide*. The *PMBOK® Guide* describes project

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risk management as "*the process of conducting risk management planning, identification, analysis, response planning, and monitoring and control on a project.*" By definition, a process can be considered a formal, controlled undertaking with little or no variation. When applied to processes, variation often equals inefficiency. It is important for you to manage risks formally by applying an agreed-upon process to establish the risk management plan. Given the realities and variables of the typical project environment, a certain amount of flexibility is appropriate. As you gain experience in managing risks, an intuitive feel for flexibility will develop depending upon style and the length, width, depth, and breadth of the projects.

The Six-Step Process

The Six-Step process is a common and practical approach to establishing the project risk plan. This process should not be created in a vacuum but typically involves a great deal of research and collaboration with the project team.

Step 1: Make a List

Brainstorm. Making a list of potential risks to the project should not be an analysis but a formal brainstorming session, when all ideas are captured. Steps 2 and 3 of the process allow for a vetting of these ideas. It is important that the entire team get involved in identifying threats and highlighting what can go wrong. Some project managers make the mistake of trying to accomplish this on their own to allow team members to complete other tasks. This is shortsighted and a bad idea. This initial step of the process must be collaborative and involve the individuals who are expert at that portion of the project work for which they are responsible. Leverage the intellectual capital (smarts) that is your team. If one or more members are left out, it is likely that some risks will remain unidentified and pose a threat to project

Step 1: Make a list.

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success. Remember, involve everyone—a procurement specialist will not be helpful in identifying potential software development problems, and vice versa.

When you work with the support of an informal team, you will need to be disciplined and realize that a certain amount of research is necessary before moving forward. This may include phone calls, e-mails, office visits, or videoconferencing—whatever it takes to elicit the information you need. You typically start with the informal team members or contributors to the project and initiate a dialogue as to what might go wrong. Usually, these discussions identify other ancillary individuals who should be contacted. Functional department managers can be very helpful in these circumstances, either assisting directly or identifying others in their department who can.

In either case, you should take a holistic approach to establishing the list, as all types of risks will need to be identified and dealt with accordingly.

Steps 2 & 3: Determine the Probability of Risk Occurrence and Negative Impact

I am combining steps 2 and 3 because they are the prioritization factors. They assist you in vetting the list of risks. These two steps allow you to prioritize all identified threats to the project and help you determine how much time, effort, staff, and money should be devoted to preventing or mitigating each. Again, this must be accomplished not in a vacuum but with full input from team members and subject matter experts (SMEs).

Steps 2 & 3: Determine the probability of risk occurrence and negative impact.

How probable is it that each risk will become a reality? This question needs to be asked and answered. It is often sufficient to use a High-Medium-Low (HML) scale and apply it to the list of brainstormed risks. If a risk is considered highly probable, it receives an H; if the probability is medium, it receives an M; and if

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the probability is low, it receives an L. These labels should not be applied arbitrarily, emphasizing the need for team collaboration or research and analysis by the project manager.

If the risk becomes a reality, how badly will it damage the project? This is the next question that needs to be asked and answered. All aspects of the project should be considered when rating the negative impact of any risk. If the risk becomes reality, how will it affect the budget, schedule, resource utilization, scope of work, and so on? The output of steps 2 and 3 results in a list of potential risks with corresponding values for probability and negative impact:

Risk	Probability	Impact
A	M	L
B	M	M
C	L	L
D	H	H

Given the assessment of risks A through D in the table, it is clear that you should focus most of your efforts mitigating risk D and that very little attention should be paid to risk C. Please remember that you could be wrong (unfortunately, I needed to be reminded of this as a young project manager). Just because you label a risk Low probability and Low impact does not guarantee that it will be, so leave it on your radar screen.

For those who prefer metrics, a simple number-based scale can be applied. As you rate probability and impact, you assign a value to each risk. The probability scale can be based on a range of 1 through 10, with 1 representing unlikely and 10 being very likely. Negative impact can be represented by the same scale or in budgetary impact:

Risk	Probability		$ Impact		Total
A	3	×	1K	=	3K
B	7	×	1K	=	7K
C	2	×	14K	=	28K
D	5	×	3K	=	15K

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According to this analysis, risk C will demand most of this project team's attention because of its relative value of 28K. It should be noted that the same method can be used to focus on schedule impact or even resource utilization.

Step 4: Prevent or Mitigate the Risk

Some risks can be prevented; others can only be mitigated. Earthquakes or the retirement of an important stakeholder, for instance, cannot be prevented. Some risks can and should be prevented in step 4. If a risk has been identified and you have the ability to prevent its occurrence, do so. Proactivity is the project manager's best friend. Kill the risk before it has a chance to grow and flourish, and you won't have to deal with it again.

Step 4: Prevent or mitigate the risk.

For example, if a vendor or supplier is targeted for your project and one of your team members has had previous dealings with the company and was not impressed, he will inform you that the supplier's material deliveries are frequently late and often rejected. Assuming that the supplier is not a sole source (your only choice), you can prevent the risk by finding an alternate supplier that is more reliable.

For those risks that cannot be prevented, an attempt should be made to mitigate or lessen the probability and/or impact should they occur. Using the example of the unreliable supplier, if you must use that company, you can create concrete steps to proactively expedite the delivery of the material, thereby mitigating the impact of the risk. If management threatens to deprioritize your project, you can lobby on your project's behalf, mitigating the chances that this will occur.

Step 5: Consider Contingencies

Preventive measures are those steps taken before the risk becomes reality. *Contingencies* represent the specific

Step 5: Consider contingencies.

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actions that will be taken if the risk occurs. Here, you answer the question "If the risk becomes reality, what will we do"?

For example, if acceptance testing for a supplier's widgets has been identified as medium to high risk and a test failure occurs, an appropriate contingency might be to supply engineering support at the vendor's expense. Another contingency might be to switch to another predetermined vendor if he has widgets in stock.

Contingencies are directly linked to the prioritization factors introduced in steps 2 and 3. If the risk is a high priority (high probability, high negative impact) you will want to identify multiple contingencies. Since there is a good chance that the risk will occur and that when it does, it will hurt the project, you want to be covered. If the risk falls in the middle range of the prioritization scale, you should establish at least one contingency. Those risks that fall in the lower level should not require much attention; it is best to invest your efforts elsewhere. When establishing your contingencies, be careful of the very low probability, very high impact risk. These tend to be totally ignored because of the low probability, but they can and sometimes do bring projects down.

Step 6: Establish the Trigger Point

The trigger point is often the most important element of the project risk plan. There is a direct relationship between the trigger point and the contingencies. True to its name, the *trigger point* is the point at which the risk becomes enough of a reality that the project manager needs to trigger the contingency. It is a judgment call meant to maximize the value of the predetermined contingency by implementing it at the optimal time. Trigger too soon and you will probably spend time, effort, or money for no good reason. Trigger too late and you may end up experiencing the full impact of the occurrence, with little value added by implementing the contingency. Let's return to our example.

Step 6: Establish the trigger point.

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If a usually reliable supplier has experienced labor issues and has shut down because of a strike, perhaps your contingency plan has identified suppliers B and C as alternatives. Each has widgets in stock and has quoted a lead time of two calendar weeks for prep and delivery. If the required delivery date is February 15, your trigger should include the two-week lead time plus a few days' buffer. An appropriate trigger point here would be January 31. If the contingency affects a task or tasks on the *critical path* (see Chapter 7), additional buffer days should be considered.

The trigger should be a specific point in time or a defined range of time. Most project managers consider this to be the trickiest part of the project risk plan, but it is well worth the effort. Often, in my role as consultant, I come across well-thought-out plans that were wasted due to untimely or nonexistent contingency implementation. The trigger point is a best practice for project managers that will improve the efficacy of the entire plan.

Establishing Reserves

The most comprehensive risk plan can be compromised if you realize that you do not have the time or means to take appropriate action. Establishing reserves enables you to leverage the plan to its fullest potential. The best-laid plans are impotent without the time and/or budget to allow for effective implementation. As a result, you need to establish contingency and management reserves.

The most comprehensive risk plan can be compromised if you realize that you do not have the time or means to take appropriate action.

Contingency reserves are designated amounts of time and/or budget to account for risks to the project that have been identified and actively accepted. They are created to cover *known* risks to the project. There is a direct relationship between contingency reserves and the previously discussed Six-Step process (or a similar approach). Once the process is com-

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plete, you should estimate the required reserves to cover the risks that have been identified and accepted.

For example, if your project team has identified the loss of a key team member to retirement as a high-priority risk (probability and impact), contingency actions will require the hiring of a replacement from outside the organization. The cost and schedule impact of the hiring process and team member assimilation must be estimated and added to the contingency reserve.

Management reserves are designated amounts of time and/or budget included in your plan to account for risks to the project that cannot be predicted. Sometimes you don't know what you don't know. Management reserves are created to cover *unknown* risks to the project. For example, if the current project involves a high percentage of research and development and an analysis of past similar projects using actuals (historical data) indicates an average budgetary overrun of 10 percent, this 10 percent is not attributed to any particular risk event. However, it should trigger the need for a 10 percent increase to the overall project budget as a management reserve.

Managing Multiproject Risks

Many, if not most, project managers find themselves leading more than one project. The multiproject manager confronts unique issues not normally encountered when managing a single project. In the multiproject world, many projects overlap or experience direct dependencies with other projects, similar to those in a typical network diagram (see Chapters 7 and 8).

Two perspectives are required here. First, you must focus on the individual project and the associated risks for each. Then, you must assess your entire portfolio and determine the nature of the relationship of these projects. Your *portfolio* is the sum of all projects under your purview. The relationship among these projects may vary widely.

A *program* typically involves multiple projects working toward the completion of a single deliverable. These projects must all be

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properly integrated toward this end. In the portfolio environment, you must identify where the projects coincide or overlap with regard to any project work. You then determine what might go wrong in these areas where the projects "touch."

The same is done in the program environment, where project relationships are usually more clearly defined. For example, track and field includes events involving four runners that must pass a baton from one to the other. The fastest team does not always win because the baton may not be handed off smoothly, or it may even be dropped. Many projects will have direct predecessor-successor relationships (one must be completed before the next can begin) in the program world. In order to promote a smooth transition from one project to the next, you must focus on this "baton" handoff. The multiproject risk plan focuses on just these events.

A *program* typically involves multiple projects working toward the completion of a single deliverable.

Coordination Points

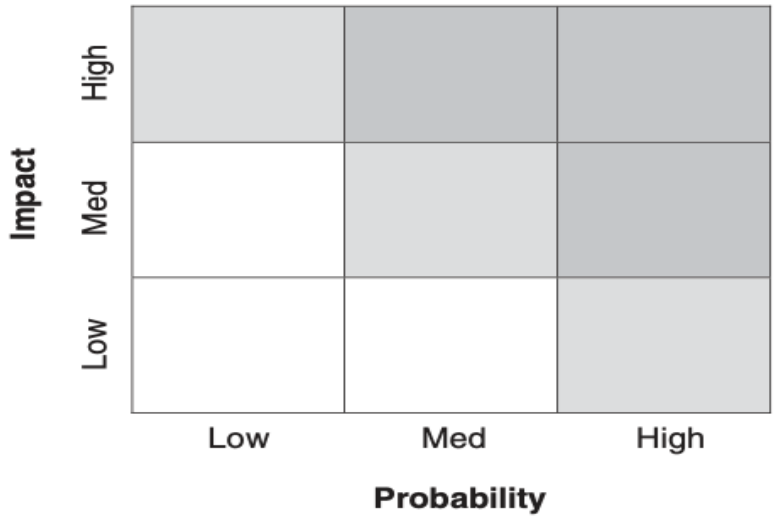
In either case, the areas where the projects touch are called *coordination points*. You need to identify these points, after which a standard multiproject risk plan can be created. It is important to emphasize that the Six-Step focus here must be on the coordination points exclusively. In reality, you focus on creating a risk plan for each project individually to manage intraproject risks and then turn your attention to the coordination points and perform the same process to manage interproject risks. The portfolio or program risk plan is meant to supplement and enhance the individual risk plan in the multiproject environment.

Risk Matrix

A useful tool when managing many risks across projects is the standard risk matrix, as shown in Figure 5-1.

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Figure 5-1. Risk matrix.



Once the threats have been plotted onto the risk matrix, an H-M-L prioritization can be applied where the highest priority risks are positioned toward the upper right corner and lower priority ones toward the lower left. You can then color code individual risks as they apply to each project. In the fog of the portfolio or program management world, this can prove to be a very effective approach.

Risk Register

The risk register is a useful tool in managing actions taken regarding accepted risks to the project, as shown in Figure 5-2.

Figure 5-2. Risk register.

ID	Risk	Outcome/Response	Owner	P	I	Active

P = Probability I = Impact

Source: The American Management Association seminar, "Improving Your Project Management Skills: The Basics for Success."

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The risk register is the last ingredient of the project risk plan. It is a living, breathing dynamic tool that can help you to track risk status as your project matures through the life cycle. The risk register also helps you identify ownership of contingency implementation, outcomes of actions taken, and active and inactive risks.

If a thorough risk analysis is not developed, you and your team will live in the reactive world, putting out fires throughout the project life cycle. This is easily the most expensive way to operate in terms of time, effort, and money, and it will jeopardize the success of any project. You must invest yourself early by adding this crucial element to your overall project plan.

Key Points to Remember

- Project risk management should begin early in the process and continue through the life cycle. A key to success in dealing with risk is to start early and lay the foundation for risk management; be proactive, not reactive; manage risks formally with a *process*; and be flexible.
- The Six-Step process to establishing a project risk plan includes making a list of potential risks; determining the probability of risk occurrence; determining its negative impact; preventing or mitigating the risk; considering contingencies; and establishing trigger points for activating contingencies.
- Establishing contingency and management reserves enables you to leverage your project risk plan to its fullest potential.
- Coordination points must be identified and analyzed in the multiproject risk environment.
- A standard risk matrix is a useful tool when managing many risks across projects.
- The risk register can be an effective tool for organizing and prioritizing threats to the project.

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Exercise

Choose one of your current or recent projects, and practice the Six-Step process. Make a list of potential risks to the project and prioritize each, utilizing H-M-L or a simple metric-based scale. Pick any three risks and establish:

- Prevent measures
- Contingencies
- Trigger points

Two or three bullet points for each should suffice.

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CHAPTER 6

Using the Work Breakdown Structure to Plan a Project

In a previous chapter, I said that planning answers the questions "What must be done?", "How long will it take?", and "How much will it cost?". Planning the *what* is vital; projects frequently fail because a significant part of the work is forgotten. In addition, once tasks have been identified, the time and resource requirements must be determined. This is called *estimating*.

A major problem in project planning is determining how long tasks will take and what it will cost to do them. Inaccurate estimates are a leading cause of project failures, and missed cost targets are a common cause of stress and recrimination in project management.

The most useful tool for accomplishing all of these tasks is the work breakdown structure (WBS). The idea behind the WBS is simple: You can subdivide a complicated task into smaller tasks until you reach a level that cannot be further subdivided. At that point, it is usually easier to estimate how long the small task will

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take and how much it will cost to perform than it would have been to estimate these factors for the higher levels.

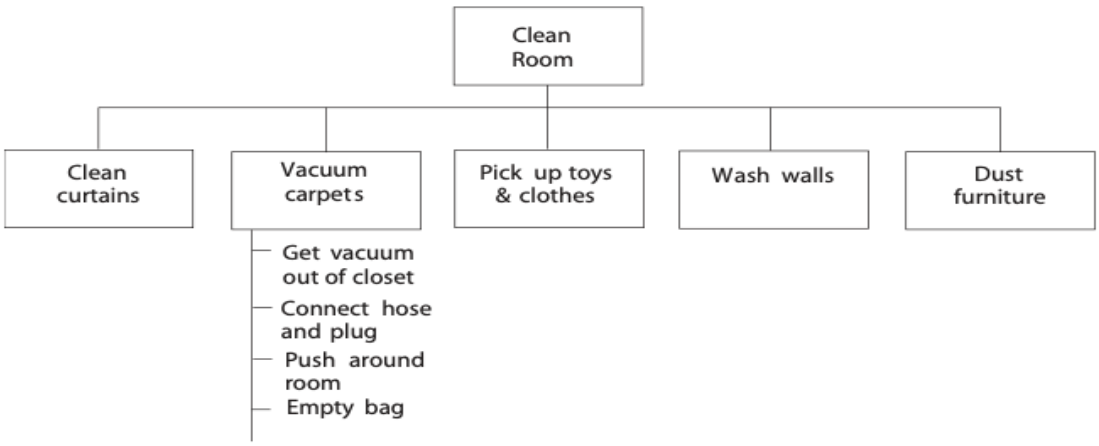
Nevertheless, it is still not easy to estimate task durations for activities that have never been performed before. Because this is the typical situation in engineering hardware and software development projects, we might expect many of these estimates to be in error, and this seems to be demonstrated by experience. Still, the work breakdown structure makes it easier to estimate knowledge tasks than any other tool we have.

A Simple Example

As an example, if I want to clean a room (see Figure 6-1), I might begin by picking up clothes, toys, and other things that have been dropped on the floor. I could use a vacuum cleaner to get dirt out of the carpet. I might wash the windows and wipe down the walls, then dust the furniture. All of these activities are *subtasks* performed to clean the room.

As for vacuuming the room, I might have to get the vacuum cleaner out of the closet, connect the hose, plug it in, push the vacuum cleaner around the room, empty the bag, and put the machine

Figure 6-1. WBS diagram to clean a room.



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back in the closet. These are still smaller tasks to be performed in accomplishing the subtask called *vacuuming*. The diagram in Figure 6-1 shows how this might be portrayed in WBS format.

Note that we do not worry about the sequence in which work is performed when we do a WBS. That will be worked out when we develop a schedule. However, you will probably find yourself thinking sequentially, as it seems to be human nature to do so. The main idea of doing a WBS is to capture all of the tasks. So if you find yourself and other members of your team thinking sequentially, don't be too concerned, but don't get hung up on trying to diagram the sequence or you will slow down the process of task identification.

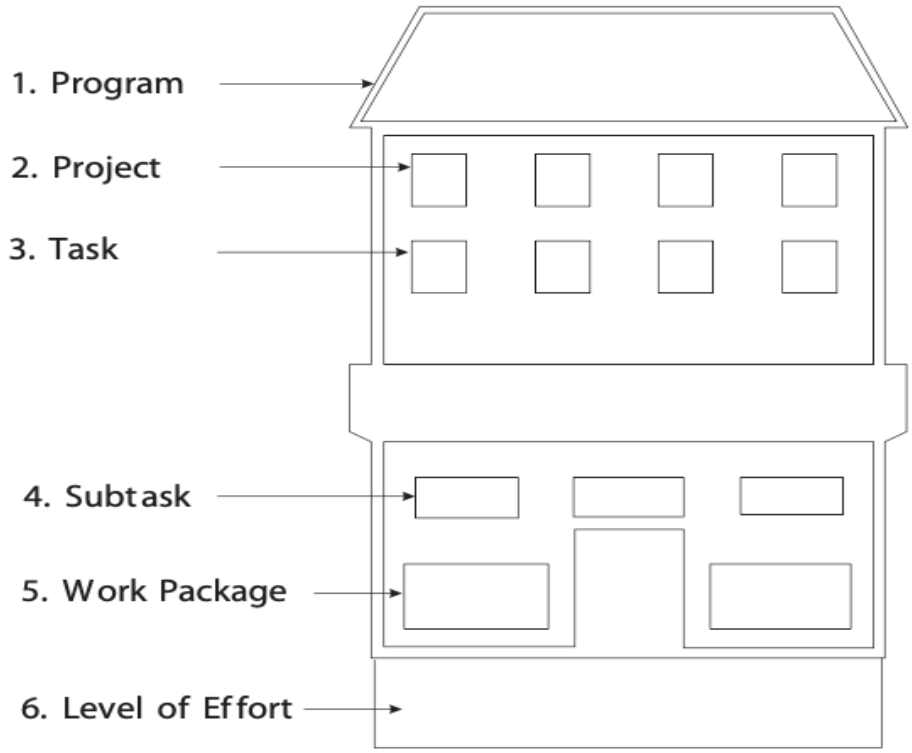
A work breakdown structure *does not show the sequence in which work is performed!* Such sequencing is determined when a schedule is developed.

The typical WBS has three to six levels, and these can be named as shown in Figure 6-2. It is, of course, possible to have projects that require a lot more levels. Twenty levels is considered to be the upper limit, and that is a huge project. Note that level 1 is called the *program* level. The difference between a program and a project is just one of degree.

An example of a program is the development of an airplane. For example, the WBS for the program might be drawn as shown in Figure 6-3. Notice that the engine, wing, and avionics are large enough jobs to be called projects in their own right. In fact, the program manager's job is to make sure that the projects are all properly integrated. The engine mounts on the wing, so, somewhere in the structure to develop the engine, there will be an activity called "Design wing mounts." And for the wing, there will be an activity called "Design engine mounts." If these are not coordinated properly, you will wind up with an engine that won't mount on the wing. The job of coordinating these is called *system integration*.

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Figure 6-2. WBS level names.



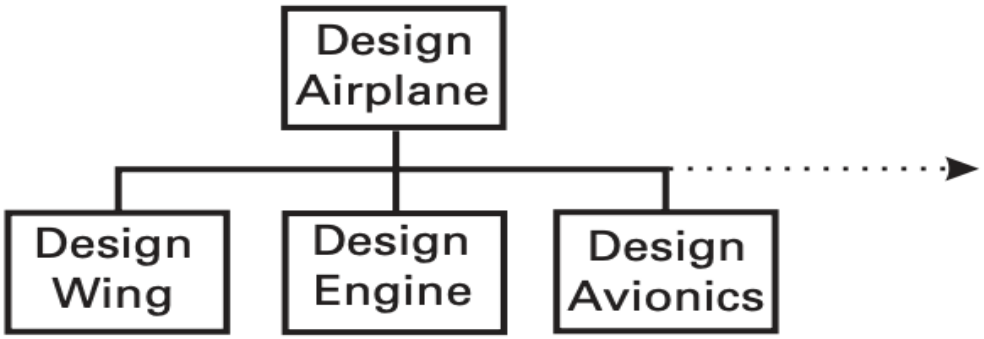
Guidelines for Developing the WBS

One important question in constructing a WBS is "When do you stop breaking down the work?" The general guideline is that you stop when you reach a point where either you can estimate time and cost to the desired degree of accuracy or the work will take an amount of time equal to the smallest units you want to schedule. If, for instance, you want to schedule to the nearest day, you break down the work to the point where tasks take about a day to perform. If you are going to schedule to the nearest hour, then you stop when task durations are in that range.

Stop breaking down work when you reach a low enough level to do an estimate of the desired accuracy.

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Figure 6-3. Partial WBS.



Remember the rule that the people who must do the work should participate in planning it? That applies here. Usually a core group identifies top-level parts of the WBS; those parts are further refined by other members of the team and then integrated to obtain the entire WBS.

One important point: the WBS should be developed before the schedule. In fact, the WBS is the device that ties the entire project together. It allows the manager to assign resources and to estimate time and cost and shows the scope of the job in graphic form. Later, as the project is tracked, the work can be identified as falling in a particular box in the WBS.

The WBS should always be developed before the schedule is worked out, but without trying to identify the sequence of activities.

There is at least one software package, SuperProject Expert™, that prints a WBS after schedule data have been entered. That is a nice feature, since it gives a graphically attractive WBS, but the rough drawing should be made before you use the scheduling software. The reason is quite simple: Until everyone has agreed that all tasks have been identified, it is misleading to develop a schedule. You cannot be sure that the critical path identified by a partial schedule will be the same for the full schedule.

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There are a number of approaches to developing the WBS. Ideally, you proceed top-down, following development of a good problem statement and mission statement. As I have mentioned, however, the mind does not always operate in such nice, linear fashion; as you develop the WBS, you may sometimes find that it helps you to understand the job better. For that reason, I am not a purist about doing things in a specific order. You do what works best for you.

A WBS does not have to be symmetrical. All paths do not have to go down to the same level.

The WBS does not have to be symmetrical. That is, all paths need not be broken down to level 6 (or whatever level you stop at). Since the rule is to break work down to a level sufficient to achieve the estimating accuracy you desire, one path may take six levels, while another may need only three.

Uses of the WBS

As I have said, the WBS is a good way to show the scope of a job. If you have ever given someone an estimate for project cost or time and seen the person's horrified look, you know that the person is seeing the project in her mind as much simpler than it is. When you show a project in WBS form, it is clear to most individuals why the job costs so much. In fact, I have had the experience of finding the planning group members themselves overwhelmed by the complexity and magnitude of the WBS. If it impresses them, think of its impact on an outsider.

The WBS is a good way to portray the scope of a project.

Assigning responsibility for tasks is another important use of the WBS. Each task to be performed should be assigned to a particular person who will be responsible for its completion. These assignments can then be listed on a separate form, often called a responsibility chart (see Figure 6-4).

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Figure 6-4. Responsibility chart.

Linear Responsibility Chart												
Project:	Date Issued:						Sheet Number:			of		
Manager:	Date Revised:						Revision No.			File: LRCFORM.61		
	Project Contributors											
Task Descriptions												
CODES: 1 = ACTUAL RESPONSIBILITY; 2 = SUPPORT; 3 = MUST BE NOTIFIED; BLANK = NOT INVOLVED												

Estimating Time, Costs, and Resources

Once the work is broken down, you can estimate how long it will take. But how? Suppose I ask you how long it will take to sort a standard deck of playing cards that has been thoroughly shuffled into numerical order by suit. How would you answer that question?

The most obvious way would be to try the task several times and get a feeling for it. But if you didn't have a deck of cards handy, you would probably think about it, *imagine* how long it would take, and give me an answer. People generally give me answers ranging from two minutes to ten minutes. My tests indicate that about three minutes is average for most adults.

An estimate can be made only by starting with the assumption that a certain resource will be assigned.

Suppose, however, we gave the cards to a child about four or five years old. It might take a lot longer, since the child would not be that familiar with the sequence in

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which cards are ordered and perhaps not yet even that comfortable with counting. So we must reach a very important conclusion: You cannot do a time or cost estimate without considering who will actually perform the task. Second, you must base the estimate on historical data or a mental model. Historical data are best.

Parkinson's Law: Work expands to fill the time allowed.

Generally, we use average times to plan projects. That is, if it takes three minutes on average for adults to sort a deck of cards, I would use three minutes as my estimate of how long it will take during execution of my project. Naturally, when I use averages, in reality some tasks will take longer than the time allowed, and some should take less. Overall, however, they should *average out.*

That is the idea, anyway. Parkinson's Law discredits this notion, however. Parkinson said that work always expands to fill the time allowed. That means that tasks may take longer than the estimated time, but they almost never take less. One reason is that when people find themselves with some time left, they tend to refine what they have done. Another is that people fear that if they turn work in early, they may be expected to do the task faster the next time or that they may be given more work to do.

We must be careful not to penalize workers who perform better than expected by loading them down with excessive work.

This is a very important point: If people are penalized for performing better than the target, they will quit doing so. We also have to understand *variation*. If the same person sorts a deck of cards over and over, we know the sort times will vary. Sometimes it will take two minutes, while other times it will take four. The average may be three, but we may expect that half the time it will take three minutes or less and half the time it will take

An exact estimate is an oxymoron!

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Fundamentals of Project Management 20/05/2021, 15:37

three minutes or more. Very seldom will it take *exactly* three minutes.

The same is true for *all* project tasks. The time it takes to perform them will vary, because of forces outside the person's control. The cards are shuffled differently every time. The person's attention is diverted by a loud noise outside. He drops a card while sorting. He gets tired. And so on.

Can you get rid of the variation? No way.

Can you reduce it? Yes—through practice, by changing the process by which the work is done, and so on. But it is important to note that the variation will always be there, and we must recognize and accept it.

The Hazards of Estimating

Consider the case of Karen. One day, her boss stopped by her desk at about one o'clock. "Need for you to do an estimate for me," he told her. "Promised the Big Guy I'd have it for him by four o'clock. You with me?"

Karen nodded and gave him a thin smile. The boss described the job for her. "Just need a ballpark number," he assured her and drifted off.

Given so little time, Karen could compare the project her boss described only to one she had done about a year before. She added a little for this and took a little off for that, put in some contingency to cover her lack of information, and gave the estimate to the boss. After that, she forgot all about the job.

Two months passed. Then the bomb was dropped. Her boss appeared, all smiles. "Remember that estimate you did for me on the xyz job?"

She had to think hard to remember, but, as her boss droned on, it came back to her. He piled a big stack of specifications on her desk. "It's your job now," he told her and drifted off again into manager dreamland.

As she studied the pile of paper, Karen felt herself growing more concerned. There were significant differences between this set of specs and what her boss had told her when she did the estimate. "Oh, well, I'm sure he knows that," she told herself.

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Finally, she managed to work up a new estimate for the job on the basis of the real specs. It was almost 50 percent higher than the ballpark figure. She checked her figures carefully, assured herself that they were correct, and went to see her boss.

He took one look at the numbers and went ballistic. "What are you trying to do to me?" he yelled. "I already told the old man we would do it for the original figure. I can't tell him it's this much more. He'll kill me."

"But you told me it was just a ballpark number you needed," Karen argued. "That's what I gave you. But this is nothing like the job I quoted. It's a lot bigger."

"I can't help that," her boss argued. "I already gave him the figures. You'll have to find a way to do it for the original bid."

Naturally, you know the rest of the story. The job cost even more than Karen's new estimate. There was a lot of moaning and groaning, but, in the end, Karen survived. Oh, they did send her off to a course on project management—hoping, no doubt, that she would learn how to estimate better in the future.

One of the primary causes of project failures is that ballpark estimates become targets.

Here are some guidelines for documenting estimates:

- Show the percent tolerance that is likely to apply.
- Tell how the estimate was made and what assumptions were used.
- Specify any factors that might affect the validity of the estimate (such as whether the estimate will still be valid in six months).

Could you fault Karen for anything? Well, perhaps. If she failed to tell the boss that a ballpark estimate might have a tolerance of perhaps ±25 percent but that the margin of error could range from −10 percent to +100 percent, then she allowed him to think that the estimate was better than it was. Also, she should have documented all working assumptions, explaining how she

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did the estimate, what project she had used for comparison, and so on. Then, if management still pulled a whammy on her, at least she would have had some protection. In fact, it is impossible to make sense of any estimate unless these steps are taken, so they should be standard practice.

Consensual Estimating

In recent years, a new method of estimating knowledge work has been developed that seems to work better than older techniques. Rather than have individuals estimate task durations, the new method asks at least three people to estimate each activity in the project that they know something about. They do this without discussing their ideas with one another. They then meet to find out what they have put on paper. In a typical situation, there may be a range of times, such as, for example, ten days, twelve days, and thirty days, in which two of the estimates are close together, but one is very different. How do you handle the discrepancy?

The best approach is to discuss what each person was considering when he made the estimate. It may be that the person who put down thirty days was thinking about something that the other two had overlooked. Or, conversely, the other two might convince the thirty-day person that his number is way too high and get him to come down to a figure nearer their estimates. In any case, they try to arrive at a number that they all can support. This is called *consensus*.

There are three advantages to this approach. First, no one person is on the hook for the final number. Second, inexperienced people learn to estimate from those more experienced. Third, several people are likely to collectively consider more issues than any one person would do working alone. For that reason, you are more likely to get an accurate estimate, although it is important to remember that it is still by definition not exact!

Improving Estimating Ability

People cannot learn unless they receive feedback on their performance. If you went out every day and ran one hundred yards,

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trying to improve your speed, but you never timed yourself, you would have no idea whether you were getting better or worse. You could be doing something that slowed you down, but you wouldn't know it. In the same way, if you estimate task durations but never record the actual time it takes to do the task, you are never going to get better at estimating. Furthermore, you have to track progress by recording times daily. If you record times once a week, I can promise you that you will be just guessing, and that won't be helpful.

Key Points to Remember

- Do not try to work out sequencing of activities when you develop a WBS. You will do that when you develop a schedule.
- A WBS ties the entire project together. It portrays scope graphically, allows you to assign resources, permits you to develop estimates of time and costs, and thus provides the basis for the schedule and the budget.
- An estimate is a *guess*, and an exact estimate is an *oxymoron*!
- Be careful that ballpark estimates don't become targets.
- Consensual estimating is a good way to deal with activities for which no history exists.
- No learning takes place without feedback. Estimate; then track your actual time if you want to improve your estimating ability.

Exercise

Following is a list of tasks to be performed in preparation for a camping trip. Draw a WBS that places the tasks in their proper relationship to one another. The solution is contained in the Answers section.

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- Arrange for supplies and equipment.
- Select campsite.
- Make site preparations.
- Make site reservation.
- Arrange time off from work.
- Select route to site.
- Prepare menu for meals.
- Identify source of supplies and equipment.
- Load car.
- Pack suitcases.
- Purchase supplies.
- Arrange camping trip (project).

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CHAPTER 7

Scheduling Project Work

One of the primary features that distinguishes project management from general management is the special attention to scheduling. Remember from Chapter 1 that Dr. J. M. Juran says a project is a problem scheduled for solution.

Project management is not just scheduling.

Unfortunately, some people think that project management is nothing but scheduling, and this is incorrect. Scheduling is just one of the tools used to manage jobs and should not be considered the primary one.

People today tend to acquire scheduling software, of which there is an abundance, and think that will make them instant project managers. They soon find that that idea is wrong. In fact, it is nearly impossible to use the software effectively unless you understand project management (and scheduling methodology in particular).

Suggestion: Whatever scheduling software you choose, get some professional training on how to use it.

I do have one suggestion about soft-

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ware. Whatever you pick, get some professional training on how to use it. In the early days of personal computers, there was a pretty significant difference between the low-end and the high-end software that was available. The low-end packages were pretty easy to use, whereas the high-end ones were not. The gap between low- and high-end software has closed to the point that this is no longer true. They are *all* difficult to use now, and the training materials (tutorials and manuals) that come with the software are often not very good. In addition, it is hard to find time to work through a tutorial without being interrupted several times, which means that self-learning is difficult. The most efficient way is to take a class.

Do check out the instructor's knowledge of project management before choosing which class to take. Some of the people teaching the software know very little about project management itself, and, when you have questions, they can't answer them.

You should expect to spend from two to three days of classroom time becoming really proficient with the software. That is still a good investment, considering the time the software can save you in the long run.

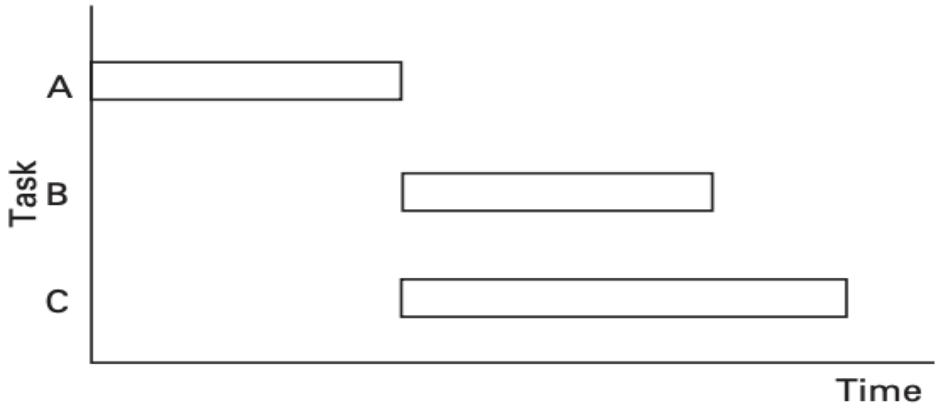
A Brief History of Scheduling

Until around 1958, the only tool for scheduling projects was the bar chart (see Figure 7-1). Because Henry Gantt developed a complete notational system for showing progress with bar charts, they are often called Gantt charts. They are simple to construct and read and remain the best tool to use for communicating to team members what they need to do within given time frames. Arrow diagrams tend to be too complicated for some teams. Nevertheless, it is often helpful to show an arrow diagram to the people doing the work so that they understand interdependencies and why it is important that they complete certain tasks on time.

Bar charts do have one serious drawback—it is very difficult to determine the impact of a slip on one task on the rest of the

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Figure 7-1. Bar chart.



project (e.g., if Task A in Figure 7-1 gets behind, it is hard to tell how this will affect the rest of the work). The reason is that the bar chart (in its original format) did not show the interdependencies of the work. (Contemporary software does show links between bars, making them easier to read. The actual name for these bar charts is "time-line critical path schedules.")

To overcome this problem, two methods of scheduling were developed in the late 1950s and early 1960s, both of which use arrow diagrams to capture the sequential and parallel relationships among project activities. One of these methods, developed by Du Pont, is called *Critical Path Method* (CPM), and the other, developed by the U.S. Navy and the Booz Allen Hamilton consulting group, is called *Program Evaluation and Review Technique* (PERT). Although it has become customary to call all arrow diagrams PERT networks, strictly speaking the PERT method makes use of probability techniques, whereas CPM does not. In other words, with PERT it is possible to calculate the probability that an activity will be completed by a certain time, whereas that is not possible with CPM.

CPM: Critical Path Method

PERT: Program Evaluation and Review Technique

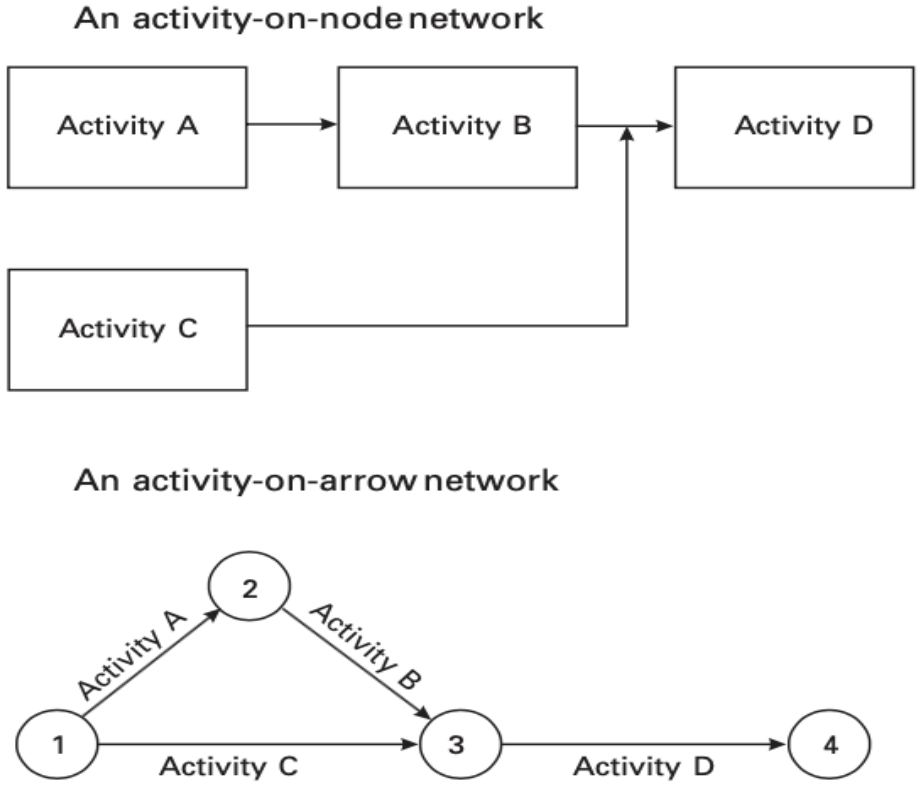
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Network Diagrams

To show the sequence in which work is performed, diagrams like those in Figure 7-2 are used. In these diagrams, Task A is done before B, while Task C is done in parallel with them.

The network in the bottom half of Figure 7-2 uses *activity-on-arrow* notation, in which the arrow represents the work being done and the circle represents an event. An event is *binary*; that is, it has either occurred or it has not. An activity, on the other hand, can be partially complete. Note that this is a special use of the word "event." We speak of a football game as an event, even though it spans time. In scheduling terminology, however, an *event* is a specific point in time where something has just started or has just been finished.

Figure 7-2. Arrow diagrams.



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The network in the top half of Figure 7-2 uses *activity-on-node* notation, which shows the work as a box or node, and the arrows show the sequence in which the work is performed. Events are not shown in activity-on-node networks unless they are *milestones*—points in the project at which major portions of the work are completed.

Why two forms of diagrams? Probably a tyranny to confuse the uninitiated. Actually, it simply happens that the schemes were developed by different practitioners.

Is one better than the other? No. They both get the same results in figuring out when work is supposed to be completed. Both forms are still used, although activity-on-node is used a bit more than the other, simply because much of today's personal computer software is programmed to use node notation.

What is the benefit of using either CPM or PERT? The main advantage is that you can tell whether it is possible to meet an important project completion date, and you can also tell exactly when various tasks must be finished in order to meet that deadline. Furthermore, you can tell which tasks have some leeway and which do not. In fact, both CPM and PERT determine the *critical path*, which is defined as the longest series of activities (that can't be done in parallel) and which therefore governs how early the project can be completed.

The *critical path* is the longest path through a project network. Because it has no slack, all activities on the critical path must be completed as scheduled, or the end date will begin to slip—one day for each day a critical activity is delayed.

The Reason for Scheduling

Naturally, the primary reason for scheduling a project is to ensure that the deadline can be met. Most projects have a deadline imposed. Furthermore, since the critical path method helps identify

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which activities will determine the end date, it also helps guide how the project should be managed.

However, it is easy to get carried away with scheduling and spend all of your time updating, revising, and so on. The scheduling software in use today should be viewed as a *tool*, and managers should not become slaves to the tool.

It is also very easy to create schedules that look good on paper but don't work in practice. The main reason is usually that resources are not available to do the work when it comes due. In fact, unless resource allocation is handled properly, schedules are next to useless. Fortunately, today's scheduling software handles resource allocation fairly well, but we leave discussion of the methods used to the software manuals. In this book, we simply examine how networks are used to show us where we need to manage.

One company found that when it stopped having people work on multiple projects, workers' productivity *doubled!*

I am often told that scope and priorities change so often in a given organization that it doesn't make sense to spend time finding critical paths. There are two points worth considering here. One is that if scope is changing often in a project, not enough time is being spent doing upfront definition and planning. Scope changes most often occur because something is forgotten. Better attention to what is being done in the beginning usually reduces scope creep.

Second, if priorities are changing often, management does not have its act together. Generally, the organization is trying to tackle too much work for the number of resources available. We all have "wish lists" of things we want to do personally, but we have to put some of them on hold until time, money, or both become available. The same is true of organizations. Experience shows that when you have individuals working on many projects, productivity suffers. One company found, as an example, that when it stopped having people work on multiple

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projects, employees' productivity *doubled!* That obviously is highly significant.

What does CPM have to do with this? Knowing where the critical path is in a project allows you to determine the impact on the project of a scope or priority change. You know which activities will be impacted most heavily and what might need to be done to regain lost time. In addition, managers can make informed decisions when you can tell them the impact of changes to the project. Thus, CPM can be an invaluable tool when used properly.

Definitions of Network Terms

ACTIVITY	An *activity* always consumes time and may also consume resources. Examples include paperwork, labor, negotiations, machinery operations, and lead times for purchased parts or equipment.
CRITICAL	A *critical activity* or event is one that must be achieved by a certain time, having no latitude (slack or float) whatsoever.
CRITICAL PATH	The *critical path* is the longest path through a network and determines the earliest completion of project work.
EVENTS	Beginning and ending points of activities are known as *events*. An event is a specific point in time. Events are commonly denoted graphically by a circle and may carry identity nomenclature (e.g., words, numbers, alphanumeric codes).
MILESTONE	*Milestones* are events that represent a point in a project of special significance. Usually, it is the completion of a major phase of the work. Project reviews are often conducted at milestones.
NETWORK	Networks are called "arrow diagrams." They provide a graphical representation of a project plan showing the relationships of the activities.

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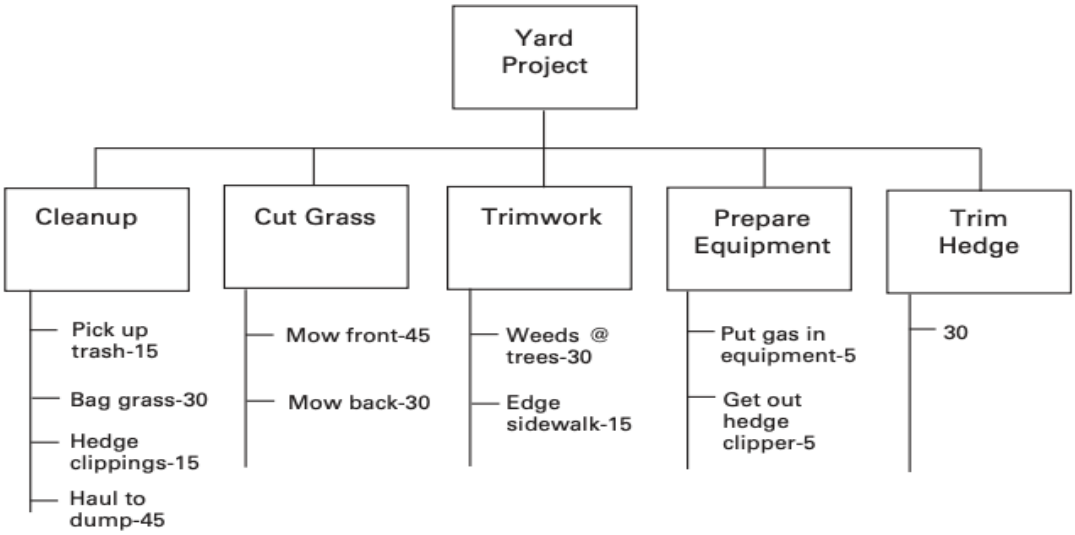
Constructing an Arrow Diagram

As was pointed out in Chapter 6, a work breakdown structure (WBS) should be developed before work on the project is scheduled. Also, we saw that a WBS can contain from two to twenty levels. To illustrate how a schedule is constructed from a WBS, we consider a simple job of maintaining the yard around a home. The WBS is shown in Figure 7-3.

In the case of this WBS, it is appropriate to schedule the tasks at the lowest level. However, this is not always true. Sometimes work is broken down to level 6 but only activities up to level 5 are entered into the schedule. The reason is that you may not be able to keep level 6 tasks on schedule. That is, you can't manage that tightly. So you schedule at a level that you can manage. This follows the general rule that you should never plan (or schedule) in more detail than you *can* manage. Some projects, such as overhauling a large power generator, are scheduled

Don't schedule in more detail than you can manage.

Figure 7-3. WBS to do yard project.



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in increments of hours. Others are scheduled in days, while some big construction jobs are scheduled to the nearest month.

While planning in too much detail is undesirable, if you plan in too little detail, you might as well not bother. As a practical example, a manager told me that his staff wanted to create schedules showing tasks with twenty-six-week durations. He protested that the staff would never complete such schedules on time. They would *back-end load* them, he argued.

What he meant was that there is a lot of security in a twenty-six-week task. When the start date comes, if the person doing the task is busy, she might say, "I can always make up a day on a twenty-six-week activity. I'll get started tomorrow." This continues until she realizes she has delayed too long. Then there is a big flurry of activity as she tries to finish on time. All the work has been pushed out to the end of the twenty-six-week time frame.

A good rule of thumb to follow is that no task should have a duration much greater than four to six weeks. A twenty-six-week task can probably be broken down into five or six subtasks. Such a plan generally keeps people from back-end loading.

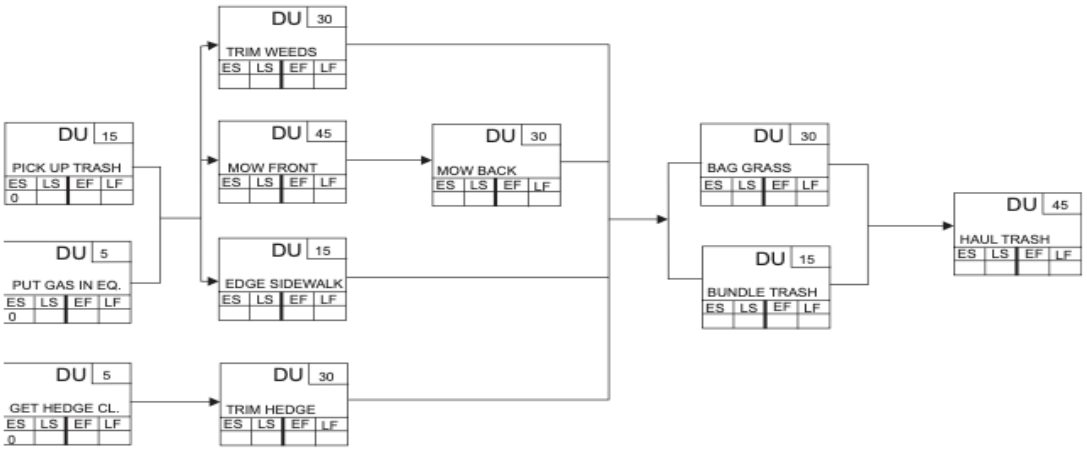
A good rule of thumb to follow is that no task should have a duration much greater than four to six weeks. For knowledge work, durations should be in the range of one to three weeks, because knowledge work is harder to track than tangible work.

There are two ways you can develop a schedule. One is to begin at the end and work back until you arrive at the beginning. The second method is to start at the beginning and work toward the end. Usually, it is easiest to start at the beginning.

The first step is to decide what can be done first. Sometimes, several tasks can start at the same time. In that case, you simply draw them side by side and start working from there. Note the

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Figure 7-4. CPM diagram for yard project.



progression in the diagram in Figure 7-4. It sometimes takes several iterations before the sequencing can be worked out completely.

This small project might be thought of as having three phases: *preparation*, *execution*, and *cleanup*. There are three preparation tasks: *pick up trash*, *put gas in equipment*, and *get out hedge clipper*. The cleanup tasks include *bagging grass*, *bundling clippings*, and *hauling trash* to the dump.

Schedules should be developed according to what is logically possible, and resource allocation should be done later. This will yield the optimum schedule.

In doing this schedule diagram, I have followed a rule of scheduling, which is to *diagram what is logically possible, then deal with resource limitations*. For a yard project, if I have no one helping me, then there really can be no parallel paths. On the other hand, if I can enlist help from the family or neighborhood youth, then parallel paths are possible, so this rule says go ahead and schedule *as if* it were possible to get help. This is especially important to remember in a work setting, or you will never get a schedule put together. You will be worrying about who will be available to do the work and end up in analysis paralysis.

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Another rule is to keep all times in the same increments. Don't mix hours and minutes—schedule everything in minutes, then convert to hours and minutes as a last step. For this schedule, I have simply kept everything in minutes.

I suggest that you draw your network on paper and check it for logical consistency before entering anything into a computer scheduling program. If the network has logical errors, the computer will just give you a *garbage-in, garbage-out* result, but it will look impressive, having come from a computer.

Another rule is to keep all times in the same increments.

It is also important to remember that there is usually no *single* solution to a network problem. That is, someone else might draw the arrow diagram a bit differently than you have done. There may be parts of the diagram that *have* to be done in a certain order, but often there is flexibility. For example, you can't deliver papers until you have printed them, so if the diagram showed that sequence, it would be wrong. The conclusion is that there is no single right solution, but a diagram can be said to be wrong if it violates logic.

It is hard to tell whether a network is absolutely correct, but it can be said to be wrong if logic is violated.

The network for the yard project could get a lot more complicated. You could have *edge front sidewalk* and *edge back sidewalk*. You could talk about trimming around trees in both front and back, and so on. But there is no need to make it too complicated. We don't usually try to capture *exactly* how we will do the work, just the gist of it.

The next step is to figure out how long it will take to do the job. Time estimates for each task are made by using history, taking into account how long each activity has taken in the past. Remember, though, that the estimate is valid only for the individual who is going to do the task. If my daughter, who is sixteen, does

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the lawn mowing using a push mower, it will probably take less time than if my son, who is only twelve, does the same task. In the following chapter, we see how to find the critical path through the network so that we can know how long it will take.

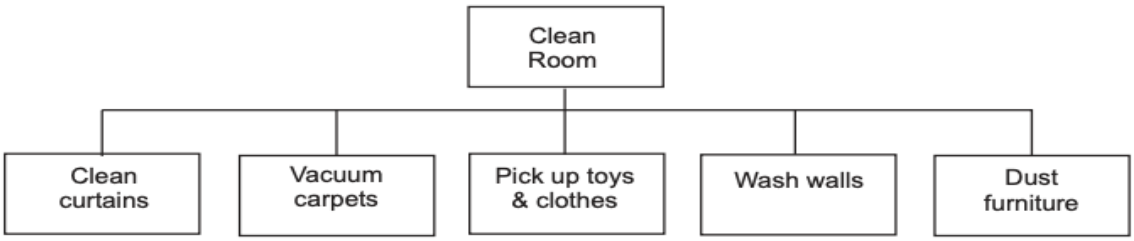
Key Points to Remember

- Project management is not just scheduling.
- Arrow diagrams allow an easier assessment of the impact of a slip on a project than is possible with Gantt charts.
- Schedule at a level of detail that can be managed.
- No task should be scheduled with a duration much greater than four to six weeks. Subdivide longer tasks to achieve this objective. Software and engineering tasks should be divided even further, to durations not exceeding one to three weeks.

Exercise

For the following WBS **(Figure 7-5)**, draw an arrow diagram. One solution is shown in the Answers section.

Figure 7-5. WBS to clean room.



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CHAPTER 8

Producing a Workable Schedule

Once a suitable network has been drawn, with durations assigned to all activities, it is necessary to determine where the longest path is in the network and to see whether it will meet the target completion date. Since the longest path through the project determines *minimum* project duration, any activity on that path that takes longer than planned will cause the end date to slip accordingly, so that path is called the *critical path.*

Schedule Computations

Normally, you would let a computer do these computations for you, so you may wonder why it is necessary to know how to do them manually. My belief is that unless you know how the computations are done, you do not fully understand the meanings of float, early and late dates, and so on. Further, you can easily fall prey to the *garbage-in, garbage-out* malady. So here is a brief treatment of how the calculations are done by the computer. (For most schedules, the computer has the added bonus of converting times to calendar dates, which is no easy task to do manually.)

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First, consider what we want to know about the project. If it starts at some *time = zero*, we want to know how soon it can be finished. Naturally, in most actual work projects, we have been told when we must be finished. That is, the end date is dictated. Furthermore, the start date for the job is often constrained for some reason: resources won't be available, specs won't be written, or another project won't be finished until that time. So scheduling usually means trying to fit the work between two fixed points in time. Whatever the case, we still want to know how long the project will take to complete; if it won't fit into the required time frame, then we will have to do something to shorten the critical path.

Failure to consider resource allocation in scheduling almost always leads to a schedule that cannot be achieved.

In the simplest form, network computations are made for the network on the assumption that activity durations are exactly as specified. However, activity durations are a function of the level of resources applied to the work, and, if that level is not actually available when it comes time to do the work, then the scheduled dates for the task cannot be met. It is for this reason that network computations must ultimately be made with resource limitations in mind. Another way to say this is that *resource allocation* is necessary to determine what kind of schedule is actually *achievable*! Failure to consider resources almost always leads to a schedule that cannot be met.

Initial schedule computations are made assuming that unlimited resources are available. This yields the best-case solution.

Still, the first step in network computations is to determine where the critical path is in the schedule and what kind of latitude is available for noncritical work, under *ideal conditions*. Naturally, the ideal situation is one in which unlimited resources

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are available, so the first computations made for the network are done without consideration of resource requirements. It is this method that is described in this chapter, and resource allocation methods are deferred to scheduling software manuals, as I said previously.

Network Rules

In order to compute network start and finish times, only two rules apply to all networks. These are listed as rules 1 and 2. Other rules are sometimes applied by the scheduling software itself. These are strictly a function of the software and are not applied to *all* networks.

Rule 1. Before a task can begin, all tasks preceding it must be completed.

Rule 2. Arrows denote the logical order of work.

Basic Scheduling Computations

Scheduling computations are illustrated using the network in Figure 8-1. First, let us examine the node boxes in the schedule. Each has the notations ES, LS, EF, LF, and DU. These mean:

ES = Early Start

LS = Late Start

EF = Early Finish

LF = Late Finish

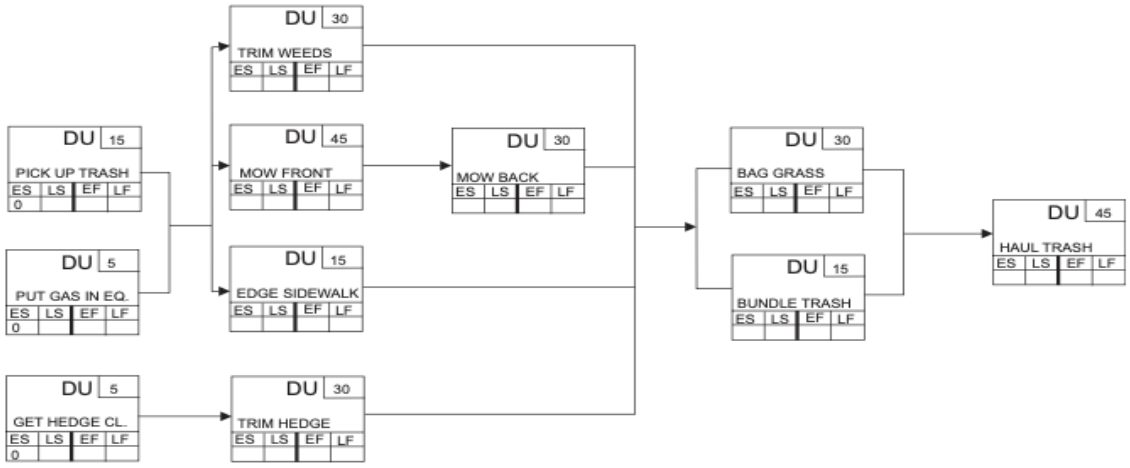
DU = Duration (of the task)

Forward-Pass Computations

Consider a single activity in the network, such as picking up trash from the yard. It has a duration of fifteen minutes. Assuming that it starts at *time = zero*, it can finish as early as fifteen minutes later. Thus, we can enter 15 in the cell labeled EF.

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Figure 8-1. Network to illustrate computation methods.



Putting gas in the mower and the weed whacker takes only five minutes. The logic of the diagram says that both of these tasks must be completed before we can begin trimming weeds, cutting the front grass, and edging the sidewalk. The cleanup task takes fifteen minutes, whereas the gas activity takes only five minutes. How soon can the following activities start? Not until the cleanup has been finished, since it is the longest of the preceding activities.

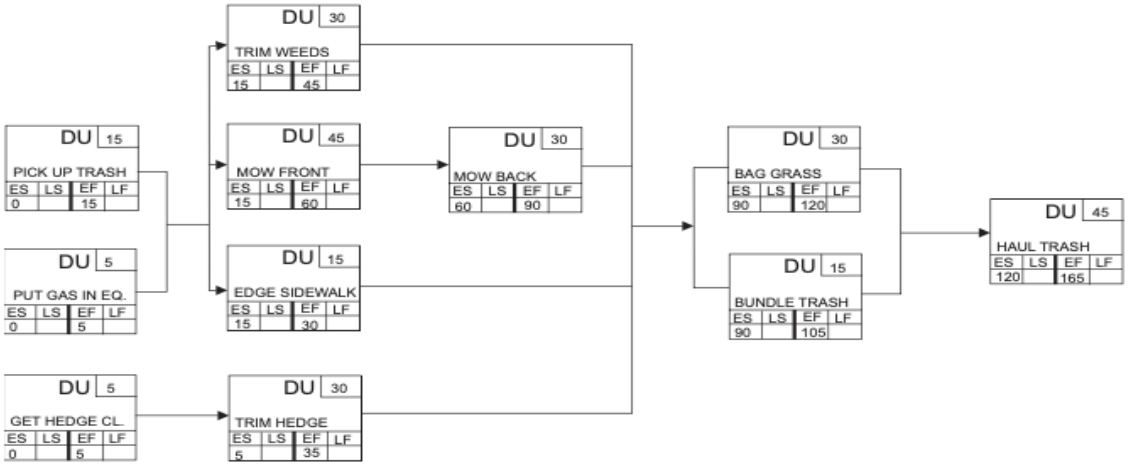
The Earliest Start for a task is the *latest* Late Finish of preceding tasks. That is, the longest path determines the earliest that a following task can be started.

In fact, then, the Early Finish for cleanup becomes the Early Start for the next three tasks. It is always true that the *latest Early Finish* for preceding tasks becomes the *Early Start* for subsequent tasks. That is, the longest path determines how early subsequent tasks can start.

Following this rule, we can fill in Earliest Start times for each task, as shown in Figure 8-2. This shows that the project will take a total of 165 minutes to complete, if all work is conducted exactly as shown. We have just performed what

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Figure 8-2. Diagram with EF times filled in.



are called *forward-pass computations* to determine Earliest Finish times for all activities. Computer programs do exactly the same thing and additionally convert the times to calendar dates, making quick work of the computations.

RULE: When two or more activities precede another activity, the earliest time when that activity can be started is the *longer* of the durations of the activities preceding it.

NOTE: The time determined for the end or final event is the earliest finish for the project in working time. Once weekends, holidays, and other breaks in the schedule are accounted for, the end *date* may be considerably later than the earliest finish in working time.

Backward-Pass Computations

A backward pass is made through the network to compute the *latest start and latest finish times* for each activity in the network. To do that, we must decide how late the project can finish. By convention, we generally don't want a project to end any later than its earliest possible completion. To stretch it out longer would be inefficient.

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We also won't insist (for now) that the project end earlier than the earliest possible finish calculated in the previous steps. If we want to finish earlier, we will have to redraw the network or shorten some activities (e.g., by applying more resources or working more efficiently). For now, we will accept the 165-minute working time and let it be the *Latest Finish* for the project.

When doing backward-pass calculations, always use the smallest number for the LF of previous activities.

If Hauling Away Trash has a Late Finish of 165 minutes and has a duration of 45 minutes, what is the latest that it could start? Clearly, if we subtract 45 from 165, we have 120 minutes, which is the Latest Start for the task. Proceeding in this manner, we get LS times for Bagging Grass and Bundling Clippings of 90 and 105 minutes, respectively. One of these two numbers must be the LF time for each of the preceding activities. Which one?

When an activity has no float, it is called *critical*, since failure to complete work as scheduled will cause the end date to slip.

Well, assume we try 105 minutes. If we do that, the schedule would say that Bagging Grass could start as late as 105 minutes, since subsequent tasks can begin as soon as preceding tasks are finished. But if we add 30 minutes for Bagging to the 105-minute ES time, we will finish at 135 minutes, which is later than the 120 minutes previously determined, and we will miss the 165-minute end time for the project.

Therefore, when we are doing *backward-pass calculations*, the *Latest Finish* for a preceding task will always be the *smallest* of the *Late Start* times for the subsequent tasks. (A simpler way to say this is: Always use the smallest number!)

RULE: When two or more activities follow another, the latest time that the preceding activity can be achieved is the *smaller* of the times.

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Now examine the path in Figure 8-3 that includes activities highlighted by bold lines. Each activity has the same ES/LS and EF/LF times. There is no *float* (or latitude for slippage) on this path. By convention, an activity with no float is called *critical*, and a total path with no float is called the *critical path*, which means that if any of the work on this path falls behind schedule, then the end date will slip accordingly. All of the activities that have ES/LS or EF/LF times that differ are said to have float. For example, Trim Weeds has an ES time of fifteen minutes and an LS time of sixty minutes, giving it forty-five minutes of float.

The final network is shown in Figure 8-3. Note that some tasks have the same EF and LF times, as well as the same ES and LS times. These tasks are on the *critical path*. In Figure 8-3, they are shown with bold outlines, to indicate exactly where the critical path lies.

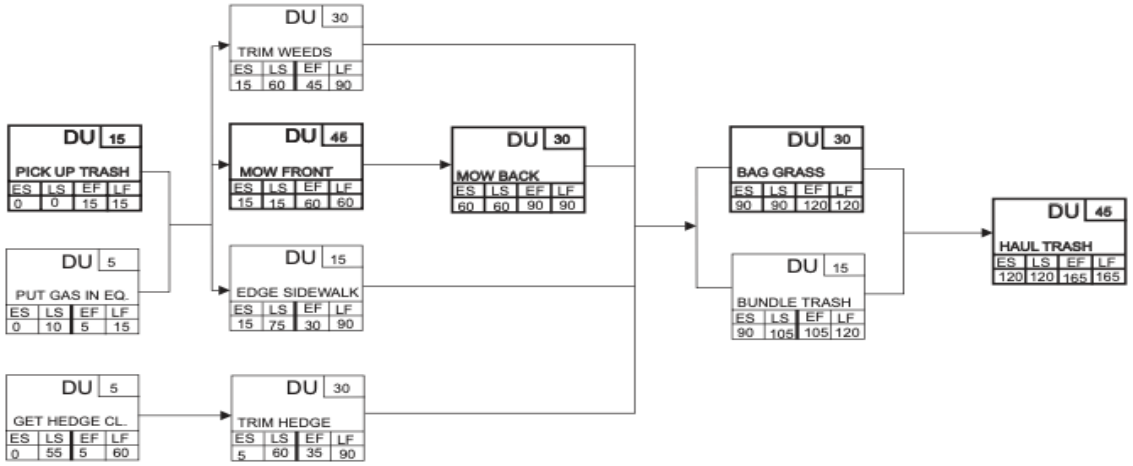
The critical path activities have no latitude. They must be completed as scheduled or the entire project will take longer than 165 minutes. Knowing where the critical path is tells a manager where his attention must be applied. The other tasks have latitude, or float. This does not mean that they can be ignored, but they have less chance of delaying the project if they encounter problems. The Edge Sidewalk task, for example, has an ES time of fifteen minutes and an LS time of seventy-five. The difference between the two is sixty minutes, which is the float for the task.

What good is the float? Well, we know we can start the task as late as seventy-five minutes into the job and still finish the project on time. If your son is doing this task, he can watch a sixty-minute television program during that time and still get his Edging task done on time.

Remember, too, that the times are all *estimates*. This means that tasks might take more or less than the scheduled time. So long as they do not take longer than the scheduled time plus the available float time, the job can be completed on time. Critical tasks, which have no float, must be managed in such a way that they take the scheduled time. This is usually done by adjusting the resources (effort) applied, either by assigning more resources or by working overtime (increasing resources in either case).

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Figure 8-3. Diagram showing critical path.



This is not always possible. Applying overtime often increases errors, leading to rework, which may mean that you don't get the job done any faster than if you had just worked a normal schedule. Furthermore, there is always a point of diminishing returns when you add *bodies* to a task. At some point, they just get in each other's way, actually slowing work down rather than speeding it. Note that overtime should be kept in reserve in case of problems, so it is never a good idea to schedule a project in a way that requires overtime just to meet the original schedule.

It is bad practice to schedule a project so that overtime is required to meet the schedule, since if problems are encountered, it may not be possible to work more overtime to solve them.

Another point of great importance: All members of the project team should be encouraged to keep float times in reserve as insurance against bad estimates or unforeseen problems. People tend to wait until the latest possible start time to start a task; then, when problems occur, they miss the end date. If there is no float left, when the task takes longer than originally planned,

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