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I N T R O D U C T I O N

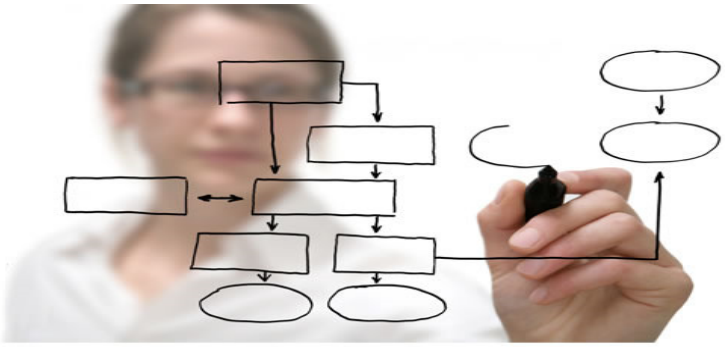
Understanding the Process of Managing Projects

People have been undertaking projects since the earliest days of organized human activity. The hunting parties of our prehistoric forebears were projects, for example; they were temporary undertakings directed at the goal of obtaining meat for the community. Large, complex projects have also been with us for a long time. The pyramids, the Great Wall of China, and Hadrian's Wall were projects that, in their time, were of roughly the same dimensions as the Manhattan Project to build an atomic bomb or the Apollo Project to send humans to the moon.

All of us are constantly undertaking projects in our day-to-day lives. Some common examples are preparing for a picnic, repairing a leaky faucet, fixing up the house , and writing a term paper for a class. Projects are an integral part of our lives.
Typically, we carry out these projects in a haphazard way. We finally get around to fixing the faucet when we can no longer tolerate the din of dripping water, and we begin writing our term paper the day before it is due. We tell a subordinate in an offhand manner to develop a marketing plan, and we are upset with him when the completed plan in no way looks like what we envisioned.

We are given money to investigate the physical properties of a new polymer, but we run out of cash before we are even half finished.

Beginning in the 1990s, project management became a hot management approach. As the U.S. economy entered a post-industrial phase, American managers discovered that many of the management guidelines established for a manufacturing economy no longer served them well in an information economy. In a manufacturing environment, emphasis is placed on predictability and repetitive activities, and to a large extent, management is concerned with standardization and rationalization of production processes.
With an information economy, uniqueness of events has replaced repetition. Information itself is dynamic and ever changing. Flexibility is the watchword of the new order, and project management is a key to this flexibility.



WHAT IS PROJECT MANAGEMENT ?

If you ask seasoned project professionals to describe their most fundamental objective in carrying out a project, you are likely to hear the following response: “To get the job done!” This is the project professional’s universal credo. If given a few moments to reflect further on their efforts, they will probably amplify their response:“My most basic objective is to get the job done—on time, within budget, and according to specifications.”

These three items are so commonly identified by project professionals as important parameters in the project management process that they have been given a name: the *triple constraint.* They constitute the focal point of the project professional’s attention and energy.

Project management entails carrying out a project as effectively as possible in respect to the constraints of time, money (and the resources it buys), and specifications.

Over the years, an array of tools has been developed to help project managers to cope with the triple constraint. To deal with the time constraint, project professionals establish deadlines and work with schedules. Some fairly sophisticated computer-assisted scheduling tools—such as MSP(Microsoft project), PERT/CPM (Program Evaluation and Review Technique/Critical Path Method), GERT (Graphical Evaluation and Review Technique), and VERT (Venture Evaluation and Review Technique)—are available to help them manage the time dimension more effectively.

Money constraints are handled with budgets. First, estimates are made as to what the project tasks will cost. Once the project is under way, the budget is monitored to see whether costs are getting out of hand. Money buys resources, and project managers have developed several tools for managing human and material resources—for example, resource loading charts, resource Gantt charts, and linear responsibility charts.

Of the three basic constraints, the most difficult to manage is specifications. Specifications describe what the product of the project effort should look like and what it should do. For example, if we are building a boat, one specification we might have to address is that the boat be 5.23 meters long. If we are designing a purchase order system, we might have to wrestle with a specification that only three days of training are necessary for the people who will use it.

The problem with specifications is that they are notoriously difficult to establish and monitor. For example, it is not enough to have specifications that define a technically masterful product; they must be geared to satisfying customers as well, even if this results in suboptimization of technical performance. For the moment, let it be noted that project professionals have been struggling mightily to come up with techniques for developing and monitoring specifications, and they have achieved some notable successes.

Operating Within the Realities of Organizational Life

There is a strong consensus among project managers that projects would be better undertaken outside the usual organizational environments. It is easy to sympathize with this view. However, it is unrealistic. Projects occur in organizations. To design and manage projects out of their organizational context is similar to designing machinery for a frictionless world. In both cases, we have something that looks good on paper but will not work very well in the real world.

we need merely reflect on several features of the basic definition of projects Consider the following:

• *Projects are temporary.* Projects occur in a finite period of time: minutes, hours, days, weeks, months, or years.

• *Projects are unique.* Projects are one-of-a-kind undertakings. At Globus Enterprises, feasibility studies of order processing systems are not a daily occurrence. Projects are structured to address momentary needs.

• *Projects are systems.* Projects are composed of different pieces linked together in intricate ways. People with specialized skills often work on the individual pieces. On the order processing automation project, the team was structured in such a way that most of the members would bring their own specialized skills to the project (for example, knowledge of the Internet, knowledge of the workings of the finance division, typing skills). Often, though, the skills are so specialized that they are employed only briefly. It is not at all uncommon to have the composition of the project team continually changing as the project progresses through its life cycle. The person who can be usefully employed full time on a project is the exception rather than the rule.

The very nature of projects requires that human and material resources be borrowed rather than permanently assigned to the undertaking. As long as project professionals are dealing with borrowed resources,

In dealing with human relations on projects, books and courses usually focus on project managers' relationships with their staff. These relationships certainly are important and warrant close scrutiny. It should be noted, however, that relations with the other actors identified like :-

Top Management
Internal Customers
Boss
Managers Controlling
Subcontractors
Colleagues
Staff
Government Subcontractors
External Customers
Suppliers

Are also important, because problems with any one of them can jeopardize the project. On a more positive note, it might

Top Management

Top management in the organization may or may not be directly involved with the project. Large projects are highly visible, and it is likely that their project managers will have direct interaction with top management. IBM's launching of the personal computer in the 1980s and Steve Jobs's ongoing support of new-generation computers at Apple are well-known examples of projects that receive constant top management scrutiny.

Obviously, managing a high-visibility project has both advantages and drawbacks. On the plus side, the highly visible project is more likely to have top management support, which means that it will be easier to recruit the best staff to carry out the project and acquire needed material resources. This visibility can also significantly boost the project manager's professional standing within the organization.

On the minus side, any failure will be quite dramatic and visible to all. Furthermore, if the project is a large and expensive one (and highly visible projects usually are), the cost of failure will be more substantial than for a smaller, less visible project.

Another negative feature of highly visible projects is that top management may find the temptation to meddle in them irresistible, leading to micromanagement. Micromanagement by top management puts project managers in an awkward position. It takes strong, self-confident, and brave project managers to resist the intense second guessing of their efforts by the organization's top brass.

With low-visibility projects, direct top management involvement is unlikely. Nevertheless, top management can still have a major impact on how the project is carried out, because it sets the tone for the whole organization. For example, if top management establishes an atmosphere of free and open communication in the organization, project managers and their staff are more likely to be honest in reporting successes and failures. If top management creates an atmosphere in which failure is not tolerated, it is likely that project managers and their staff will be less than honest in reporting progress (or lack of it).

Boss

Today, the concept of "boss" is being reassessed. As modern organizations move away from traditional chain-of-command structures and drift toward team-focused structures, the issue of who reports to whom becomes quite clouded. Although we have clearly moved away from autocratic models of supervisors who possess absolute authority over their workers, bosses have not become extinct. They still exist and still must be dealt with. The importance of the boss to project professionals is obvious, since the boss plays a significant role in creating the daily working environment and is instrumental in determining the project manager's career prospects within the organization.

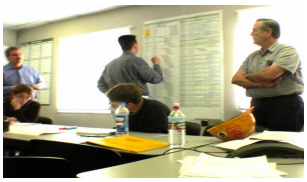
Our boss can make life in the organization reasonably comfortable or painful. Typically, the boss decides what our assignment is and who can work with us on our project. If things go wrong on our project (and they probably will), it is nice to have an understanding and supportive boss who will go to bat for us if necessary. If, on the contrary,

the boss pounces on us at the first sign of trouble or disowns us, our lives can be very uncomfortable.

Colleagues

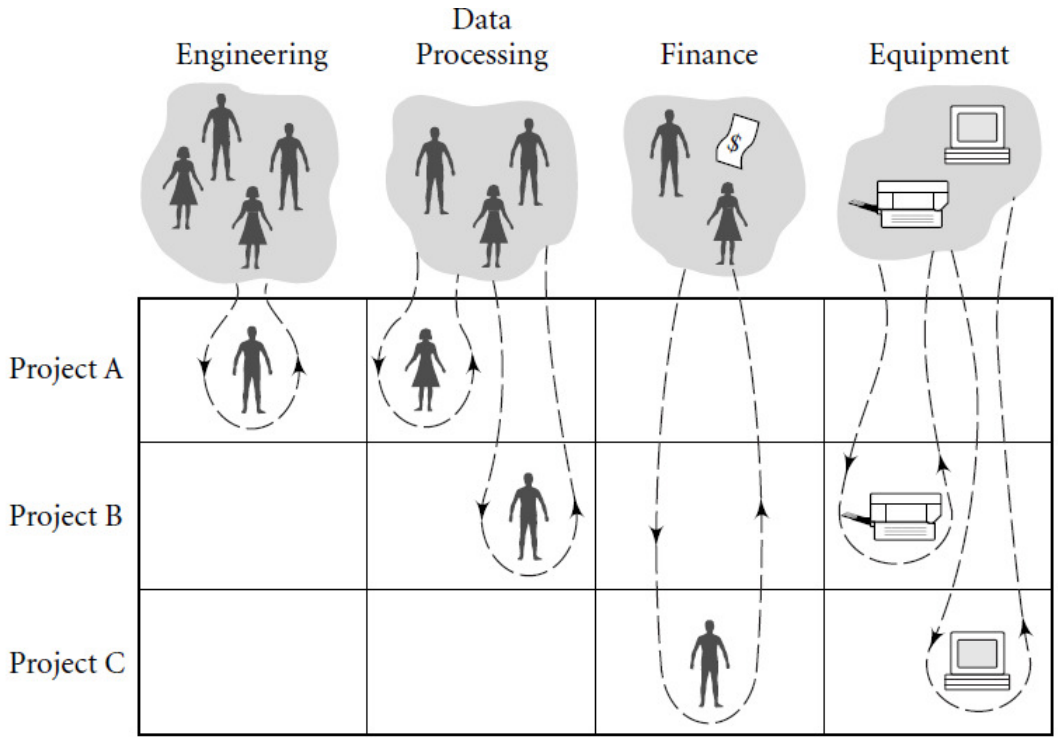
Fellow project managers and other peers in the organization can be friends or foes, or—quite commonly—a little bit of both. They can be friends in at least two senses. First, they can be useful resources, providing a project manager with important information or human or material assistance. Second, they can serve as helpful allies in getting things done within the organization. For example, whereas individual project managers may not have enough clout to get their company to purchase what they perceive to be a necessary piece of equipment, in concert with their colleagues they may possess sufficient collective influence to release funds for the purchase.
Colleagues can also be foes. An obvious source of conflict between colleagues is resource scarcity. It is not uncommon for project managers to find themselves competing against their fellows to get good staff or necessary equipment. If this competition is undertaken in a friendly spirit, it need not get out of hand. Colleagues may also be foes in the sense that they are competitors for career advancement. This last point can be particularly poignant in this era of downsized and flattened organizations.

Staff



I have noted that the staff whom project managers have available to them are usually borrowed rather than assigned to the project on a permanent, full-time basis. Recognizing this fact, project-oriented organizations occasionally organize themselves into a matrix structure.
A pure matrix structure is pictured in Figure 1.2. Running along the horizontal axis are the functional groups that serve as resource repositories. The engineering department is filled with a wide assortment of engineers, the data processing department is peopled with programmers and analysts, the finance department is filled with accountants and financial experts, and so on. On the left side of the matrix, along the vertical axis, are the individual projects that present specific resource needs. Project A, for example, has a need for engineers and data processors.When this need ends, they return to their respective functional groups, where they are available for work on

other projects.
The matrix structure formally incorporates what I have noted several times: because of the temporary, unique, and complex character of projects, it makes more sense to have a project borrow resources on



an as-needed basis than to assign resources full time to the project throughout its duration.
Today, there are two driving forces behind matrix management. One is that when it functions properly, it leads to the efficient employment of resources. If I need editors for only two days on a threeweek project, why should I hire them for three weeks? With the matrix, we use resources as we need them, and when we are done with them, we send them home to their functional areas.
A second force behind matrix management is that it allows for cross-functional solutions to problems. Today's complex problems require inputs from a broad range of players. For example, to increase the likelihood of customer satisfaction, a software development team should contain members who are aware of business concerns as well as technical issues.
Although the matrix approach may reduce resource inefficiencies and encourage cross-functional problem solving, it also is the primary source of the project managers' chief complaint: that they have little control over the resources they need, since these resources are only on loan to them and owe allegiance elsewhere—usually to their functional groups and their functional group manager.

Managers Controlling Internal Resources

One special category of colleague that is particularly important to a project professional is other managers who control needed resources. Because project managers are typically in a position of borrowing resources, their relations with the people controlling these resources are especially important. If their relations are good, they may be able consistently to acquire the best staff and the best equipment for their projects. If relations are not so good, they may find themselves unable to get the people and material resources necessary to get the job done properly.

Internal Customers

Projects may be undertaken to satisfy the needs of internal or external customers. Internal customers are individuals within the organization who have particular needs that will be addressed with an internally executed project. Data processing department projects, for example, are usually carried out to meet internal demands. Perhaps the data processing department wants to upgrade the corporate accounts receivable system or help an office in its automation effort.

External Customers

External customers are individuals and organizations in the external environment. Projects can address their needs in two ways. In the first, a project may focus on developing a product or process that will eventually be marketed to outside consumers. In this case, there is no guarantee that the consumer will want to buy the product or process, so the project faces the serious risk that it might fail in the marketplace.

Project managers may be ever conscious of producing something that will succeed in the market. If they are developing an important new product, it may be especially crucial that they complete their project in a timely fashion; if they do not, the product may lose its competitive edge. The business press is filled with stories of companies announcing the forthcoming introduction of a new product and then being embarrassed when the product hits the market several months behind schedule.

Projects also address external customer needs through contracts The government, for example, commonly funds contractors to carry out desired projects.Here project managers have a clear idea of who the customers are; given thisknowledge, they are obliged to maintain good communications withcustomers, to make sure that they are indeed meeting the customer needs.

This is easier said than done.
, customers often do not have a precise idea of what they want. Consequently, their needs tend to change as the project evolves and they gain a better appreciation of precisely what the project is developing. In such circumstances, project managers must balance their desire to satisfy customers with knowledge that constant changes to the project will lead to time and cost overruns.

Government

Most project managers do not have to deal with government in their projects unless they are government contractors, in which case the government is their customer. However, those working in certain heavily regulated environments—for example, in the pharmaceutical, pesticide, or banking industries—must be fully conversant with government regulations that bear on their projects. Not only do they face the problems common to all other project managers, but they must work under additional stringent regulatory constraints as well.

Subcontractors

There are times when organizations do not have sufficient skills or capabilities to undertake all project tasks themselves. This is often true of large, complex projects and of construction projects in general. Under these circumstances, work is farmed out to subcontractors. Project managers working with subcontractors must keep close tabs on their performance, since the success of the project will depend in part on their work.

Any number of problems can arise with subcontractors. The quality of their work may be substandard, or they may run into cost overruns, or they may face schedule slippages. Keeping tabs on them is not easy, since they operate outside the project professional's immediate organizational environment. It is hard enough trying to keep tabs on individuals one encounters on a daily basis within the organization; keeping tabs on outsiders is even more difficult.

In working with subcontractors, the project manager should have substantial knowledge of the provisions in the contract with the subcontractor, as well as a rudimentary knowledge of contract law.

Suppliers

Many projects are heavily dependent on goods provided by outside suppliers. This is true, for example, of construction projects, where lumber, nails, brick, and mortar come from outside suppliers. If the supplied goods are delivered late or are in short supply or are of poor quality, or if the price at delivery is higher than the quoted price, the project may suffer seriously.Many construction projects are thrown off schedule because required materials do not arrive on time, or because the delivered goods are of such poor quality that the delivery has to be rejected.

Reliable suppliers are important to successful project management. The Japanese have long recognized this in the manufacturing sector. Major Japanese corporations dedicate a good deal of attention to their relationships with suppliers, and the famed just-in-time system, in which supplies arrive at the plant the day they are to be used, has been an important factor in Japan's phenomenal success at producing high-quality goods at a low price.

Project managers have so many balls to juggle that they are often tempted to downplay potential supplier problems in order to focus their attention on other crucial actors. "These suppliers are professionals, and I will assume that they will behave in a professional manner," they say to themselves. The project manager who operates on this assumption, and consequently pays little attention to possible supplier problems, may be in for a number of nasty surprises.

THE POLITICS OF PROJECTS

Politics is the art of influence. The fundamental job of candidates running for public office is to influence a majority of the electorate to vote for them. This is what the speeches, the kissing of babies, and the paid political advertisements are all about. Once in office, the politicians are busy influencing other politicians to back them on legislative proposals, position themselves to be appointed the chair of important committees, and release funds for projects that will enrich their constituencies. The purpose of all this effort is to influence the electorate to vote for them again in the next election. This ability to influence others to do one's bidding is a politician's most important asset. With rare exceptions, politicians are not inherently powerful people. Generally, they do not have large sums of money that they can use as an instrument of power. They do not flex large biceps to intimidate people into doing what they want. They do not possess invaluable knowledge of the secrets of nature that gives them a hold over others. The power they possess is rooted in their ability to influence others.When they lose this ability, they no longer function effectively as politicians. Even the seemingly omnipotent—such as Winston Churchill during World War II—fall quickly when they can no longer exert sufficient influence over their fellows.

Project managers are something like politicians. Typically, they are not inherently powerful, capable of imposing their will directly on coworkers, subcontractors, and suppliers. Like politicians, if they are to get their way, they have to exercise influence effectively over others. We saw previously in this chapter that one way to get others to do one's bidding is to create and nurture authority. But politicians need more than the simple possession of authority; they also need to possess a keen understanding of the overall environment in which this authority is to be exercised. They need to be realists.

Good project politicians follow.

1. Assess the environment.
2. Identify the goals of the principal actors.
3. Assess your own capabilities.
4. Define the problem.
5. Develop solutions.
6. Test and refine the solutions.

The first four steps are designed to help the project professional acquire a realistic view of what is happening. Most project professionals, when tackling a project, skip over those steps and immediately begin offering solutions to problems. They are not good project politicians. Because all projects involve politics and these politics often have an important bearing on whether projects proceed smoothly or roughly, it is worthwhile to examine these six steps in some detail.

Step 1: Assess the Environment

The most important elements in the environment are the other actors involved either directly or indirectly with a project. In assessing the environment, the project professional should try to identify all the relevant

actors. This is harder to do than it may seem at first blush.
Consider, for example, a project to introduce a new accounting system into an office. Good project management practice suggests beginning with an analysis of the needs of the users of the accounting system. Who are the users? An obvious set of users are accountants who maintain the company's books and the finance experts who use the accounting data to carry out financial analyses of the company's business performance. Another important set of users are all managers who engage in any sort of financial transactions. Their principal need is for an accounting system that generates reports with the information they require to do their job. For example, department heads need data on expenditures incurred by their departments, and the payments office requires information on accounts receivable. Clerical personnel who input data into the accounting system are a type of user as well. Their principal need is for a system that accepts data readily and is easy to use.
Beyond these obvious users are additional stakeholders that need to be considered. Because implementing an accounting system requires substantial cooperation from the IT department, the views of IT personnel about approaches to implementing the accounting system should be solicited. Their chief concern is that the system that is implemented makes technical sense. The executive committee of senior managers comprises important stakeholders. They want to be sure that the accounting system that is adopted serves the organization's overall needs. A stakeholder we often overlook who has a role to play on many projects is the purchasing department. If we plan to purchase goods and services in the course of the project, we better consult with the folks in the purchasing department, because they have a set of procedures that we need to follow; if we ignore them, we may not get the goods and services we need in a timely fashion.
Once the relevant actors have been identified, we try to determine where the power lies. In the vast cast of characters we confront, who counts most? Whose actions will have the greatest impact?

Step 2: Identify Goals

After determining who the actors are, we should identify their goals. What is it that drives them? What is each after? In examining their goals, we should not shy away from speculating about psychological motivations, since these may be more powerful than purely work-related motivations.
We should, of course, pay attention to stated goals. However, we should also be aware of the hidden agenda, that is, goals that are not openly articulated. In the example of updating the computerized accounting system, one overt goal of the project sponsor might be to increase productivity and accuracy of financial data; a hidden goal might be to be recognized as the foremost guru who promotes best practices in the organization. To satisfy both the overt and hidden goals, the project professional should consider purchasing high-quality accounting software that also has a nifty look to it.
In dealing with both overt and hidden goals, we should focus special attention on the goals of the actors who hold the power. By knowing who holds the power and recognizing their overt and hidden goals, we reduce the likelihood of making gaffes that upset those people

whose actions have great impact. Furthermore, we can use our knowledge in a positive way to determine how we can influence these people to help us achieve our project goals.

Step 3: Assess Your Own Capabilities

Know thyself. Project professionals should have a good idea of their strengths and weaknesses and should be able to determine how those traits bear on the project. Self-assessment is a crucial step in developing a realistic outlook on the project and its environment. If project managers have a distorted view of their own capabilities, the project is likely to run into trouble.

Particularly important capabilities are the abilities to work well with others and to communicate well. Project professionals who are basically inarticulate should not offer to make weekly progress presentations to higher management, since these presentations will only highlight their poor ability to communicate. If weekly management reviews are necessary, inarticulate managers should rely heavily on articulate staff members.

In assessing their own capabilities, project professionals should also be sensitive to their personal values. To a large extent, our own value systems define who we are. They are the perceptual filters that determine how we view the world and offer us guidance on how to behave. Project professionals are not automatons emerging from a common template. Their decisions are governed by their value systems.

Some project professionals may see their project as one small element in their broader life, whereas others may subordinate everything to the project. Operationally, the first will be less willing to put in overtime on weekends, while the second may eat, sleep, and drink project efforts round the clock. Project professionals who are sensitive to their personal values will avoid situations that generate value conflicts, or, if these conflicts are unavoidable, they will at least understand the sources of the conflicts.

Step 4: Define the Problem

Only now, after project professionals are thoroughly familiar with their project environments and their own capabilities, are they ready to intelligently define the problems facing them. The problem definition effort should be systematic and analytical. The facts that constitute the problem should be isolated and closely examined. The basic assumptions underlying the approach to defining the problem should be understood.

Over and over again, the following question should be raised: “What is the *real* situation?” Project professionals who take this approach are unlikely to define the problem according to superficial realities.

Step 5: Develop Solutions

Too often, project staff begin the whole process at this step. They start offering solutions before they fully understand the problem.With such an approach, the solutions they offer are not very useful.

If instead they can exercise self-control and refrain from offering premature solutions while they carry out the first four steps, the ultimate solutions they develop will have the important advantage of

being realistic and relevant to the *real* problem that must be addressed. Consequently, they diminish the likelihood of project failure—that is, of producing deliverables that are rejected, underused, or misused by customers.

Step 6: Test and Refine the Solutions

The solutions devised in step 6 will be rough, requiring further refinement. Solutions must be continuously tested and refined. If project staff have done the proper spadework with the first five steps, this last step should involve no major rework effort, but rather should focus on putting the finishing touches on intelligently developed, realistic solutions.

Project Planning and Control

Tools and Techniques for Keeping the Project on Course

Thus far, we have focused on two major categories of pitfalls commonly encountered in project management: organizationally induced problems, arising from the very structure of projects and the organizations in which they are carried out, and problems associated with the identification of needs and the specification of requirements.
In this chapter, we investigate a third important source of project difficulties: poor planning and control.
Project managers, staff, and customers can be sure that problems in each of these three areas will arise. With this knowledge and an understanding of the specific nature of many of these problems, they can avoid stumbling into avoidable pitfalls and can better manage the difficulties they will inevitably encounter.
In the project management literature, more attention is directed toward planning and control than any other topic. I suspect this is largely a consequence of the fact that project managers and their staff can exercise a high degree of discretion over how they carry out planning and control activities. It also reflects a philosophy that we should devote most of our study time to learning about things over which we have some influence.

On a project, many things happen that are out of our hands and beyond our control. An important subcontractor may go bankrupt, our department budget may be slashed in half, the people assigned to us may not have the skills necessary to do a good job. Project managers facing a steady flow of problems outside their realm of control often assume a reactive posture, responding to difficulties after they occur in the best way they can with a limited tool kit of project management techniques and skills. However, with planning and control, wise project managers can turn things to their advantage. They can assume a proactive posture, planning in advance for problems and finding ways to head them off. Proactive management entails initiating actions that will help project managers anticipate what needs to be done to carry out a project effectively (this is planning) and then make sure things are being undertaken as planned once the project is under way (this is control).
Good planning and control are necessary conditions for project success. It is hard to imagine how an unplanned project with no controls could possibly succeed except, perhaps, through blind luck. Sadly, good planning and control are not sufficient conditions for success. If we want to succeed, we need to be diligent in our planning and control efforts. However, diligence alone will not ensure success, since, despite our best efforts, surprises may arise that have a devastating impact on our project.
In this chapter, I focus on commonly accepted planning and control practices employed on projects. These practices have evolved over the years, arising chiefly from construction and engineering. The techniques described here are relevant to most information age projects.
Their systematic application will help project managers and staff avoid creating problems that should never arise.

THE PROJECT PLAN

A project plan is basically a road map that shows how to get from A to B. Typically, the plan is the launching point of a project—a beginning, a guide to future developments. However, it is important to recognize that a plan is the consequence of a good deal of effort. The plan emerges gradually as needs are defined, requirements are specified, predictions are made about the future, and available resources are tallied. Only after these and other matters are mulled over, pieced together, refined, scrapped, reworked, and refined again do we finally encounter a plan that can serve as our road map.

Plans are generally three-dimensional: they focus on time, money, and human and material resources. Planning tools have been developed for each of the three dimensions. The time dimension is handled through schedules. A broad array of scheduling tools—some sophisticated, some simple—is available for use on projects. These tools enable us to determine when different tasks should begin, when milestones will be achieved, and so on. In this chapter, we examine two of the most common scheduling tools: Gantt charts and scheduling networks.

The money dimension is handled by means of budgets, which lay out how project funds are to be allocated. The need for budgeting is a universal reality in organizations, and most organizations—in the private, public, academic, or nonprofit sectors—spend a substantial amount of effort putting together budgets. Although there are universal principles underlying sound budgeting practice, the specific way in which budgets are formulated varies considerably from organization to organization. Budgeting is a personal thing, reflecting organizational philosophies, attitudes, and structures.

In this chapter, we briefly consider basic budgeting principles; we then devote most attention to examining how budget variances can be used to strengthen project control. In the next chapter, we look at the budgeting issue again when we examine the earned-value technique, a cost accounting technique that is gaining great popularity in project management.

The human and material resource dimension is concerned with how best to allocate the limited resources on projects. Many resource allocation tools exist. In this chapter, we examine resource Gantt charts, resource spread sheets, resource matrices, and resource loading charts.

PLANNING AND UNCERTAINTY

Mastery of planning tools is extremely helpful in managing projects, but even an expert with good tools cannot create the perfect plan. Planning entails the future, and dealing with the future means dealing with uncertainty. A fundamental reality of planning, then, is that it involves uncertainty, which means that even the very best plans are estimates, mere approximations of what the future may hold. Sometimes these estimates can be highly accurate, as when, after completing work on 999 identical houses, a builder estimates how long it will take to build the last house in a 1,000-unit housing subdivision. Uncertainty here is reduced because of ample historical experience on which to base guesses about the future. More often, though, our estimates are quite rough, because what we want to do has never before

been done in precisely the way we need. This is especially true on information age projects. In carrying out these novel projects, we are to a large extent trailblazers, and the maps we devise (our plans) are much like the maps of the fifteenth-century Portuguese explorers, filled with broad, vague spaces labelled *terra incognita.*

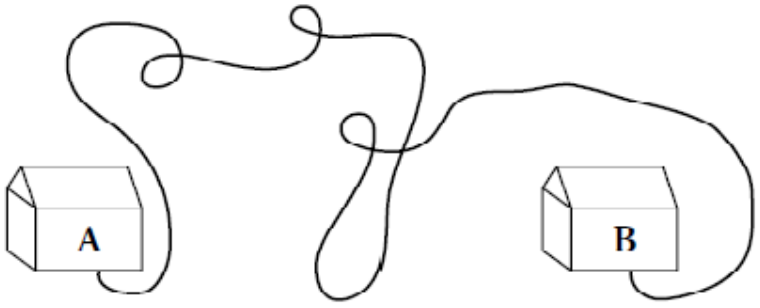
It is important that project managers, staff, and customers recognize how uncertainty bears on the planning effort. The character of the plan is largely determined by the level of uncertainty of the proposed project. With projects involving low levels of uncertainty, we can create highly detailed plans, because we have a good idea of precisely how the project will proceed. When we are building the thousandth identical unit in a housing development, plans can specify precisely how the foundation should be poured, where studs should be placed, where nails should be driven, and so on. Because we have built this particular type of house so frequently, few surprises remain. In fact, in such a situation, we would be remiss *not* to plan in great detail, since these details will help avoid leaving things to chance. Projects with high levels of uncertainty, in contrast, cannot support this degree of detailed planning, because there is insufficient information on how things will proceed. Consider a project aimed at finding a cure for cancer. The researchers undertaking this project have very little idea of what they will find. How they carry out their work depends, to a large extent, on their step-by-step discoveries, so their project plan must be rather vague and imprecise.

Good planning here may mean phased planning. For example, a high-risk two-year project may be broken into six planning phases, with detailed planning initially undertaken only for phase 1 (months one through four). Toward the end of phase 1, detailed planning commences for phase 2, and so on. This method is sometimes called the *rolling wave approach* to planning. To force project staff on a highly uncertain project to develop sophisticated, detailed plans for the whole project is an exercise in futility.

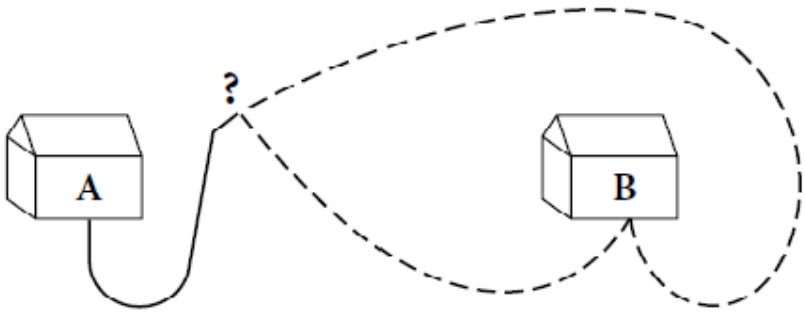
We should bear in mind an important distinction between complexity and uncertainty. I have had participants in my project management seminars ask, “How can you say that there are low levels of uncertainty in building houses and bridges? Even a routine bridge is highly complex and filled with uncertainty.”

That is true. Even a routine bridge *is* highly complex. However, if the bridge is truly routine—that is, if bridges of this sort have been built so many times that the steps for constructing them are clearly laid out—we have a precise idea of what we will encounter in our efforts to build it. By definition, then, we are involved in a situation where uncertainty is low; that doesn’t mean it isn’t complex. The difference between uncertainty and complexity is illustrated in Figure 6.1. In both parts of this figure, we are concerned with getting from A to B. In Figure 6.1a, the path from A to B is long, twisting, and complex. (This pattern is common on construction projects.) Nonetheless, the path is precisely known, and if we carefully follow our map, we will ultimately arrive at B. In Figure 6.1b, we no longer

encounter the complexity of Figure below ; there are few twists and turns. However, we do have a problem when we reach the fork in the road: we are not sure which path will get us to B. In fact, in projects where there are truly high levels of uncertainty (for example, in the cancer project), we are not even certain that B exists. This high level of uncertainty is common on many information age projects.



(a) High Complexity, Low Uncertainty.



(b) Low Complexity, High Uncertainty.

Figure 6.1. Getting from A to B.

PROJECT CONTROL

Project control entails looking at the plan, looking at what is actually happening on the project, and comparing the two. As in project planning, attention focuses on the three dimensions of time, money, and human and material resources.

The purpose of control is to keep the project on track by keeping track of the project. Control serves a feedback function. For example, a driver is in control of her car when, as it veers slightly to the left, she compensates by steering slightly to the right. Analogously, a project manager is in control of her project when, say, after learning from her schedule data that a certain task is falling behind, she directs more resources to the task to put it back on track.

Too often project personnel approach the control function by asking, "Are there variances between the plan and the actuals?" That is, is there a difference between the time we were scheduled to finish a task and when we actually finished it? Is there a difference between what we planned to spend on the task and what we actually spent? Is there a difference between how we thought we would use our human and material resources and how we actually used them?

Without knowing anything about the project in question, I can say yes to these questions and be quite certain that my answer is correct. One of the fundamental realities of project management is that *there will be variances between actuals and the plan.* Remember that all plans are guesses, and while our best guesses may be quite good, it is unlikely they will be perfect. And the higher the level of uncertainty is in projects, the greater is the likelihood that guesses are substantially off the mark.

The question that should be asked is, "Are the variances we encounter on our project acceptable?" By basing our approach to project control on this question, we are taking the realistic position that there will be variances. Our attention focuses on whether the variances we inevitably encounter are reasonable or wildly askew.

To answer the basic control question, we must establish criteria of acceptability for variances. On high-risk projects with high levels of uncertainty, we typically are willing to accept large variances. For example, on the cancer project, we may be willing to live with variances of 20 percent. That is, although the plan stipulates that a given task will cost $1,000, we may be willing to accept a cost overrun or underrun of up to $200.We accept such large variances because we recognize that the plan entails some rather heroic guesswork on how much it will cost to carry out specific tasks.With low-risk projects, such as routine construction efforts, our criteria of acceptability are much more restrictive, because our knowledge of how things should work out on the project is precise. For example, deviations of more than 2 percent from the plan may be viewed as unacceptable on a routine project.

Given that we have established criteria that define acceptable variances, we do not spend much time fretting over tasks that fall within the acceptable range. Instead, our management efforts are directed at reviewing tasks with variances outside this range. If we spend 8 percent more than planned in March and our criterion of acceptability is a variance of plus or minus 5 percent, we ask, "What is happening with this task that is resulting in unacceptable overruns?

During the course of the project, some variance from the plan is acceptable; as the project comes to termination, however, variance for the entire project should approach zero if the project is to conclude close to planned schedule and budget. By the end of the project, the acceptable positive and negative variances that occurred throughout the project should more or less cancel each other out, leaving a near zero overall variance—if we have done a good job of planning and control.

Note the distinction here between *acceptable variances* and *unacceptable project overruns.* Practicality and realism suggest that we must be willing to accept some variance from the plan in the day-to-day operation of our project simply because we lack the perfect knowledge that would enable us to predict exactly what will happen. However, although we may accept 5 percent variances from the plan as the project is being carried out, we may not have the luxury of accepting a 5 percent cost or schedule overrun for the project overall. If we are willing to accept such overall overruns, we should build something called *management reserve* into our budget and schedule. This management reserve covers what we view to be an acceptable overrun for the project as a whole.

HOW MUCH PLANNING AND CONTROL IS ENOUGH?

Anyone undertaking a planning effort or designing a project control methodology ultimately faces the question, “How much planning and control should we engage in?” There is no obvious best answer to this question. On the surface, it might seem that we should always implement a major planning and control effort in order to minimize project uncertainty and be in full control of the project. Our philosophy on this matter might be reflected in statements such as, “You can’t plan too much” and “A project with weak controls is a project out of control.”

Unfortunately, planning and control have costs associated with them. The relationship between project costs and the costs of planning and control is illustrated in the following simple formula:

Project costs = Production costs + administrative costs

This formula shows that increases in the costs of planning and control (that is, administrative costs) drive up total project costs. It also illustrates that increases in planning and control costs mean that we are spending smaller and smaller proportions of our project budget on directly productive activities.

What proportion of the project budget should be dedicated to planning and control costs? Ten percent? Twenty percent? Fifty percent? More? How we answer this question is related to a number of important factors.

Project Complexity

How complex is the project? The greater the level of complexity is, the greater the need is to specify precisely what steps should be taken to carry out the project. In general, highly complex projects need greater planning and control efforts than simple projects. This is exemplified in such complex undertakings as the space shuttle project.

Project Size

Very large projects require enormous amounts of coordination. On such projects, it is easy for details to get lost in the shuffle, easy for us to lose track of what has been done and what should be done. Consequently, planning and control must be highly formal on large projects, with detailed rules developed that describe how the project should be undertaken.

On very large projects—say, over $200 million—administrative costs associated with planning, coordinating, and controlling may constitute from one-half to two-thirds of the total project cost. Such a high overhead on a $10,000 project would be ridiculous, since the small size of the project makes it possible to keep track of things in a more relaxed, less formal way. On small projects, we should start worrying about over planning and too elaborate controls when the administrative costs begin edging over the 15 to 25 percent range.

Level of Uncertainty

It is often futile to develop elaborate plans and employ sophisticated control techniques on projects with high levels of uncertainty. As we know, the problem with such projects is that we have very little information about what the future holds. Given great uncertainty, it is guaranteed that the plan, however elaborate it is, will undergo continual modification, so that detailed planning and stringent controls may not work. In fact, they may actually hurt a project if they enforce rigidity on a project that needs flexibility. Projects with low levels of uncertainty can support detailed planning and tight control, because we have substantial knowledge of what is necessary to bring them to fruition.

Organizational Requirements

Organizations vary widely in their approach to planning and control. The business press is filled with stories of companies that make it a habit to rush into projects without planning adequately for them, as well as tales of companies that go through an elaborate planning exercise before they make any important decisions. We often read of companies tottering on the brink of bankruptcy because of loose corporate control over operations, as well as companies with such tight control systems that management knows precisely how every penny is spent.

In general, organizations with a corporate culture that places emphasis on good corporate wide planning and control employ good planning and control practices on their projects. The danger here is that senior management may require project managers to go through the same planning and control procedures with a $3,000 project as with a $10 million project. Organizations in which corporate culture tolerates sloppy planning and control procedures are likely to foster

projects that are poorly planned and controlled.

User Friendliness of the Planning and Control Tools

If planning and control tools are difficult to learn or cumbersome to use, their employment on the project is likely to reduce project efficiency and drive up administrative costs. There are a large number of software solutions being sold that are designed to help organizations manage project schedules, budgets, and resource allocations. They vary substantially in learnability and usability. In selecting an appropriate software solution, buyers should consider user friendliness as well as technical features.

PLANNING AND CONTROL TOOLS: THE SCHEDULE

A major portion of the planning effort entails determining the relationship of different tasks to each other and then scheduling these tasks in such a way that the project is carried out efficiently and logically. A number of tools have been developed over the years that make this undertaking rather routine. The M.S project (Microsoft project) and primavera programme are very important for this issue.

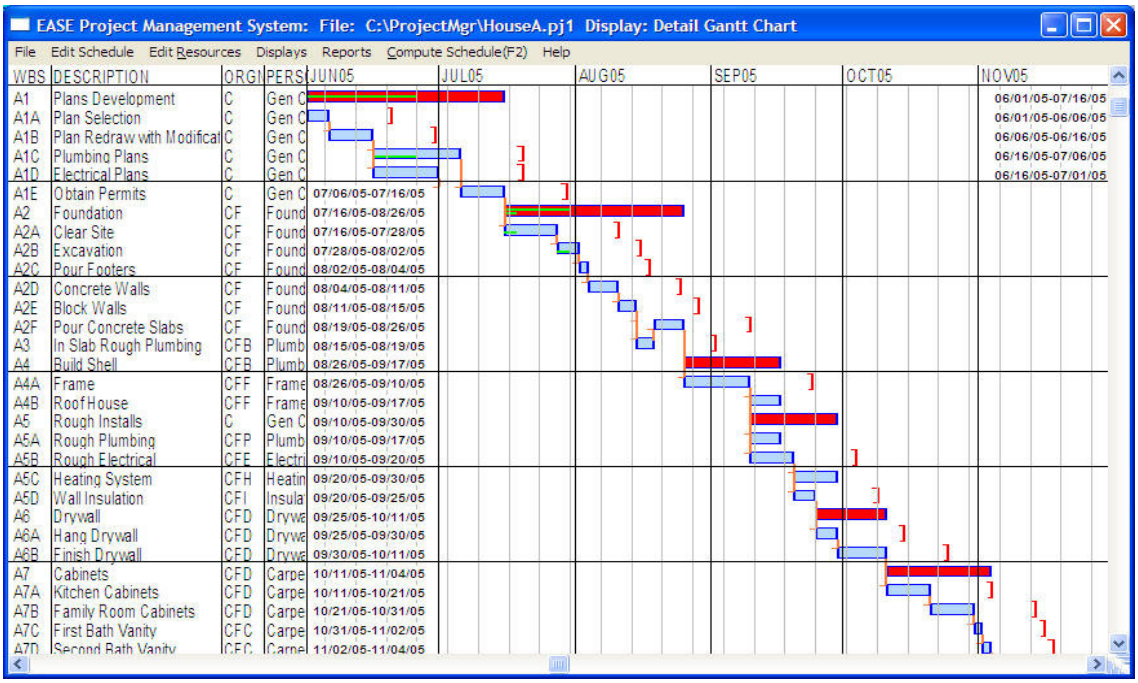
Microsoft Project

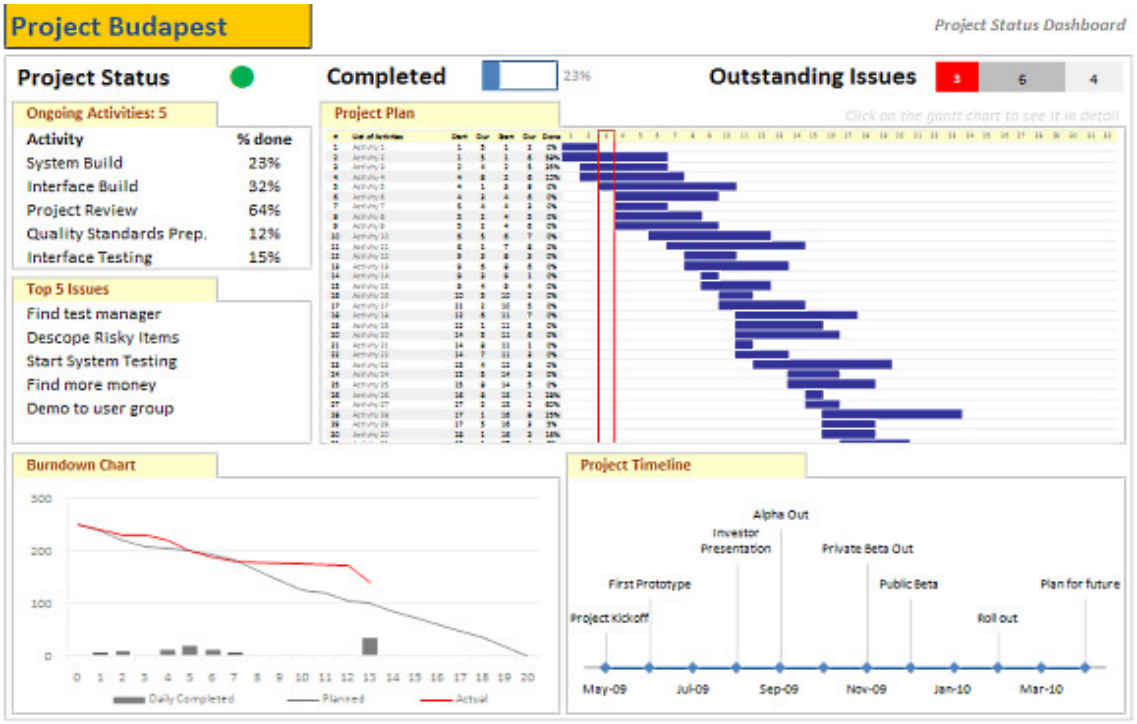
(MSP, MSOP or WinProj) is a project management software program, developed and sold by Microsoft, which is designed to assist aproject manager in developing a plan, assigning resources to tasks, tracking progress, managing the budget, and analyzing workloads.

MS Project was the company's third Microsoft Windows-based application, and within a couple of years of its introduction it became the dominant PC-based project management software.

Project creates budgets based on assignment work and resource rates. As resources are assigned to tasks and assignment work estimated, the program calculates the cost, equal to the work times the rate, which rolls up to the task level and then to any summary tasks and finally to the project level. Resource definitions (people, equipment and materials) can be shared between projects using a shared resource pool. Each resource can have its own calendar, which defines what days and shifts a resource is available. Resource rates are used to calculate resource assignment costs which are rolled up and summarized at the resource level. Each resource can be assigned to multiple tasks in multiple plans and each task can be assigned multiple resources, and the application schedules task work based on the resource availability as defined in the resource calendars. All resources can be defined in label without limit. Therefore it cannot determine how many finished products can be produced with a given amount of raw materials. This makes MS Project unsuitable for solving problems of available materials constrained production. Additional software is necessary to manage a complex facility that produces physical goods.

The application creates critical path schedules, and critical chain and event chain methodology third-party add-ons also are available. Schedules can beresource leveled, and chains are visualized in a Gantt chart. Additionally, MS Project can recognize different classes of users. These different classes of users can have differing access levels to projects, views, and other data. Custom objects such as calendars, views, tables, filters, and fields are stored in an enterprise global which is shared by all users





PLANNING AND CONTROL TOOLS: THE BUDGET

One major responsibility of many project managers is developing and adhering to a budget for the project. Often they will be rated a success or failure as project managers according to whether the project comes in under, on, or over budget.

Overshooting the budget can have serious consequences for project managers and the organizations in which they work. Consider a project that is funded through a contract: a cost overrun may lead to litigation, penalties, and financial losses for the performing organization. If the project is funded internally, an overrun may lead to a serious drain of scarce organizational resources.

In view of the importance of budgeting, it is not surprising that many organizations focus much of their management attention on that area. Consequently, many organizations have well-developed budgeting techniques that are custom-made for the organization's particular environment and operating style.

Components of the Budget

Project costs are typically composed of four components: direct labor costs, overhead, fringe benefits, and auxiliary costs. *Direct labor costs* are determined by multiplying the workers' hourly (or monthly) wages by the amount of time that they are expected to spend on the project. In most service projects, which are not capital intensive, direct labor costs are the largest component of project costs.

Overhead costs are the typical expenses incurred in maintaining the environment in which the workers function. Included here are the costs of office supplies, the electric bill, rent, and, frequently, secretarial expenses. It should be noted that what is treated as an overhead expense in one organization may be given different treatment in another. In an organization that does not typically use secretarial service, for example, secretarial expenses might be included as a direct labor expense or even as an auxiliary expense. Overhead costs tend to be relatively fixed in relation to direct labor costs. For example, if over the long run labor costs increase by 50 percent, overhead costs similarly tend to increase by 50 percent.

Fringe benefits are nonsalary benefits that workers derive from the organization. They include the employer's contribution to the workers' social security payments. Depending on the organization, they may also include employer contributions to the workers' health insurance, life insurance, profit-sharing plan, stock options, pension plan, bonuses, and university tuition. Fringe benefit expenses are also directly proportional to direct labor costs.

Auxiliary expenses are project-specific expenses that the organization does not incur with any obvious regularity. Project travel expenses, purchases of special equipment and materials, computer time, consultant fees, and report reproduction costs are typical items in this category.

Overview

A project manager is a professional in the field of project management. Project managers can have the responsibility of the planning, execution and closing of any project, typically relating to construction industry, architecture, Aerospace and Defence, computer networking, telecommunications or software development.

Many other fields in the production, design and service industries also have project managers

A project manager is the person responsible for accomplishing the stated project objectives. Key project management responsibilities include creating clear and attainable project objectives, building the project requirements, and managing the triple constraint for projects, which are *cost*, *time*, and *quality*.

A project manager is often a client representative and has to determine and implement the exact needs of the client, based on knowledge of the firm they are representing. The ability to adapt to the various internal procedures of the contracting party, and to form close links with the nominated representatives, is essential in ensuring that the key issues of cost, time, quality and above all, client satisfaction, can be realized.

The term and title 'project manager' has come to be used generically to describe anyone given responsibility to complete a project. However, it is more properly used to describe a person with full responsibility and the same level of authority required to complete a project. If a person does not have high levels of both responsibility and authority then they are better described as a project administrator, coordinator, facilitator or expeditor.