CHAPTER

6

Project Activity Planning

PMBOK Guide

This chapter initiates our discussions of *Time* and *Quality Management,* PMBOK knowledge areas 3 and 5, respectively. Time management is an extensive topic which is further discussed in Chapters 8, 10, and 11. Quality management will also be discussed further in Chapter 12.

In the *Reader's Digest* (March 1998, p. 49) Peter Drucker is quoted on planning: "Plans are only good intentions unless they immediately degenerate into hard work." To make such a transformation possible is no easy task. Inadequate planning is a cliché in project management. Occasionally, articles appear in project management periodicals attesting to the value of good planning. Project managers pay little attention. PMs say, or are told, that planning "takes too much time," "customers don't know what they want," "if we commit we will be held accountable," and a number of similar weak excuses (Bigelow, 1998, p. 15). Tom Peters, well-known seeker of business excellence, was quoted in the *Cincinnati Post*: "Businesses [believe] a lot of dumb things. . . . The more time you spend planning, the less time you'll need to spend on implementation. Almost never the case! Ready. Fire. Aim. That's the approach taken by businesses I most respect." We strongly disagree and, as we will report below (and in Chapter 13), there is a great deal of research supporting the view that careful planning is solidly associated with project success—and none, to our knowledge, supporting the opposite position. On the other hand, sensible planners do not kill the plan with overanalysis. This leads to a well-known "paralysis by analysis." In an excellent article, Langley (1995) finds a path inbetween the two extremes.

Thus far, we have dealt with initiating a project. Now we are ready to begin the process of planning the work of the project in such a way that it may be translated into "hard work" that actually leads to a successful completion of the project. There are several reasons why we must use considerable care when planning projects. The primary purpose of planning, of course, is to establish a set of directions in sufficient detail to tell the project team exactly what must be done, when it must be done, what resources will be required to produce the deliverables of the project successfully, and when each resource will be needed.

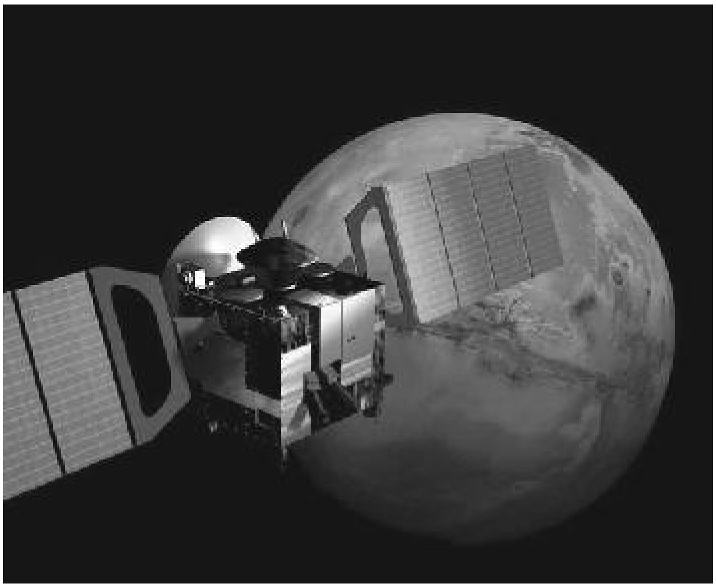
As we noted in Chapter 1, the deliverables (or scope, or specifications, or objectives) of a project are more than mere descriptions of the goods and/or services we promise to deliver to the client at a quality level that will meet client expectations. The scope of a project also includes the time and cost required to complete the project to the client's satisfaction.

The plan must be designed in such a way that the project outcome also meets the objectives of the parent organization, as reflected by the project portfolio or other strategic selection process used to approve the project. Because the plan is only an estimate of what and when things must be done to achieve the scope or objectives of the project, it is always carried out in an environment of uncertainty. Therefore, the plan must include allowances for risk and features that allow it to be *adaptive*, i.e., to be responsive to things that might disrupt it while it is being carried out. One such disruption—"scope creep," or the tendency of project objectives to be changed by the client, senior management, or individual project workers with little or no discussion with the other parties actively engaged in the work of the project—is particularly common in software projects. A formal process to change the project scope will be discussed further in Chapter 11. In addition, the plan must also contain methods to ensure its integrity, which is to say it must include means of controlling the work it prescribes.

Finally, and quite apart from the specification on output required by the project itself, the plan must include any constraints on activities and input materials proscribed by law and society. Among the many sources of outside constraints are the Food and Drug Administration, the Occupational Health and Safety Administration, various engineering societies, the PMI, Labor Unions, and the "Standards Practices" of many different industries. Such constraints

Project Management in Practice

Beagle 2 Mars Probe a Planning Failure



As the Beagle 2 Mars probe designed jointly by the European Space Agency and British National Space Center headed to Mars in December of 2003, contact was lost and it was never heard from again. In retrospect, it appears that inadequate project planning (and replanning) was to blame. Excessive pressure on time, cost, and weight compromised the mission right from the start. With insufficient public funding, the design team had to spend much of their time raising private funds instead of addressing difficult technical issues.

In addition, late changes forced the team to reduce the Beagle's weight from 238 pounds to 132 pounds! And when the three airbags failed to work properly in testing, a parachute design was substituted but inadequately tested due to lack of time.

A review commission recommended that in the future:

- Requisite financing be available at the outset of a project
- Formal project reviews be conducted on a regular basis
- Milestones should be established where all stakeholders reconsider the project
- Expectations of potential failure should be included in the funding consideration
- Robust safety margins should be included and funded for uncertainties

Source: Project Management Institute. "Mars or Bust," *PM Network,* October 2004, p. 1.

are meant to protect us all from unsafe or harmful structures, machines, rugs, equipment, services, and practices.

There is an extensive literature on project planning. Some of it is concerned with the strategic aspects of planning, being focused on the choice of projects that are consistent with the organization's goals. Another group of works is aimed at the process of planning individual projects, given that they have been chosen as strategically acceptable. Most fields have their own accepted set of project planning processes. Except for the names given to the individual processes, however, they are all similar, as we shall soon see. For example, in the field of Information Systems they refer to the standard "systems development cycle" for software projects, consisting of four or six or seven "phases," depending on which author is being consulted (e.g., see Rakos, 1990 or Boehm, 1988).

The purpose of planning is to facilitate later accomplishment. The world is full of plans that never become deeds. The planning techniques covered here are intended to smooth the path from idea to accomplishment. It is a complicated process to manage a project, and plans act as a map of this process. The map must have sufficient detail to determine what must be done next but be simple enough that workers are not lost in a welter of minutiae.

In the pages that follow we discuss a somewhat formal method for the development of a project plan. Almost all project planning techniques differ only in the ways they approach the process of planning. Most organizations, irrespective of the industry, use essentially the same processes for planning and managing projects, but they often call these processes by different names. What some call "setting objectives," others call "defining the scope" of the project, or "identifying requirements." What some call "evaluation," others call "test and validation." No matter whether the project is carried out for an inside or outside client, the project's "deliverables" must be "integrated" into the client's operating "system."

We have adopted an approach that we think makes the planning process straightforward and fairly systematic, but it is never as systematic and straightforward as planning theorists would like. At its best, planning is tortuous. It is an iterative process yielding better plans from not-so-good plans, and the iterative process of improvement seems to take place in fits and starts. The process may be described formally, but it does not occur formally. Bits and pieces of plans are developed by individuals, by informal group meetings, or by formalized planning teams (Paley, 1993), and then improved by other individuals, groups, or teams, and improved again, and again. Both the plans themselves and the process of planning should start simple and then become more complex. If the appropriate end product is kept firmly in mind, this untidy process yields a *project plan*. In this chapter we focus on designing the physical aspects of the project, defining what the project is supposed to accomplish, and who will have to do what for the project's desired output to be achieved. Here we describe the actual process of project planning. Organizing the work of the project, acquiring a project manager, and forming a project team are parts of project initiation. The project's budget and schedule are major parts of the project plan, but we delay discussion of them until Chapters 7 and 8. Indeed, what must be done to test and approve project outputs at both interim and final stages, and what records must be kept are both parts of the project plan and these are covered in later chapters, as is the part of the plan that covers ending the project. There is nothing sacrosanct about this sequence. It is simply in the order that these parts of the project plan tend to develop naturally.

Project activity plans may take many forms and in the coming pages we will mention several of these. A *project plan* should include the elements described in the next section. As we will see later, it should also include a record of all changes and adjustments that were made to the project during its life because it can then serve as the primary document of project termination, the *project history* (see Chapter 13). The project plan will include a complete set of schedules together with the associated resources and personnel needed to perform all of the tasks required to complete the project. For many purposes, we sometimes use an *action plan*, a portion of the project plan detailing the activities, their schedules, and resources, including personnel. Like a project plan, an action plan can take many forms and we illustrate a few of these somewhat later. The focus of an action plan, however, is on the schedule/resource/personnel elements of the activities and/or events required by the project. In the case of both the project plan and the action plan, we may use a partial version or enhanced version of either at any time, depending on the need.

In Section 6.4, we describe the project *work breakdown structure* (WBS) that is another (usually hierarchical) way of viewing the activities in the action plan. Often, the WBS consists of a simple list of all project activities with major activities broken down into subactivities, and these broken down still further. Schedules may also be shown, and resources, budget account numbers, and other specific aspects of the project may be displayed. The project *linear responsibility chart* (or *table*) is another specialized view of the action plan and focuses on who has what responsibility (e.g., performing, approving, communicating, supporting) associated with each project task. Many different forms may be used for both the WBS and responsibility charts.

It is appropriate to ask, "Why so many different ways of showing similar types of information?" As is true of so many things, tradition is probably the major reason. The project plan is usually a large and complex document. PMs need fast and simple ways of communicating specific kinds of information about their projects. Action plans, WBSs, and responsibility charts are simple and highly flexible ways of doing this.

6.1 INITIAL PROJECT COORDINATION AND THE PROJECT PLAN

It is crucial that the project's objectives be clearly tied to the overall mission, goals, and strategy of the organization, such as might be reflected in the project portfolio process. Senior management should delineate the firm's intent in undertaking the project, outline the scope of the project, and describe how the project's desired results reinforce the organization's goals. Without a clear beginning, project planning (and later progress) can easily go astray. It is also vital that a senior manager call and be present at the *project launch meeting*, an initial coordinating meeting, as a visible symbol of top management's commitment to the project.

The individual leading the launch meeting is first to define the scope of the project. The success of the project launch meeting is absolutely dependent on the existence of a well-defined set of objectives. Unless all parties to the planning process have a clear understanding of precisely what it is the project is expected to deliver, planning is sure to be inadequate or misguided. The precise nature of the scope statement depends on the nature of the project itself, and because of this, it reflects the fact that all projects are, to some extent, unique. For some useful comments on the scope statement, see Duncan (1994). We have more to say about project scope and its management in Chapters 4 and 11.

At the launch meeting, the project is discussed in sufficient detail that potential contributors develop a general understanding of what is needed. If the project is one of many similar projects, the meeting will be short and routine, a sort of "touching base" with other interested units. If the project is unique in most of its aspects, extensive discussion may be required.

It is useful to review the major risks facing the project during the launch meeting. The known risks will be those identified during the project selection process. These are apt to focus largely on the market reaction to a new process/product, the technical feasibility of an innovation, and like matters. The risk management plan for the project must be started at the launch meeting so that further risk identification can be extended to include the technology of the process/product, the project's schedule, resource base, and a myriad of other risks facing the project but not really identifiable until the project plan has begun to take form. In addition to the matters discussed below, one of the outcomes of the project planning process will be the formulation of the project's risk management group and the initial risk management plan that the group develops during the process of planning the project.

While various authors have somewhat different expectations for the project launch meeting (e.g., see Knutson, 1995; Martin et al., 1998), we feel it is important not to allow plans, schedules, and budgets to go beyond the most aggregated level (Level 1), possibly Level 2 (see Section 6.3 for a description of planning levels) if the project deliverables are fairly simple and do not require much interdepartmental coordination. To fix plans in more detail at this initial meeting tends to prevent team members from integrating the new project into their ongoing activities and from developing creative ways of coordinating activities that involve two or more organizational units. Worse still, departmental representatives will be asked to make "a ballpark estimate of the budget and time required" to carry out this first-blush plan. Everyone who has ever worked on a project is aware of the extraordinary propensity of preliminary estimates to metamorphose instantaneously into firm budgets and schedules. Remember that this is only one of a series of meetings that will be required to plan projects of more than minimal complexity. It is critical to the future success of the project to take the time required to do a technically and politically careful job of planning. "If this means many meetings and extensive use of participatory decision making, then it is well worth the effort" (Ford et al., 1992, p. 316).

Whatever the process, the outcome must be that: (1) technical scope is established (though perhaps not "cast in concrete"); (2) basic areas of performance responsibility are accepted by the participants; (3) any tentative delivery dates or budgets set by the parent organization are clearly noted; and (4) a risk management group is created. Each individual/unit accepting responsibility for a portion of the project should agree to deliver, by the next project meeting, a preliminary but detailed plan about how that responsibility will be accomplished. Such plans should contain descriptions of the required tasks, and estimates of the budgets (labor and resources) and schedules.

Simultaneous with these planning activities, the risk management group develops a risk management plan that includes proposed methodologies for managing risk, the group's budget, schedule, criteria for dealing with risk, and required reports. Further, necessary inputs to the risk data base are described and various roles and responsibilities for group members are spelled out, as noted in PMBOK (Project Management Institute, 2004).

PMBOK Guide

It must be emphasized that the process of managing risk is not a static process. Rather, it is ongoing, with constant updating as more risks are identified, as some risks vanish, as others are mitigated—in other words as reality replaces conjecture—and new conjecture replaces old conjecture.

The various parts of the project plan, including the risk management plan, are then scrutinized by the group and combined into a composite project plan. The composite plan, still not completely firm, is approved by each participating group, by the project manager, and then by senior organizational management. Each subsequent approval hardens the plan somewhat, and when senior management has endorsed it, any further changes in the project's scope must be made by processing a formal *change order*. If the project is not large or complex, informal written memoranda can substitute for the change order. The main point is that no *significant* changes in the project are made, without written notice, following top management's approval. The definition of "significant" depends on the specific situation and the people involved.

Project Management in Practice

Child Support Software a Victim of Scope Creep

In March 2003, the United Kingdom's Child Support Agency (CSA) started using their new £456 million ($860 million) software system for receiving and disbursing child support payments. However, by the end of 2004 only about 12 percent of all applications had received payments, and even those took about three times longer than normal to process. CSA thus threatened to scrap the entire system and withhold £1 million ($2 million) per month in service payments to the software vendor. The problem was thought to be due to both scope creep and the lack of a risk management strategy. The vendor claimed that the project was disrupted constantly by CSA's 2500 change requests, while CSA maintained there were only 50, but the contract did not include a scope management plan to help define what constituted a scope change request. And the lack of a risk management strategy resulted in no contingency or fallback plans in case of trouble, so when project delays surfaced and inadequate training became apparent, there was no way to recover.

Source: Project Management Institute. "Lack of Support," *PM Network*, January. 2005, p. 1.

The PM generally takes responsibility for gathering the necessary approvals and assuring that any changes incorporated into the plan at higher levels are communicated to, and approved by, the units that have already signed off on the plan. Nothing is as sure to enrage functional unit managers as to find that they have been committed by someone else to alterations in their carefully considered plans without being informed. Violation of this procedure is considered a betrayal of trust. Several incidents of this kind occurred in a firm during a project to design a line of children's clothing. The anger at this *change without communication* was so great that two chief designers resigned and took jobs with a competitor.

Because senior managers are almost certain to exercise their prerogative to change the plan, the PM should always return to the contributing units for consideration and reapproval of the plan as modified. The final, approved result of this procedure is the project plan, also sometimes known as the *baseline plan.* When the planning phase of the project is completed, it is valuable to hold one additional meeting, a postplanning review (Martinez, 1994). This meeting should be chaired by an experienced project manager who is not connected with the project (Antonioni, 1997). The major purpose of the postplanning review is to make sure that all necessary elements of the project plan have been properly developed and communicated.

Outside Clients

When the project is to deliver a product/service to an outside client, the fundamental planning process is unchanged except for the fact that the project's scope cannot be altered without the *client's* permission. A common "planning" problem in these cases is that marketing has promised deliverables that engineering may not know how to produce on a schedule that manufacturing may be unable to meet. This sort of problem usually results when the various functional areas are not involved in the planning process at the time the original proposal is made to the potential client. We cannot overstate the importance of a carefully determined set of *deliverables*, accepted by both project team and client (Martin et al., 1998).

Two objections to such early participation by engineering and manufacturing are likely to be raised by marketing. First, the sales arm of the organization is trained to sell and is expected to be fully conversant with all technical aspects of the firm's products/services. Further, salespeople are expected to be knowledgeable about design and manufacturing lead times and schedules. On the other hand, it is widely assumed by marketing (with some justice on occasion) that manufacturing and design engineers do not understand sales techniques, will be argumentative and/or pessimistic about client needs in the presence of the client, and are generally not "housebroken" when customers are nearby. Second, it is expensive to involve so much technical talent so early in the sales process—typically, prior to issuing a proposal. It can easily cost a firm more than $10,000 to send five technical specialists on a short trip to consider a potential client's needs, not including a charge for the time lost by the specialists. The willingness to accept higher sales costs puts even more emphasis on the selection process.

The rejoinder to such objections is simple. It is almost always cheaper, faster, and easier to do things right the first time than to redo them. When the product/service is a complex system that must be installed in a larger, more complex system, it is appropriate to treat the sale like a project, which deserves the same kind of planning. A great many firms that consistently operate in an atmosphere typified by design and manufacturing crises have created their own panics. (Software producers and computer system salespeople take note!) In fairness, it is appropriate to urge that anyone meeting customers face to face should receive some training in the tactics of selling.

Project Management in Practice

Shanghai Unlucky with Passengers

To speed passengers to Shanghai's new international airport, China built a magnetic levitation (maglev) train that runs every 10 minutes from Shanghai's business center to the Pudong International Airport. Reaching speeds over 300 miles an hour, it whisks people to the airport 20 miles away in less than 8 minutes. However, according to the vice-director of the train company, "We are not lucky with ticket sales." since the trains are virtually empty. The reason is because to meet the project's time deadline and budget, the train station was located 6 miles outside the city center, requiring lengthy public transportation to get there. So in spite of the technical, budget, and timing success of the project, it failed to meet the needs of the passengers. China is currently investigating extending the line to the downtown area, but that will be a much more expensive and time-consuming project.

Source: Project Management Institute. "A Derailed Vision," *PM Network,* April 2004, p. 1.

A potential remedy for these problems is the use of multifunctional teams, also known in this context as *concurrent engineering*. This latter term, born in the 1980s, has been applied to product/service development "where, typically, a product design and its manufacturing process are developed simultaneously, cross-functional groups are used to accomplish integration, and the voice of the customer is included in the product development process" (Smith, 1997, p. 67). Multifunctional teaming may also be applied to the software design and development process. In software projects it is critically important to keep the customer involved in the process of developing software requirements from the start of the project. Clients often ask such questions as "While you're at it, can you fix it so the software will also . . . ?" Software writers tend to focus on technical feasibility when dealing with these questions and not uncommonly fail to note the additional time and cost required. More will be said about multifunctional teaming later in this chapter. In any event, if multifunctional planning is not utilized, the risk management group should be informed. The group will have additional work to do.

A special approach developed by the software industry for determining the project performance requirements is called *requirements formulation*. Although intended for use with outside clients, it applies equally well for internal clients and for nonsoftware projects. As suggested above, it involves having the project team work with the customer to elaborate through "stories" how they see the "actor" who will use the software (project results) interacting with it. The actor may be a person, group, or even other computer systems. The project team members work with the client to elaborate the stories and better understand how the software will interact and operate, and all the various actions it needs to be able to take. The stories, often called "use cases," are broken into small enough units that the project work can be clearly understood; its effort, schedule, and cost determined; and any new technologies identified. Last, it is understood that the client's stories will change over time—some added, some changed, some dropped—and that the team will have to stay in touch with the client to determine how their needs have changed.

Project Plan Elements

Given the project plan, approvals really amount to a series of authorizations. The PM is authorized to direct activities, spend monies (usually within preset limits) request resources and personnel, and start the project on its way. Senior management's approval not only signals its willingness to fund and support the project, but also notifies subunits in the organization that they may commit resources to the project.

The process of developing the project plan varies from organization to organization, but any project plan must contain the following elements:

- ***Overview*** This is a short summary of the objectives and scope of the project. It is directed to top management and contains a statement of the goals of the project, a brief explanation of their relationship to the firm's objectives, a description of the managerial structure that will be used for the project, and a list of the major milestones in the project schedule.
- ***Objectives or Scope*** This contains a more detailed statement of the general goals noted in the overview section. The statement should include profit and competitive aims as well as technical goals.
- ***General Approach*** This section describes both the managerial and the technical approaches to the work. The technical discussion describes the relationship of the project to available technologies. For example, it might note that this project is an extension of work done by the company for an earlier project. The subsection on the managerial approach takes note of any deviation from routine procedure—for instance, the use of subcontractors for some parts of the work.
- ***Contractual Aspects*** This critical section of the plan includes a complete list and description of all reporting requirements, customer-supplied resources, liaison arrangements, advisory committees, project review and cancellation procedures, proprietary requirements, any specific management agreements (e.g., use of subcontractors), as well as the technical deliverables and their specifications, delivery schedules, and a specific procedure for changing any of the above. (Project change orders will be discussed in Chapter 11.) Completeness is a necessity in this

section. If in doubt about whether an item should be included or not, the wise planner will include it.

- ***Schedules*** This section outlines the various schedules and lists all milestone events. Each task is listed, and the estimated time for each task should be obtained from those who will do the work. The projected baseline schedule is constructed from these inputs. The responsible person or department head should sign off on the final, agreed-on schedule.
- ***Resources*** There are two primary aspects to this section. The first is the budget. Both capital and expense requirements are detailed by task, which makes this a *project budget* (discussed further in Chapter 7). One-time costs are separated from recurring project costs. Second, cost monitoring and control procedures should be described. In addition to the usual routine elements, the monitoring and control procedures must be designed to cover special resource requirements for the project, such as special machines, test equipment, laboratory usage or construction, logistics, field facilities, and special materials.
- ***Personnel*** This section lists the expected personnel requirements of the project. Special skills, types of training needed, possible recruiting problems, legal or policy restrictions on work force composition, and any other special requirements, such as security clearances, should be noted here. (This reference to “security” includes the need to protect trade secrets and research targets from competitors as well as the need to protect the national security.) It is helpful to time-phase personnel needs to the project schedule. This makes clear when the various types of contributors are needed and in what numbers. These projections are an important element of the budget, so the personnel, schedule, and resources sections can be cross-checked with one another to ensure consistency.
- ***Risk Management Plans*** This covers potential problems as well as potential lucky breaks that could affect the project. Sometimes it is difficult to convince planners to make a serious attempt to anticipate potential difficulties or benefits. One or more issues such as subcontractor default, unexpected technical breakthroughs, strikes, hurricanes, new markets for our technology, tight deadlines and budgets, and sudden moves by a competitor are certain to occur—the only uncertainties are which, when, and their impact. In fact, the timing of these disasters and benefits is not random. There are times in the life of every project when progress depends on subcontractors, the weather, or timely technical successes. Plans to deal with favorable or unfavorable contingencies should be developed early in the project’s life. Some PMs avoid dealing with risk because “Trying to list everything that can go wrong gets everyone in a negative state of mind. I want my people to be positive!” Some PMs disdain this section of the plan on the grounds that crises and lucky breaks cannot be predicted. Further, they claim to be very effective firefighters. No amount of current planning can solve the current crisis, but preplanning may avert or mitigate some. As Zwikael et al. (2007) report, in high-risk projects better project planning improved success on four measures: schedule overrun, cost overrun, technical performance, and customer satisfaction. They conclude that improving the project plan is a more effective risk management approach than using the usual risk management tools.
- ***Evaluation Methods*** Every project should be evaluated against standards and by methods established at the project’s inception, allowing for both the direct and ancillary goals of the project, as described in Chapter 1. This section contains a brief description

of the procedure to be followed in monitoring, collecting, storing, and evaluating the history of the project.

These are the elements that constitute the project plan and are the basis for a more detailed planning of the budgets, schedules, work plan, and general management of the project. Once this basic plan is fully developed and approved, it is disseminated to all interested parties.

Before proceeding, we should make explicit that this formal planning process is required for relatively large projects that cannot be classified as "routine" for the organization. The time, effort, and cost of the planning process we have described is not justified for routine projects, for example, most plant or machine maintenance projects. Admittedly, no two routine maintenance projects are identical, but they do tend to be quite similar. It is useful to have a complete plan for such projects, but it is meant to serve as a template that can easily be modified to fit the specific maintenance project at hand. The template also can serve as a benchmark in a continuous improvement program.

Project Planning in Action

Project plans are usually constructed by listing the sequence of activities required to carry the project from start to completion. This is not only a natural way to think about a project; it also helps the planner decide the necessary sequence of things—a necessary consideration for determining the project schedule and duration. In a fascinating paper, Aaron and his colleagues (1993) describe the planning process used at a telecommunications firm.

Using a planning process oriented around the life-cycle events common for software and hardware product developers, they divide the project into nine segments:

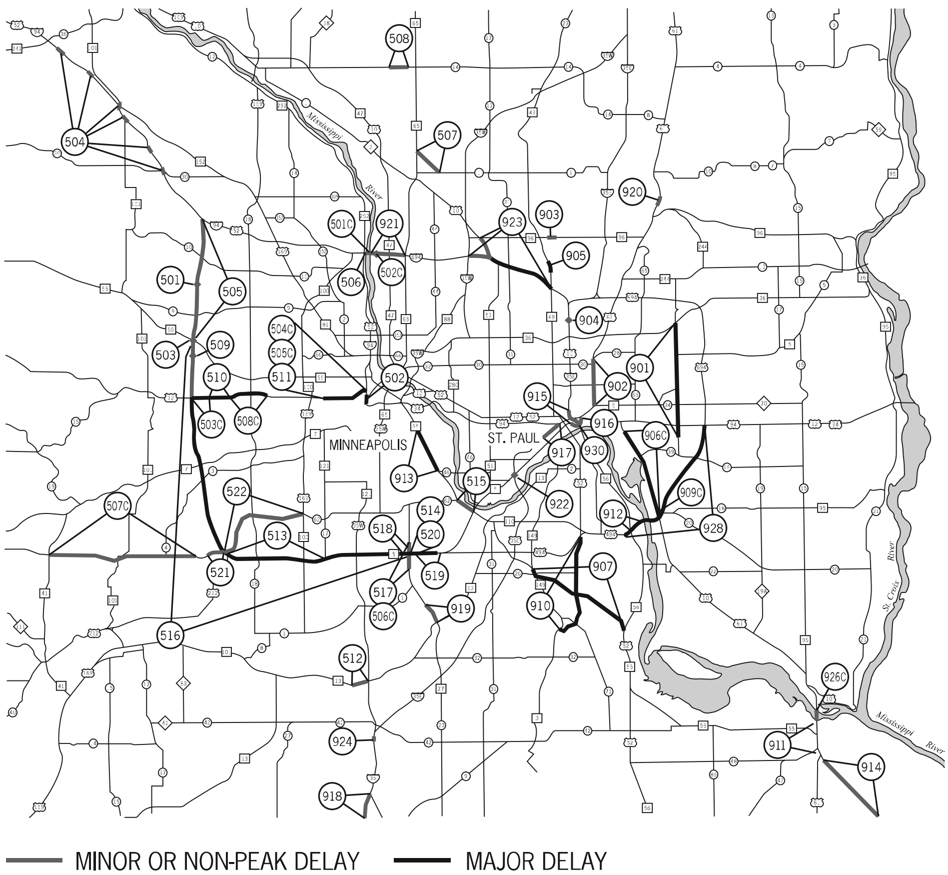
- Concept evaluation
- Requirements identification
- Design
- Implementation
- Test
- Integration
- Validation
- Customer test and evaluation
- Operations and maintenance

Each segment is made up of activities and milestones (significant events). As the project passes through each of the segments, it is subjected to a series of "quality gates" (also known as "phase gates," "toll gates," etc.) that must be successfully passed before proceeding to the next segment. Note that the planning process must pass through the quality gates as must the physical output of the project itself. For example, the requirements identification segment must meet the appropriate quality standards before the design segment can be started, just as design must be approved before implementation can begin. See Section 6.5 for more on this system.

Beginning in Chapter 1, we have argued that quality should be an inherent part of the project's specification/deliverables. The approach taken by Aaron et al. (1993) is a direct embodiment of our position. Indeed, it "goes us one better," by applying quality standards to the process of managing the project as well as to the project's deliverables.

Project Management in Practice

Minnesota DOT Project Planning



The Minnesota Department of Transportation (DOT) is responsible for facility construction and maintenance for highways, bridges, airports, waterways, railroads, and even bicycle paths. At any given time, there will be approximately 1100 projects—typically, highway improvements—in active development, with a turn-over of about 300 per year. These projects will range from \$50,000 paint jobs to multimillion dollar freeway interchanges. The computerized Project Management and Scheduling System (PMSS) used to manage these projects is based on a work breakdown structure detailing about 100 activities involving 75 functional groups, 40 of which are in-house groups and the rest being consultants.

The PMSS encompasses three major areas: scheduling, funding, and human resource planning. It allows planning, coordination, and control of the work progress and resource requirements for multiple projects over a multiyear time span, since projects may continue for up to four years in some cases. This integration offers the capability to relate work plans to funding availability as well as human resource availability. Conversely, resource use can be planned according to the construction project schedule. Other constraints can also be included in the system and its reports, such as avoiding projects that might overly congest a high-traffic area (see figure) or properly sequencing subprojects such as grading, surfacing, and finishing.

The PMSS system gives management a "big picture" perspective of what is happening in terms of workflow over time and geography. It has also enhanced the department's ability to answer questions about activities, funding, labor, and equipment, and to present reports in a variety of configurations to satisfy the needs of many different parties.

Source: R. Pearson, "Project Management in the Minnesota Department of Transportation," *PM Network,* November 1988.

6.2 SYSTEMS INTEGRATION

Systems integration (sometimes called *systems engineering* or *concurrent engineering*) is one part of *integration management*, discussed further in Section 6.5, and plays a crucial role in the performance aspect of the project. We are using this phrase to include any technical specialist in the science or art of the project who is capable of integrating the technical disciplines to achieve the customer's objectives, and/or integrating the project into the customer's system. As such, systems integration is concerned with three major objectives.

1. *Performance* Performance is what a system does. It includes system design, reliability, quality, maintainability, and repairability. Obviously, these are not separate, independent elements of the system, but are highly interrelated qualities. Any of these system performance characteristics are subject to overdesign as well as underdesign but must fall within the design parameters established by the client. If the client approves, we may give the client more than the specifications require simply because we have already designed to some capability, and giving the client an overdesigned system is faster and less expensive than delivering precisely to specification. At times, the aesthetic qualities of a system may be specified, typically through a requirement that the appearance of the system must be acceptable to the client.
2. *Effectiveness* The objective is to design the individual components of a system to achieve the desired performance. This is accomplished through the following guidelines:
   - Require no component performance specifications unless necessary to meet one or more systems requirements.
   - Every component requirement should be traceable to one or more systems requirements.
   - Design components for effective system performance, not the performance of subsystems.

   It is not unusual for clients or project teams to violate any or all of these seemingly logical dicta. Tolerances specified to far closer limits than any possible system requirement, superfluous "bells and whistles," and "off the shelf" components that do not work well with the rest of the system are so common they seem to be taken for granted by both client and vendor. The causes of these strange occurrences are probably associated with some combination of inherent distrust between buyer and seller, the desire to overspecify in order "to be sure," and the feeling that "this part will do just as well." As we saw in Chapter 4, these attitudes can be softened and replaced with others that are more helpful to the process of systems integration.

3. *Cost* Systems integration considers cost to be a design parameter, and costs can be accumulated in several areas. Added design cost may lead to decreased component cost, leaving performance and effectiveness otherwise unchanged. Added design cost may yield decreased production costs, and production cost may be traded off against unit cost for materials. Value engineering (or value analysis) examines all these cost trade-offs and is an important aspect of systems integration (Morris, 1979). It can be used in any project where the relevant cost trade-offs can be estimated. It is simply the consistent and thorough use of cost/effectiveness analysis.

Multifunctional teaming (see Section 6.5) is a way of achieving systems integration and, as such, may play a major role in the success or failure of any complex project. If a risky approach is taken by systems integration, it may delay the project. If the approach is too conservative, we forego opportunities for enhanced project capabilities or advantageous project economics. A good design will take all these trade-offs into account in the initial stages of the technical approach. A good design will also avoid locking the project into a rigid solution with little flexibility or adaptability in case problems occur later or changes in the environment demand changes in project performance or effectiveness. Multifunctional teams are also valuable for assessing and mitigating risk in the project, particularly in anticipating crises during the execution of the project (refer to the Directed Reading: "Planning for Crises in Project Management" at the end of this chapter).

The details of systems integration are beyond the scope of this book. The interested reader is referred to Blanchard et al. (2006). In any case, the ability to do systems integration/engineering depends on at least a minimal level of technical knowledge about most parts of the project. It is one of the reasons project managers are expected to have some understanding of the technology of the projects they head.

6.3 THE ACTION PLAN

In this and the following sections of this chapter, and in Chapters 7 and 8 on budgeting and scheduling, we move into a consideration of the details of the project. We need to know exactly what is to be done, by whom, and when. All activities required to complete the project must be precisely delineated and coordinated. The necessary resources must be available when and where they are needed, and in the correct amounts. Some activities must be done sequentially, but some may be done simultaneously. If a large project is to come in on time and within cost, a great many things must happen when and how they are supposed to happen. Yet each of these details is uncertain and thus each must be subjected to risk management. In this section, we propose a conceptually simple method to assist in sorting out and planning all this detail. It is a *hierarchical planning system*—a method of constructing an action plan and, as we will see shortly, a WBS. We have also named it the "*level planning process*."

To accomplish any specific project, a number of major activities must be undertaken and completed. Make a list of these activities in the general order in which they would occur. This is Level 1. A reasonable number of activities at this level might be anywhere between 2 and 20. (There is nothing sacred about these limits. Two is the minimum possible breakdown, and 20 is about the largest number of interrelated items that can be comfortably sorted and scheduled at a given level of aggregation.) Now break each of these Level l items into 2 to 20 tasks. This is Level 2. In the same way, break each Level 2 task into 2 to 20 subtasks. This is Level 3. Proceed in this way until the detailed tasks at a level are so well understood that there is no reason to continue with the work breakdown.

It is important to be sure that all items in the list are at roughly the same level of task generality. In writing a book, for example, the various chapters tend to be at the same level of generality, but individual chapters are divided into finer detail. Indeed, subdivisions of a chapter may be divided into finer detail still. It is difficult to overstate the significance of this simple dictum. It is central to the preparation of most of the planning documents that will be described in this chapter and those that follow.

The logic behind this simple rule is persuasive. We have observed both students and professionals in the process of planning. We noted that people who lack experience in planning tend to write down what they perceive to be the first activity in a sequence of activities, begin to break it down into components, take the first of these, break it further, until they have reached a level of detail they feel is sufficient. They then take the second step and proceed similarly. If they have a good understanding of a basic activity, the breakdown into detail is handled well. If they are not expert, the breakdown lacks detail and tends to be inadequate. Further, we noted that integration of the various basic activities was poor. An artist of our acquaintance explained: When creating a drawing, the artist sketches in the main lines of a scene, and then builds up the detail little by little over the entire drawing. In this way, the drawing has a “unity.” One cannot achieve this unity by drawing one part of the scene in high detail, then moving to another part of the scene and detailing it. He asked a young student to make a pen-and-ink sketch of a fellow student. Her progress at three successive stages of her drawing is shown in Figure 6-1.

Figure 6-1 The “level planning process.”

This illustrates the "level planning process." The PM will probably generate the most basic level (Level 1) and possibly the next level as well. Unless the project is quite small, the generation of additional levels will be delegated to the individuals or groups who have responsibility for doing the work. Maintaining the "level planning" discipline will help keep the plan focused on the project's deliverables rather than on the work at a subsystem level.

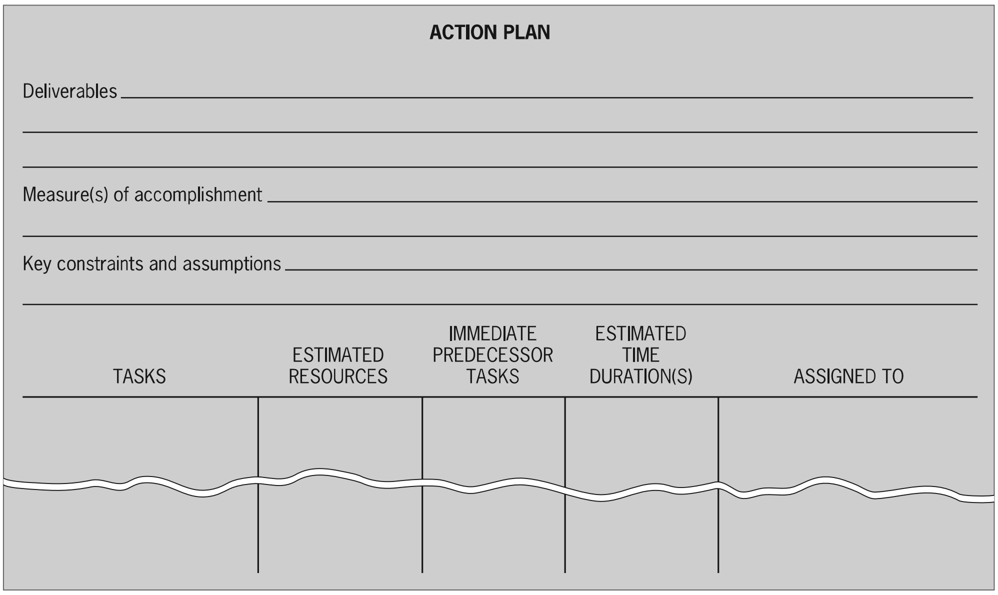
Some project deliverables may be time sensitive in that they may be subject to alteration at a later date when certain information becomes available. A political campaign is an example of such a project. A speech may be rewritten in whole or in part to deal with recently released data about the national economy, for instance. This describes a planning process that must be reactive to information or demands that change over time. This type of process is sometimes called "rolling wave planning." The overall structure of the reactive planning process still should be hierarchical.

Sometimes a problem arises because some managers tend to think of outcomes when planning and others think of specific tasks (activities). Many mix the two. The problem is to develop a list of both activities and outcomes that represents an exhaustive, nonredundant set of results to be accomplished (outcomes) and the work to be done (activities) in order to complete the project.

In this hierarchical planning system, the objectives are taken from the project plan. This aids the planner in identifying the set of required activities for the objectives to be met, a critical part of the action plan. Each activity has an outcome (event) associated with it, and these activities and events are decomposed into subactivities and subevents, which, in turn, are subdivided again.

Assume, for example, that we have a project whose purpose is to acquire and install a large machining center in an existing plant. In the hierarchy of work to be accomplished for the installation part of the project, we might find such tasks as "Develop a plan for preparation of the floor site" and "Develop a plan to maintain plant output during the installation and test period." These tasks are two of a larger set of jobs to be done. The task "...preparation of the floor site" is subdivided into its elemental parts, including such items as "Get specifics on machine center mounting points," "Check construction specifications on plant floor," and "Present final plan for floor preparation for approval." A form that may help to organize this information is shown in Figure 6-2. (Additional information about each element of the project will be added to the form later when budgeting and scheduling are discussed.) Figure 6-3 shows a partial action plan for a college "Career Day." (Clearly, Figure 6-3 is not complete. For example, the list of activities does not show such items as "setting and decorating the tables." In the interest of simplicity and in order to avoid doubling the length—and cost—of this book, the examples shown in this and following chapters are meant to be indicative, not exhaustive.)

A short digression is in order before continuing this discussion on action plans. The actual form the action plan takes is not sacrosanct. As we will show in this and the coming chapters, not even all elements of the action plan shown in Figure 6-2 may be shown in all cases. In some cases, for example, the amounts of specific resources required may not be relevant. In others, "due dates" may be substituted for activity durations. The appearance of an action plan will probably differ in different organizations, and may even differ between departments or divisions of the same organization (though standardization of format is usual, and probably desirable in any given firm). In some plans, numbers are used to identify activities; in others, letters. In still others, combinations of letters and numbers are used. In this chapter, we will illustrate several different forms of action plans drawn from "real life." Our purpose is not to confuse the reader, but to focus the reader's attention on the *content* of the plan, not its *form*.



ACTION PLAN

Deliverables

Measure(s) of accomplishment

Key constraints and assumptions

TASKS	ESTIMATED RESOURCES	IMMEDIATE PREDECESSOR TASKS	ESTIMATED TIME DURATION(S)	ASSIGNED TO

Figure 6-2 A form to assist hierarchical planning.

An action plan can also be represented by a simplified hierarchy, like the tree diagram in Figure 6-4, though this is more akin to the Work Breakdown Structure discussed in the next section. Professor Andrew Vazsonyi has called this type of diagram a *Gozinto chart*, after the famous, Italian mathematician Prof. Zepartzat Gozinto (of Vazsonyi's invention). Readers familiar with the Bill of Materials in a Materials Requirements Planning (MRP) system will recognize the parallel to nested hierarchical planning, or the basic organizational chart depicting the formal structure of an organization.

If the project does not involve capital equipment and special materials, estimates may not be necessary. Some projects require a long chain of tasks that are mostly sequential—for example, the real estate syndication of an apartment complex or the development and licensing of a new drug. Other projects require the coordination of many concurrent tasks that finally come together—for example, the design and manufacture of an aircraft engine or the construction of a house. Still others have the characteristics of both. An example of a plan to acquire a subsidiary is illustrated in Figures 6-5a and 6-5b. A verbal "action plan" was written in the form of a memorandum, Figure 6-5a, and was followed by the more common, tabular plan shown in Figure 6-5b. Only one page of a five-page plan is shown. The individuals and groups mentioned developed similar plans at a greater level of detail. (Names have been changed at the request of the firm.)

As we have noted several times, the importance of careful planning can scarcely be overemphasized. Pinto et al. (1987, 1988) developed a list of ten factors that should be associated with success in implementation projects. The factors were split into strategic and tactical clusters. Of interest here are the strategic factors:

1. *Project mission*. It is important to spell out clearly defined and agreed-upon objectives in the project plan.
2. *Top management support*. It is necessary for top managers to get behind the project at the outset and make clear to all personnel involved that they support successful completion.

ACTION PLAN

Objective Career Day				
Steps	**Responsibility**	**Time (weeks)**	**Prec.**	**Resources**
1. Contact Organizations				
a. Print forms	Secretary	6	–	Print shop
b. Contact organizations	Program manager	15	1.a	Word processing
c. Collect display information	Office manager	4	1.b	
d. Gather college particulars	Secretary	4	1.b	
e. Print programs	Secretary	6	1.d	Print shop
f. Print participants' certificates	Graduate assistant	8	–	Print Shop
2. Banquet and Refreshments				
a. Select guest speaker	Program manager	14	–	
b. Organize food	Program manager	3	1.b	Caterer
c. Organize liquor	Director	10	1.b	Dept. of Liquor Control
d. Organize refreshments	Graduate assistant	7	1.b	Purchasing
3. Publicity and Promotion				
a. Send invitations	Graduate assistant	2	–	Word processing
b. Organize gift certificates	Graduate assistant	5.5	–	
c. Arrange banner	Graduate assistant	5	1.d	Print shop
d. Contact faculty	Program manager	1.5	1.d	Word processing
e. Advertise in college paper	Secretary	5	1.d	Newspaper
f. Class announcements	Graduate assistant	1	3.d	Registrar's office
g. Organize posters	Secretary	4.5	1.d	Print shop
4. Facilities				
a. Arrange facility for event	Program manager	2.5	1.c	
b. Transport materials	Office manager	.5	4.a	Movers

Figure 6-3 Partial action plan for college "Career Day."

3. *Project's action plan*. A detailed, scheduled plan of the required steps in the implementation process needs to be developed, including all resource requirements (money, raw materials, staff, etc.).

Extensive empirical testing showed these factors to be required for implementation project success. (Tactical factors are also necessary for success, but they are not a consideration here.)

At this point, it might be helpful to sum up this section with a description of how the planning process actually works in many organizations. Assume that you, the PM, have been given responsibility for developing the computer software required to transmit a medical X-ray from one location to another over a telephone line. There are several

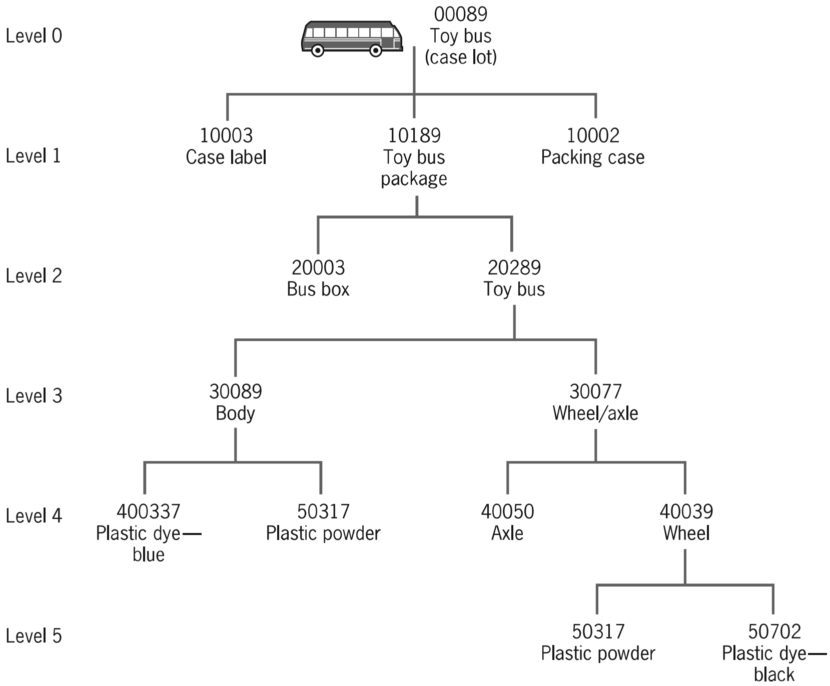


Figure 6-4 Gozinto chart for a toy bus. *Source*: Harris et al., 1981.

problems that must be solved to accomplish this task. First, the X-ray image must be translated into computer language. Second, the computerized image must be transmitted and received. Third, the image must be displayed (or printed) in a way that makes it intelligible to the person who must interpret it. You have a team of four programmers and a couple of assistant programmers assigned to you. You also have a specialist in radiology assigned part-time as a medical advisor.

Your first action is to meet with the programmers and medical advisor in order to arrive at the technical requirements for the project. From these requirements, the project mission statement and detailed specifications will be derived. (Note that the original statement of your "responsibility" is too vague to act as an acceptable mission statement.) The basic actions needed to achieve the technical requirements for the project are then developed by the team. For example, one technical requirement would be to develop a method of measuring the density of the image at every point on the X-ray and to represent this measurement as a numerical input for the computer. This is the first level of the project's action plan.

Responsibility for accomplishing the first level tasks is delegated to the project team members who are asked to develop their own action plans for each of the first level tasks. These are the second level action plans. The individual tasks listed in the second level plans are then divided further into third level action plans detailing how each second level task will be accomplished. The process continues until the lowest level tasks are perceived as "units" or "packages" of work.

Early in this section, we advised the planner to keep all items in an action plan at the same level of "generality" or detail. One reason for this is now evident. The tasks at any

MEMO

To allow Ajax to operate like a department of Instat by April 1, 1996, we must do the following by the dates indicated.

September 24
Ajax Management to be advised of coming under Instat operation. The Instat sales department will begin selling Ajax Consumer Division production effective Jan. 1, 1996. There will be two sales groups: (1) Instat, (2) Ajax Builder Group.

October 15
Instat Regional Managers advised—Instat sales department to assume sales responsibility for Ajax products to distribution channels, Jan. 1, 1996.

October 15
Ajax regional managers advised of sales changes effective Jan. 1, 1996.

October 15
Instat Management, Bob Carl, Van Baker, and Val Walters visit Ajax management and plant. Discuss how operations will merge into Instat.

October 22
Ajax regional managers advise Ajax sales personnel and agents of change effective Jan. 1, 1996.

October 24
Brent Sharp and Ken Roadway visit Instat to coordinate changeover.

October 29
Instat regional managers begin interviewing Ajax sales personnel for possible positions in Instat's sales organization.

November 5
Instat regional managers at Ajax for sales training session.

November 26
Walters visits Ajax to obtain more information.

November 30
Data Processing (Morrie Reddish) and Mfg. Engineering (Sam Newfield): Request DP tapes from Bob Cawley, Ajax, for conversion of Ajax to Instat eng. records: master inventory file, structure file, bill of materials file, where-used file, cross-reference Instat to Ajax part numbers, etc.
Allow maximum two weeks until December 14, 1995, for tapes to be at Instat.

December 3
ADMINISTRATIVE (Val Walters): Offer Norwood warehouse for sublease.

December 3
SALES (Abbott and Crutchfield): Week of sales meeting . . . Instruction of salespeople in Ajax line . . . including procedure in writing Ajax orders on separate forms from Instat orders . . . temporarily, adding weight and shipping information, and procedure below:
Crutchfield to write procedure regarding transmission of orders to Instat, credit check, and transmission of order information to shipping point, whether Norwood, San Francisco, or, later, Instat Cincinnati.

Figure 6-5a Partial action plan for merger of Ajax Hardware into Instat Corp (page 1 of 5).

level of the action plan are usually monitored and controlled by the level just above. If senior managers attempt to monitor and control the highly detailed work packages several levels down, we have a classic case of micromanagement. Another reason for keeping all items in an action plan at the same level of detail is that planners have an unfortunate tendency to plan in great detail all activities they understand well, and to be dreadfully vague in planning activities they do not understand well. The result is that the detailed parts of the plan are apt to be carried out and the vague parts of the plan are apt to be given short shrift.

ACTION PLAN

Objective: Merger of Ajax Hardware into Instat Corp. by April 1, 1996			
Steps	**Due Date**	**Responsibility**	**Precedent**
1. Ajax management advised of changes	September 24	Bob Carl, Van Baker	–
2. Begin preparing Instat sales dept. to sell Ajax Consumer Division products effective 1/1/96	September 24	Bob Carl	1
3. Prepare to create two sales groups: (1) Instat, (2) Ajax Builder Group effective 1/1/96	September 24	Bob Carl	1
4. Advise Instat regional managers of sales division changes	October 15	Bob Carl	2,3
5. Advise Ajax regional managers of sales division changes	October 15	Van Baker	2,3
6. Visit Ajax management and plan to discuss merger of operations	October 15	Bob Carl, Van Baker, Val Walters	4,5
7. Advise Ajax sales personnel and agents	October 22	Van Baker	6
8. Visit Instat to coordinate changeover	October 24	Brent Sharp, Ken Roadway	6
9. Interview Ajax sales personnel for possible position	October 29	Instat regional managers	7
10. Sales training sessions for Ajax products	November 5	Instat regional managers	9
11. Visit Ajax again	November 26	Val Walters	8,10
12. Request DP tapes from Bob Cawley for conversion	November 30	Morrie Reddish, Sam Newman	6
13. Offer Norwood warehouse for sublease	December 3	Val Walters	11
14. Write order procedures	December 3	Doug Crutchfield	10
15. Sales meeting (instruction—product line and procedures)	December 3	Fred Abbott, Doug Crutchfield	14
16. DP tapes due for master inventory file, bill of materials, structure file	December 14	Bob Cawley	12
. . .			
. . .			
. . .			

Figure 6-5b Tabular partial action plan for Ajax-Instat merger based on Figure 6-4a.

In practice, this process is iterative. Members of the project team who are assigned responsibility for working out a second, third, or lower-level action plan generate a tentative list of tasks, resource requirements, task durations, predecessors, etc., and bring it to the delegator for discussion, amendment, and approval. This may require several amendments and take several meetings before agreement is reached. The result is that delegator and delegatee both

Project Management in Practice

Disaster Project Planning in Iceland

Natural hazards abound in the remote island nation of Iceland. Not only is it one of the most volcanically active countries in the world but its remote and exposed location in the North Atlantic Ocean leaves it vulnerable to gales, landslides, snow avalanches, and other such natural disasters.

There are three phases of a natural disaster: the disaster itself, the response in terms of planning for the future, and the actual rebuilding project phase. Based on previous disasters such as the 1995 avalanche in Suodavik which claimed 15 lives, it has been proposed that the response phase be moved up in terms of contingency planning so the rebuilding phase can begin immediately after the disaster.

The normal stakeholders in an Icelandic disaster typically include the population experiencing the disaster, the local government, the insurance bodies, Iceland Catastrophe Insurance, the Landslide and Avalanche Fund, and the consulting and contracting repair organizations. In the past, these bodies have not been coordinated so every natural disaster had a delayed response to the event until all the political issues could be resolved, which often took months.

The proposal for reorganizing the response phase includes such items as:

- Documenting the response plans in a compulsory project handbook
- Charging the financing bodies with directing the actual rebuilding process
- Identifying an appropriate coordinating body for each disaster type and location
- Identifying a process for the appointment of a project manager independent, both financially and emotionally, of all the main stakeholders.

Source: G. Torfason, " Lessons from a Harsh Land: Project Management and Disaster Preparedness in Iceland," *PM Network,* February 1998, pp. 39–42.

Buried homes in Heimaey, Iceland, from 1973 volcano.

have the same idea about what is to be done, when, and at what cost. Not uncommonly, the individuals and groups that make commitments during the process of developing the action plan actually *sign-off* on their commitments. The whole process involves negotiation and will be further developed in the chapters to follow. Of course, like any managers, delegators can micromanage their delegatees, but micromanagement will not be mistaken for negotiation—especially by the delegatees.

6.4 THE WORK BREAKDOWN STRUCTURE AND LINEAR RESPONSIBILITY CHART

As was the case with project action plans and contrary to popular notion, the Work Breakdown Structure (WBS) is not one thing. It can take a wide variety of forms that, in turn, serve a wide variety of purposes. The WBS often appears as an outline with the Level 1 tasks on the left and successive levels appropriately indented. The WBS may also picture a project subdivided into hierarchical units of tasks, subtasks, work packages, etc. as a type of Gozinto chart or tree constructed directly from the project's action plan. Most current project management software will generate a WBS on command. Microsoft's Project®, for example, links the indented activity levels with a Gantt chart (see Chapter 8, Figure 8-21) that visually shows the activity durations at any level. Much more will be said about this view in Chapter 9 on resource allocation.

Another type of WBS shows the organizational elements associated with specific categories of tasks. Figure 6-6 is such a WBS for a conference. The Food group in the Facilities staff has responsibility for meals and drinks, including coffee breaks and water pitchers in the conference rooms. Five different food functions are shown, each presumably broken down into more detailed tasks. In this case, the account numbers for each task are shown so that proper charges can be assigned for each piece of work done on the project.

Occasionally, planners attempt to plan by using Gantt charts, a network device commonly used to display project schedules (cf. Chapter 8, Section 8.2). The Gantt chart was invented as a scheduling aid. In essence, the project's activities are shown on a horizontal bar chart with the horizontal bar lengths proportional to the activity durations. The activity bars are connected to predecessor and successor activities with arrows. While it is a useful device for displaying project progress, it is an awkward approach to project planning.

Some writers recommend using the WBS as the fundamental tool for planning (Hubbard, 1993, for instance). We find nothing logically wrong with this approach, but it seems overly structured when compared to the way that firms noted for high-quality planning actually proceed. If this approach is used, the PM is well advised to adopt the general philosophy of building the WBS that was used when building the action plan (see Section 6.3). Other writers pay scant attention to the WBS, giving the subject little more than a mention. We do not find this a fatal error as long as the planning activity is otherwise carried out to an appropriate level of detail.

In general, the WBS is an important document and can be tailored for use in a number of different ways. It may illustrate how each piece of the project contributes to the whole in terms of performance, responsibility, budget, and schedule. It may, if the PM wishes, list the vendors or subcontractors associated with specific tasks. It may be used to document that all parties have signed off on their various commitments to the project. It may note detailed specifications for any work package, establish account numbers, specify hardware/software to be used, and identify resource needs. It may serve as the basis for making cost estimates (see Chapter 7) or estimates of task duration (see Chapter 8). Its uses are limited only by the needs of the project and the imagination of the PM. No one version of the WBS will suit all needs, so the WBS is not *a* document, but any given WBS is simply one of many possible documents.

On occasion, it may be useful to create an *Organizational Breakdown Structure* (OBS) that displays the organizational units responsible for each of the various work elements in the WBS, or who must approve or be notified of progress or changes in its scope, since the WBS and OBS may well not be identical. That is, some major section of the WBS may be the responsibility of two or more departments, while other sections of the WBS, two or more, say, may all be the responsibility of one department. Such a document can be useful for department managers to see their total responsibilities for a particular project. The OBS is similar to the Linear Responsibility Chart discussed just below.

The following general steps explain the procedure for designing and using the WBS. For small- or moderate-size projects, and depending on the use for which the WBS is designed, some of the following steps might be skipped, combined, extended, and handled less formally than our explanation indicates, particularly if the project is of a type familiar to the organization.

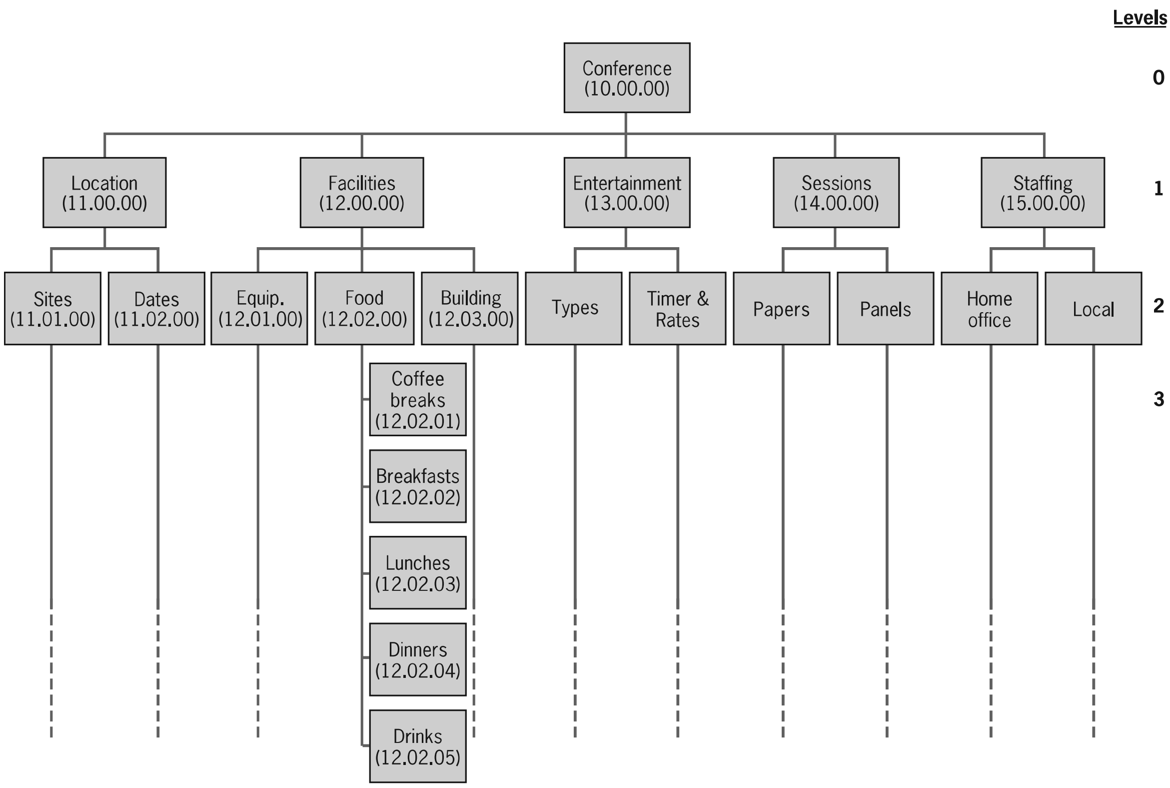


Figure 6-6 Work breakdown structure (account numbers shown).

1. Using information from the action plan, list the task breakdown in successively finer levels of detail. Continue until all meaningful tasks or work packages have been identified and each task or package can be individually planned, budgeted, scheduled, monitored, and controlled. It should be obvious that if the set of work package descriptions is not complete and properly arranged, it is highly unlikely the project can be completed on time, on budget, and to specification.
2. For each such work package, identify the data relevant to the WBS (e.g., vendors, durations, equipment, materials, special specifications). List the personnel and organizations responsible for each task. It is helpful to construct a *linear responsibility chart* (sometimes called a *responsibility matrix*) to show who is responsible for what. This chart also shows critical interfaces between units that may require special managerial coordination. With it, the PM can keep track of who must approve what and who must report to whom. Such a chart is illustrated in Figure 6-7. If the project is not too complex, the responsibility chart can be simplified (see Figure 6-8). Figure 6-9 shows one page of a verbal responsibility chart developed by a firm to reorganize its distribution system. In this case, the chart takes the form of a 30-page document covering 116 major activities.
3. All work package information should be reviewed with the individuals or organizations who have responsibility for doing or supporting the work in order to verify the WBS's accuracy. Resource requirements, schedules, and subtask relationships can now be aggregated to form the next higher level of the WBS, continuing on to each succeeding level of the hierarchy. At the uppermost level, we have a summary of the project, its budget, and an estimate of the duration of each work element. For the moment, we are ignoring

WBS		**Responsibility**					
		Project Office				**Field Oper.**	
Subproject	Task	Project Manager	Contract Admin.	Project Eng.	Industrial Eng.	Field Manager	
Determine need	A1	○		●	▲		
	A2	■	○	▲	●		
Solicit quotations	B1	○	■	▲		●	
Write approp. request.	C1	■	▲	○	●		
	C2		●	○	▲		
	C3	●	■	▲		■	
"	"						
"	"						
"	"						

Legend:
▲ Responsible
● Support
■ Notification
○ Approval

Figure 6-7 Linear responsibility chart.

uncertainty in estimating the budget and duration of work elements. We will deal with these subjects in Chapters 7 and 8.

4. For the purpose of pricing a proposal, or determining profit and loss, the total project budget should consist of four elements: direct budgets from each task as just described; an indirect cost budget for the project, which includes general and administrative overhead costs (G&A), marketing costs, potential penalty charges, and other expenses not attributable to particular tasks; a project "contingency" reserve for unexpected emergencies; and any residual, which includes the profit derived from the project, which may, on occasion, be intentionally negative. In Chapter 7 we argue that the budget used for pricing or calculation of profit should not be the same budget that the PM uses to control the project.
5. Similarly, schedule information and milestone (significant) events can be aggregated into a *projected baseline schedule*. The projected baseline schedule integrates the many different schedules relevant to the various parts of the project. It is comprehensive and may include contractual commitments, key interfaces and sequencing, milestone events, and progress reports. In addition, a time contingency reserve for unforeseeable delays might be included. A graphic example of a projected baseline schedule is shown in Figure 6-10.

	Vice-president	General manager	Project manager	Manager engineering	Manager software	Manager manufacturing	Manager marketing	Subprogram manager manufacturing	Subprogram manager software	Subprogram manager hardware	Subprogram manager services
Establish project plan	6	2	1	3	3	3	3	4	4	4	4
Define WBS		5	1	3	3	3	3	3	3	3	3
Establish hardware specs		2	3	1	4	4	4				
Establish software specs		2	3	4	1		4				
Establish interface specs		2	3	1	4	4	4				
Establish manufacturing specs		2	3	4	4	1	4				
Define documentation		2	1	4	4	4	4				
Establish market plan	5	3	5	4	4	4	1				
Prepare labor estimate			3	1	1	1		4	4	4	4
Prepare equipment cost estimate		3	1	1	1			4	4	4	4
Prepare material costs			3	1	1	1		4	4	4	4
Make program assignments			3	1	1	1		4	4	4	4
Establish time schedules		5	3	1	1	1	3	4	4	4	4

1 Actual responsibility
2 General supervision
3 Must be consulted
4 May be consulted
5 Must be notified
6 Final approval

Figure 6-8 Simplified linear responsibility chart.

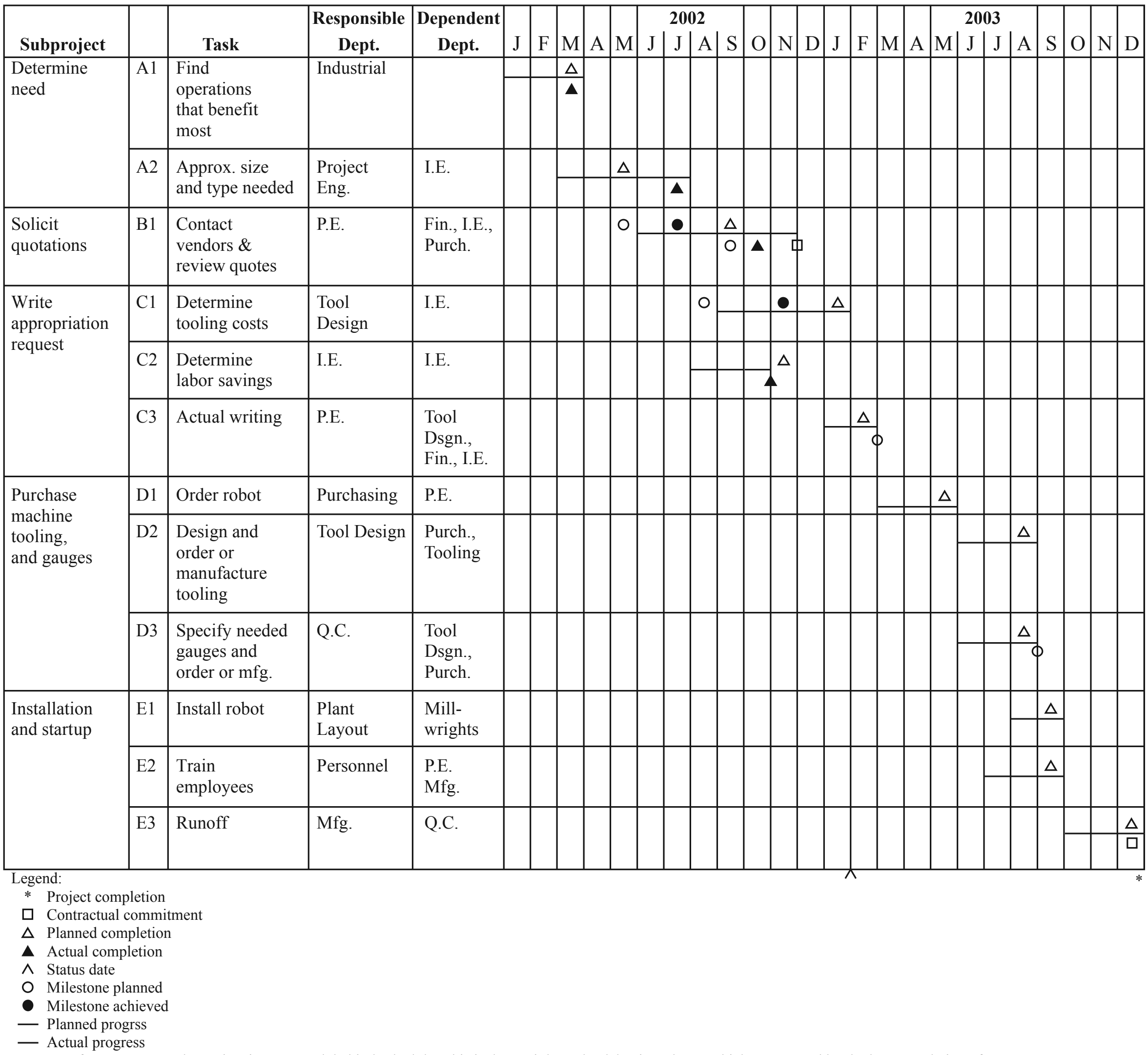
		Responsible Individuals	
Activities	***Initiate Action***	***Work with***	***Clear Action with***
Distribution System and Its Administration			
1. Recommend distribution system to be used.	Mktg Officers	ILI & IHI LOB MCs M-A Cttee VP&Agcy Dir	Sr VP Mktg
	Mktg Officers	Group LOB MC M-A Cttee VP & Agcy Dir	Sr VP Mktg
	Mktg Officers	IA LOB MC M-A Cttee VP&Agcy Dir	Sr VP Mktg
Compensation			
2. Determine provisions of sales-compensation programs (e.g., commissions, subsidies, fringes).	Compensation Task Force	Mktg, S&S & Eqty Prod Offrs	President
	Compensation Task Force	Mktg, S&S & Eqty Prod Offrs	
	Compensation Task Force	Mktg, S&S & Eqty Prod Offrs	President
3. Ensure cost-effectiveness testing of sales compensation programs.	Compensation Task Force	Mktg, S&S & Eqty Prod Offrs	President
Territory			
4. Establish territorial strategy for our primary distribution system.	VP&Agcy Dir	Dir MP&R M-A Cttee	Sr VP Mktg
5. Determine territories for agency locations and establish priorities for starting new agencies.	VP&Agcy Dir	Dir MP&R M-A Cttee	Sr VP Mktg
6. Determine agencies in which advanced sales personnel are to operate.	Dir Ret Plnng Sls Dir Adv Sls	VP S & S	Sr VP Mktg

Legend: IA, ILI, IHI: Product lines
LOB: Line of business
MC: Management committee
M-A Cttee: Marketing administration committee
S&S: Sales and service
MP&R: Marketing planning and research

Figure 6-9 Verbal responsibility chart.

Listed items 1 to 5 focus on the WBS as a planning tool. It may also be used as an aid in monitoring and controlling projects. Again, it is important to remember that no single WBS contains all of the elements described and any given WBS should be designed with specific uses in mind.

6. As the project is carried out, step by step, the PM can continually examine actual resource use, by work element, work package, task, and so on up to the full project level. By comparing actual against planned resource usage at a given time, the PM can identify problems, harden the estimates of final cost, and make sure that relevant corrective actions have been designed and are ready to implement if needed. It is necessary to examine resource usage



Note: As of Jan. 31, 2003, the project is one month behind schedule. This is due mainly to the delay in task C1, which was caused by the late completion of A2.

Figure 6-10 Projected baseline schedule.

in relation to results achieved because, while the project may be over budget, the results may be farther along than expected. Similarly, the expenses may be exactly as planned, or even lower, but actual progress may be much less than planned. Control charts showing these *earned values* are described in more detail in Chapter 10. In Chapters 7 and 8, as we have just noted, the details of how to include risk in the budget and in the schedule will be covered.

7. Finally, the project schedule may be subjected to the same comparisons as the project budget. Actual progress is compared to scheduled progress by work element, package, task, and complete project, to identify problems and take corrective action. Additional resources may be brought to those tasks behind schedule to expedite them. These added funds may come out of the budget reserve or from other tasks that are ahead of schedule. This topic is discussed further in Chapter 9.

6.5 INTERFACE COORDINATION THROUGH INTEGRATION MANAGEMENT

PMBOK Guide

This section covers the PMBOK knowledge area 1 concerning *Project Integration Management*. Unlike the more extensive knowledge areas such as *Risk*, or *Communication*, this topic can be treated in a standalone fashion in this single section.

The most difficult aspect of implementing the plan for a complex project is the coordination and integration of the various elements of the project so that they meet their joint goals of performance, schedule, and budget in such a way that the total project meets its goals.

As projects become more complex, drawing on knowledge and skills from more areas of expertise—and, thus, more subunits of the parent organization as well as more outsiders—the problem of coordinating multidisciplinary teams (MTs) becomes more troublesome. At the same time, and as a result, uncertainty is increased. As the project proceeds from its initiation through the planning and into the actual process of trying to generate the project's deliverables, still more problems arise. One hears, "Why didn't you tell us that when we could have done something about it?" One hears, "We tried to tell you that this would happen, but you didn't pay any attention to us." These, as well as less printable remarks, are what one hears when the members of an MT do not work and play well together—in other words, when the various individuals and groups working on the project are not well integrated. Rather than operating as a team, they work as separate and distinct parts, each of which has its own tasks and is not much interested in the other parts.

The intricate process of coordinating the work and timing of the different groups is called *integration management*. The term *interface coordination* is used to denote the process of managing this work across multiple groups. The linear responsibility chart discussed above is a useful aid to the PM in carrying out this task. It displays the many ways the members of the project team (which, as usual, includes all of the actors involved, not forgetting the client and outside vendors) must interact and what the rights, duties, and responsibilities of each will be.

An early approach to this problem was developed by Benningson (1972). Called TREND (Transformed Relationships Evolved from Network Data), the analysis was designed to illustrate important linkages and dependencies between work groups. The aim was to alert the PM to potential problems associated with cross-functional interfaces and to aid in the design of effective ways to avoid or deal with potential interface problems. Benningson added interdependence, uncertainty, and prestige to the mix. The precise way in which these elements were attached to the relationships delineated in the project plan is best seen by reference to Benningson (1972). (A brief explanation of TREND also appeared in the third edition of this work, pp. 221–24.) A key point is that mapping all dependencies in the project can show a complete description of project interfaces.

Recent work on managing the interfaces focuses on the use of MTs to plan the project as well as design the products/services the project is intended to produce. There is general agreement that MT has a favorable impact on product/service design and delivery. As we noted in Chapter 4, Section 4.3, the Chrysler Corporation's use of concurrent engineering (CE), one form of MT, not only resulted in excellent design, it also produced major economic benefits by shortening the design cycle. Work by Hauptman et al. (1996, p. 161) shows that CE has had a "favorable impact…on attainment of project budget goals, but achieves this without any adverse impact on quality, cost or schedule." [Note: this entire issue of *IEEE Transactions on Engineering Management* is devoted to CE.] The process also was associated with higher levels of team job satisfaction.

The use of MTs in product development and planning is not without its difficulties. Successfully involving cross-functional teams in project planning requires that some structure be imposed on the planning process. The most common structure is simply to define the task of the group as having the responsibility to generate a plan to accomplish whatever is defined as the project scope. There is considerable evidence that this is not sufficient for complex projects. Using MT creates what Kalu (1993) has defined as a virtual project. In Section 4.3, we noted the high level of conflict in many virtual projects (cf. de Laat, 1994). It follows that MT tends to involve conflict. Conflict raises uncertainty and thus requires risk management. Obviously, many of the risks associated with MT involve intergroup political issues. The PM's negotiating skill will be tested in dealing with intergroup problems, but the outcomes of MT seem to be worth the risks. At times, the risks arise when dealing with an outside group. For an interesting discussion of such issues and their impact on project scope, see Seigle (2001).

In an interesting attempt to give structure to the product design and planning problem and to make creative use of the conflict inherent in MT, Tan et al. (1996) proposed a planning model with four components: (1) an integrated base of information about the product plus design and production constraints, both technical and human; (2) software to aid the process of detecting conflicts in the information base, and to aid in the process of resolving those conflicts; (3) software that, given a product design, could generate a production plan and could also simulate changes in the plan suggested by design changes resulting from resolving conflicts; and (4) a model incorporating the knowledge base of the autonomous project team members and a network linking them, their intelligent-agents (computerized assistants), and their computers. The components all use an electronic blackboard for communication so the participants do not need to be in a common location. We suggest that risk identification and assessment be added.

With these parts, the design/planning process is conceptually straightforward. Team members with different technical backgrounds will view the product design task differently. Therefore, initial design ideas will be in conflict. Conflict resolution will result in design improvement, which alters the production plans that are simulated to test manufacturing feasibility. Conflict avoidance, on the other hand, will prevent design improvement. At base, the approach suggested by Tan and her colleagues (1996) uses MT to generate conflicts on the design of a product, and uses the resolution of the conflicts to suggest feasible design improvements.

Bailetti et al. (1994) make a different attack on the problem of interface management. They define and map all interdependencies between various members of the project team. The concept of mapping interdependencies recalls TREND, but TREND maps interfaces on the firm's organization chart while Bailetti et al. map the interdependencies directly. Because the nature of these interfaces may differ during different phases of the product/service design/production process, they map each major phase separately. Figure 6-11 shows the mapping for the design of a silicon chip.

The logic of this approach to structuring MT is strong. The WBS and linear responsibility charts are a good initial source of information on interfaces, but they do not reflect the uncertainty associated with tasks on large, complex projects. Further, they implicitly assume that interfaces are stable within and across project phases—an assumption often contrary to fact. This does not ignore the value of the WBS, PERT/CPM networks, and similar tools of longstanding use and proven value in project management. It simply uses interface maps as a source of the coordination requirement to manage the interdependencies. The fundamental structure of this approach to interface management is shown in Figure 6-12.

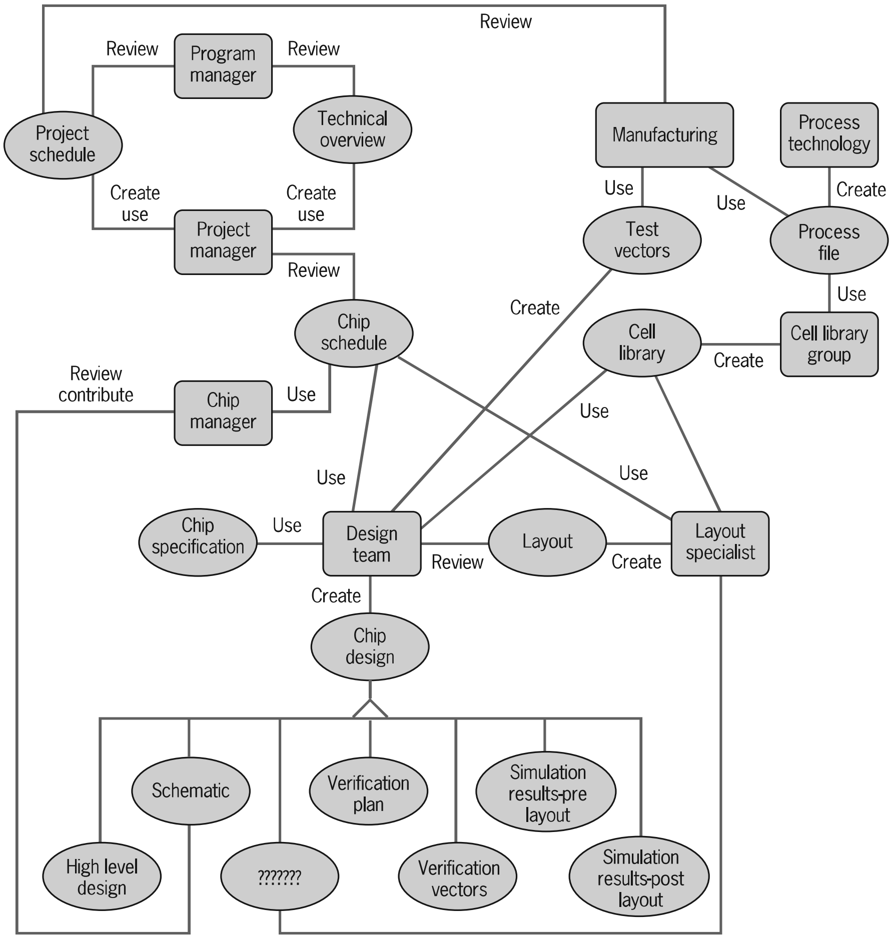


Figure 6-11 Interface map of silicon chip design. *Source*: Bailetti et al., 1994.

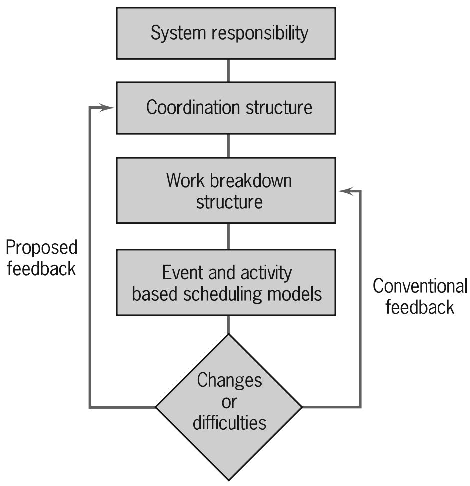


Figure 6-12 Coordination structure model of project management. *Source*: Bailetti et al., 1994.

Managing Projects by Phases and Phase-Gates

The subsection just above notes several ways of attacking the problems that result when the interfaces are not well coordinated. It is clear that they are quite helpful but, alone, are not enough to solve the problems. In addition to mapping the interfaces, a necessary but not sufficient condition for MT peace, the process of using MTs on complex projects must be subject to some more specific kinds of control. Stressing the project's overall objective(s) seems to be inadequate as a unifying force for most teams.

One of the ways to control any process is to break the overall objectives of the process into shorter term subobjectives and to focus the MT on achieving the subobjectives, often in a preset sequence. If this could be done, and if multidisciplinary cooperation and coordination were required in order to be successful in accomplishing the project, the level of conflict would surely fall. At least there is evidence that if team members work cooperatively and accomplish their short-term goals, the project will manage to meet its long-term objectives; moreover, the outcome of any conflict that does arise will be creative work on the project. This was one of the lessons learned from the concurrent engineering work at Chrysler and from similar successful experiments done elsewhere.

The project life cycle serves as a readily available way of breaking a project up into component parts, each of which has a unique, identifiable output. Cooper et al. (1993) developed such a system with careful reviews conducted at the end of each "stage" of the life cycle. A feature of this system was feedback given to the entire project each time a project review was conducted.

Another attack on the same problem was tied to project quality, again, via the life cycle (Aaron et al., 1993). They created 10 phase-gates associated with milestones for a software project. To move between phases, the project had to pass a review. (They even note that in the early stages of the project when there is no "inspectable product," that "*. . . managing quality on a project means managing the quality of the subprocesses* that produce the delivered product." Emphasis in the original.) While feedback is not emphasized in this system, reports on the finding of project reviews are circulated. The quality-gate process here did not allow one phase to begin until the previous phase had been successfully completed, but many of the phase-gate systems allow sequential phases to overlap in an attempt to make sure that the output of one phase is satisfactory as an input to the next. Another approach that also overlaps phases is called "fast tracking," and here the phases are run in parallel as much as possible to reduce the completion time of the project; of course, this also increases the project risk as well. The use of the phase-gate process or project control is demonstrated in Chapter 11, Section 11.2.

There are many such control systems, but the ones that appear to work have two elements in common. First, they focus on relatively specific, short-term, interim outputs of a project with the reviews including the different disciplines involved with the project. Second, feedback (and feedforward) between these disciplines is emphasized. No matter what they are called, they use the fundamental approach of concurrent engineering. When using CE, it must be made clear to all involved that cooperation between the multiple disciplines is required for success, that all parties to the project are mutually dependent on one another.

Finally, it should be stressed that phase-gate management systems were not meant as substitutes for the standard time, cost, and performance controls usually used for project management. Instead, phase-gate and similar systems are intended to create a rigorous set of standards against which to measure project progress. Their primary purpose is to keep senior management informed about the current state of projects being carried out.

The Design Structure Matrix

One observation that can be made regarding integration management and concurrent engineering is that both are fundamentally concerned with coordinating the flow of information. Furthermore, while the need to coordinate the flow of information is a challenge that confronts virtually all projects, the use of MTs tends to magnify this challenge. This is particularly serious for new product development projects.

Compounding this problem is the fact that traditional project management planning tools such as Gantt charts and precedence diagrams (both discussed in Chapter 8) were developed primarily to coordinate the execution of tasks. This is because these tools were originally developed to help manage large but relatively well structured projects such as construction projects and ship building. However, in some cases such as new product development projects, the issue of information flows can be as important as the sequencing of tasks. In essence, traditional project management planning tools help identify which tasks have to be completed in order for other tasks to be started. Often, however, a more important issue is what information is needed from other tasks to complete a specific task?

To address the issue of information flows, Steven Eppinger (2001), a professor at MIT's Sloan School of Management, proposes the development and use of a *Design Structure Matrix* (DSM). The first step in developing a DSM is to identify all the project's tasks and list them in the order in which they are typically carried out. This list of tasks makes up both the rows and columns of the DSM. Next, moving across one row at a time, all tasks that supply information to the task being evaluated are noted. When the DSM is completed, all the tasks that provide information that is needed to complete a given task can be determined by looking across that particular task's row. Likewise, moving down a particular task's column shows all the other tasks that depend on it for information.

An example DSM corresponding to a project with six activities is shown in Figure 6-13. According to the table, completing activity **c** requires the gathering of information from activities **b** and **f**. Furthermore, the table indicates that activities **c** and **f** both depend on information from activity **b**. As the example illustrates, a key benefit of constructing a DSM is the ability to quickly identify and better understand how information is needed. It can also highlight potential information flow problems even before the project is started. For example, all the X's above the diagonal in Figure 6-13 are related to situations where information obtained from a subsequent task might require the rework of an earlier completed task. To illustrate, in the second row we observe that activity **b** requires information from activity **e**. Since activity **e** is completed after activity **b**, activity **b** may need to be revisited and reworked depending on what is learned after completing activity **e**.

The DSM also helps evaluate how well the need to coordinate information flows has been anticipated in the project's planning stage. To make this assessment, a shaded box

	a	**b**	**c**	**d**	**e**	**f**
a						
b	X				X	
c		X				X
d	X		X		X	
e			X			
f	X	X		X		

X—information flow

Figure 6-13 Example DSM for Project with Six Activities

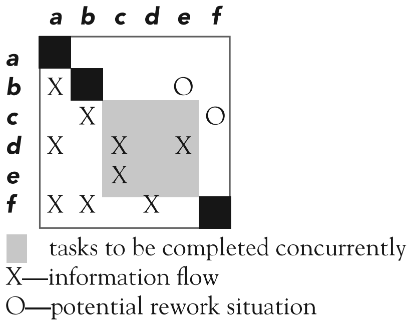


Figure 6-14 Modified DSM to Show Activities to Be Completed Concurrently

is added to the DSM around all tasks that are planned to be executed concurrently. For example, the DSM would appear as shown in Figure 6-14 if it had been planned that tasks **c**, **d**, and **e** were to be done concurrently. Also notice that in Figure 6-14 any remaining entries above the diagonal of the matrix are highlighted as potential rework by replacing each X with an O.

In examining Figure 6-14, there are two potential rework situations. Fortunately, there are a couple of actions that can be taken to minimize or even eliminate potential rework situations. One option is to investigate whether the sequence of the project activities can be changed so that the potential rework situations are moved below the diagonal. Another option is to investigate ways to complete additional activities concurrently. This later option is a bit more complex and may necessitate changing the physical location of where the tasks are completed.

SUMMARY

In this chapter we initiated planning for the project in terms of identifying and addressing the tasks required for project completion. We emphasized the importance of initial coordination of all parties involved and the smooth integration of the various systems required to achieve the project objectives. Last, we described some tools such as the Work Breakdown Structure (WBS), the linear responsibility chart, the action plan, and the Gozinto chart to aid in the planning process. We also briefly investigated several methods for controlling and reducing conflict in complex projects that use multidisciplinary teams.

Specific points made in the chapter are these:

- The preliminary work plans are important because they serve as the basis for personnel selection, budgeting, scheduling, and control.
- Top management should be represented in the initial coordinating meeting where technical objectives are established, participant responsibility is accepted, and preliminary budgets and schedules are defined.
- The approval and change processes are complex and should be handled by the project manager.
- Common elements of the project plan are the overview, statement of objectives, general approach, contractual requirements, schedules, budget, cost control procedures, evaluation procedures, and potential problems.
- Systems integration concerns the smooth coordination of project systems in terms of cost, performance, and effectiveness.
- The hierarchical approach (level planning process) to project planning is most appropriate and can be aided by a tree diagram of project subsets, called a Gozinto chart, and a Work Breakdown Structure (WBS). The WBS relates the details of each subtask to its task and provides the final basis for the project budget, schedule, personnel, and control.
- A linear responsibility chart is often helpful to illustrate the relationship of personnel to project tasks and to identify where coordination is necessary.
- When multifunctional terms are used to plan complex projects, their work must be integrated and coordinated. Interface maps are a useful way of

identifying the interdependencies that must be managed.

- The use of a Design Structure Matrix can show critical information flows, the need for concurrent tasks, and potential rework situations.

This topic completes our discussion of project activity planning. In the next part of the text, we address the subject of budgeting and look at various budgeting methods. The chapter also addresses the issue of cost estimation and its difficulty.

GLOSSARY

Action Plan The set of activities, their schedules, and the resources needed to complete the project.

Bill of Materials The set of physical elements required to build a product.

Control Chart A graph showing how a statistic is changing over time compared to its average and selected control limits.

Deliverables The physical items to be delivered from a project. This typically includes reports and plans as well as physical objects.

Earned Value A measure of project progress, frequently related to the planned cost of tasks accomplished.

Effectiveness Achieving the objectives set beforehand; to be distinguished from efficiency, which is measured by the output realized for the input used.

Engineering Change Orders Product improvements that engineering has designed after the initial product design was released.

Gozinto Chart A pictorial representation of a product that shows how the elements required to build a product fit together.

Hierarchical Planning A planning approach that breaks the planning task down into the activities that must be done at each managerial level. Typically, the upper level sets the objectives for the next lower level.

Interface Management Managing the problems that tend to occur between departments and disciplines, rather than within individual departments.

Material Requirements Planning (MRP) A planning and material ordering approach based on the known or forecast final demand requirements, lead times for each fabricated or purchased item, and existing inventories of all items.

Project Plan The nominal plan to which deviations will be compared.

Systems Engineering The engineering tasks involved in the complete system concerning the project and the integration of all the subsystems into the overall system.

Value Engineering An approach that examines each element of a product or system to determine if there is a better or cheaper way of achieving the same function.

Work Statement A description of a task that defines all the work required to accomplish it, including inputs and desired outputs.

QUESTIONS

Material Review Questions

1. List the nine component planning sequences of software project planning.
2. Any successful project plan must contain nine key elements. List these items and briefly describe the composition of each.
3. What are the basic guidelines for systems design which assure that individual components of the system are designed in the best manner?
4. What are the general steps for managing each work package within a specific project?
5. Describe the “even planning process” and explain why it is helpful.
6. What is shown on a linear responsibility chart? How is it useful to a PM?
7. What should be accomplished at the initial coordination meeting?
8. Why is it important for the functional areas to be involved in the project from the time of the original proposal?
9. What are the three major objectives of systems integration?
10. What are the basic steps to design and use the Work Breakdown Structure?
11. What is the objective of interface management?
12. Contrast the Project Plan, the Action Plan, and the WBS.

Class Discussion Questions

13. What percentage of the total project effort do you think should be devoted to planning? Why?

14. Why do you suppose that the coordination of the various elements of the project is considered the most difficult aspect of project implementation?

15. What kinds of risk categories might be included in the project plan?

16. What is the role of systems integration in project management? What are the three major objectives of systems integration?

17. In what ways may the WBS be used as a key document to monitor and control a project?

18. Describe the process of subdivision of activities and events that composes the tree diagram known as the Work Breakdown Structure or Gozinto chart. Why is the input of responsible managers and workers so important an aspect of this process?

19. Why is project planning so important?

20. What are the pros and cons concerning the early participation of the various functional areas in the project plan?

21. What trade-offs might exist among the three objectives of system integration?

22. Task 5-C is the critical, pacing task of a rush project. Fred always nitpicks anything that comes his way, slowing it down, driving up its costs, and irritating everyone concerned. Normally, Fred would be listed as "Notify" for task 5-C on the responsibility matrix but the PM is considering "forgetting" to make that notation on the chart. Is this unethical, political, or just smart management?

23. How might we plan for risks that we cannot identify in the risk management section of the project plan?

Questions for Project Management in Practice

Minnesota DOT Project Planning

24. Why are the three areas of scheduling, funding, and human resource planning needed in such a system? Why aren't equipment planning and materials requirements included?

25. How would the system facilitate planning? Coordination? Control?

26. What other big-picture issues might this system be useful for besides identifying when projects might overly congest an area?

Disaster Project Planning in Iceland

27. The United States emergency body FEMA (Federal Emergency Management Act) was formed for much the same reasons as Iceland's disasters. How do the two approaches appear to differ?

28. Given a nation so prone to disasters, why do you think it took so long to formulate a contingency disaster plan?

29. The directed reading at the end of this chapter describes four tools for crises in projects. Might any of these be useful to Iceland in their planning?

Beagle 2 Mars Probe a Planning Failure

30. What should the project manager have done about the challenges facing this project?

31. Are the recommendations complete? Would you add anything else?

Child Support Software a Victim of Scope Creep

32. What was the source of the problem here?

33. What would you suggest to recover the project?

Shanghai Unlucky with Passengers

34. Was Shanghai unlucky or was it something else?

35. Why do you think they didn't consider the situation of the passengers?

INCIDENTS FOR DISCUSSION

Ringold's Pool and Patio Supply

John Ringold, Jr., just graduated from a local university with a degree in industrial management and joined his father's company as executive vice-president of operations. Dad wants to break John in slowly and has decided to see how he can do on a project that John Sr. has never had time to investigate. Twenty percent of the company's sales are derived from the sale of above-ground swimming pool kits. Ringold's does not install the pools. John Sr. has asked John Jr. to determine whether or not they should get into that business. John Jr. has decided that the easiest way to impress Dad and get the project done is personally to estimate the cost to the company of setting up a pool and then call some competitors and see how much they charge. That will show whether or not it is profitable.

John Jr. remembered a method called the work breakdown structure (WBS) that he thought might serve as a useful tool to estimate costs. Also, the use of such a tool could be passed along to the site supervisor to help evaluate the performance of work crews. John Jr.'s WBS is shown in Table A. The total cost John Jr. calculated was $185.00, based on 12.33 labor-hours at $15.00/labor-hour. John Jr. found that, on average, Ringold's competitors charged $229.00 to install a similar pool. John Jr. thought he had a winner. He called his father and made an appointment to present his findings the next morning. Since he had never assembled a pool himself, he decided to increase the budget by 10 percent, "just in case."

Questions: Is John Jr.'s WBS projection reasonable? What aspects of the decision will John Sr. consider?

Stacee Laboratories

Stacee Labs, the research subsidiary of Stacee Pharmaceuticals, Inc., has a long history of successful research and development of medical drugs. The work is conducted by pure project teams of scientists that operate with little in the way of schedules, budgets, and precisely predefined objectives. The parent company's management felt that scientific research teams should not be encumbered with bureaucratic record-keeping chores, and their work should go where their inspiration takes them.

A Special Committee of Stacee Pharm's Board of Directors has completed a study of Stacee Labs and has found that its projects required a significantly longer time to complete than the industry average and, as a result, were significantly more expensive. These projects often lasted 10–15 years before the drug could be released to the market. At the same time, Stacee Labs projects had a very high success rate.

The board called in a management consultant, Ms. Millie Tasha, and asked her to investigate the research organization briefly and report to the board on ways in which the projects could be completed sooner and at lower expense. The board emphasized that it was not seeking nit-picking, cost-cutting, or time-saving recommendations that might lower the quality of Stacee Labs's results.

Ms. Tasha returned after several weeks of interviews with the lab's researchers as well as with senior representatives of the parent firm's Marketing, Finance, Government Relations, and Drug Efficacy Test Divisions, as well as the Toxicity Test Department. Her report to the Board began with the observation that lab scientists avoided contact with Marketing and Governmental Relations until they had accomplished most of their work on a specific drug family. When asked why they waited so long to involve marketing, they responded that they did not know what specific products they would recommend for sale until they had completed and tested the results of their work. They added that marketing was always trying to interfere with drug design and wanted them to make exaggerated claims or to design drugs based on sales potential rather than on good science.

Ms. Tasha also noted that lab scientists did not contact the toxicity or efficacy testing groups until scientific work was completed and they had a drug to test. This resulted in long delays because the testing groups were usually occupied with other matters and could not handle the tests promptly. It usually took many months to organize and begin both toxicity and efficacy testing.

In Ms. Tasha's opinion, the only way to make significant cuts in the time and cost required for drug research projects was to form an integrated team composed of representatives of all the groups who had a major role to play in each drug project and to have them involved from the beginning of the project. All parties could then follow progress with drug development and be prepared to make timely contributions to the projects. If this were done, long delays and their associated costs would be significantly reduced.

Questions: Do you think Millie Tasha is right? If so, how should new drug projects be planned and organized? If Stacee Pharmaceutical goes ahead with a reorganization of lab projects, what are the potential problems? How would you deal with them? Could scope creep become more of a problem with the new integrated teams? If so, how should it be controlled?

Table A. Pool Installation WBS

Works Tasks	***Labor-Hours (estimated)***	
Prepare ground surface		2.67
Clear	1	
Rake	$\frac{1}{3}$	
Level	1	
Sand bottom	$\frac{1}{3}$	
Lay out pool frame		2.50
Bottom ring	1	
Side panels	$\frac{1}{2}$	
Top ring	1	
Add plastic liner		0.50
Assemble pool		1.66
Build wooden support		3.00
Layout	1	
Assemble	2	
Fill and test		2.00
Total		12.33

Source: Thamhain et al., 1975.