

# 1

# PROJECT MANAGEMENT FUNDAMENTALS

COPYRIGHTED MATERIAL



# 1

# Project Management Fundamentals

The goal of this book is to help the reader become a more effective construction project manager, or to help a construction company carry out more effective project management and control. A major element in the process of project management is scheduling the work of the project, and then keeping it on track and on time as the project unfolds. This book is devoted specifically to that part of the project management. However, if we are to schedule as effectively as possible, it is important for us to understand the underlying principles of management as they relate to project management generally and scheduling specifically. These general principles form the basis for specific tasks we must execute as we schedule and control a project. The following chapter is, therefore, aimed at helping the reader understand these principles as a starting point for subsequent chapters.

## WHAT IS MANAGEMENT IN GENERAL?

The general principles of management are probably one of the most widely known subject areas in the modern world. The concepts involved in managing enterprises of all types, whether in business or government, are of intense interest to individuals working at all levels of organizations all over the world,

The question is: What are these principles and how can they be useful to those of us who manage construction projects? To develop a set of tools that can be useful for us, we should look at a basic general definition of management and work forward from basics to specifics.

To begin with, a basic definition: “management is the process of planning, organizing, directing, and controlling.”

The concepts contained in this definition are so well known that a web search for these exact words yields over 4,750, 000 “hits”!

We can further extend this definition by looking at the specific concepts contained within it. The ideas that are most important to us for purposes of schedule and control construction project are these:

- Goals
- Process
- Planning
- Control

At the very beginning, we recognize that **goals** are always involved. In a philosophical sense, without a set of goals, there is no point in even taking actions. In practical terms, a construction company or manager must have profit as an overall goal, and completing the work on time is an essential part of meeting profit goals. Establishing smaller and more focused short-term goals is a very important part of the overall task of project management.

**Process** can be defined as a set of continuing systematic actions over time. The management process must be carried on continually throughout the life of the job or company. Management must be done in a **systematic** way, which means an orderly, regular, and dependable way, using a set of established procedures or methods.

Management also means that **decisions** must be made in order to achieve the goals of the project or company. These decisions must be made **rationally**, that is, based on facts, not hunches or inaccurate information. One of the primary reasons for setting up a systematic, orderly method of management is to deliver accurate, timely information to the decision makers on the job.

Once a sound project management system is in place, the project manager may use it to carry out the more specific functions of **planning** and **controlling**. *Planning* can be defined as deciding what tasks must be performed to accomplish the goals of the project. This means establishing realistic schedules and budgets, coordinating resources to get the work done, and most importantly, making sure everyone knows what the plan of action is.

**Controlling** is the final action in the management process. To achieve and maintain control, the project manager must monitor the progress of the job. When short-term goals are not being met, the project manager must take action to get everything back on track.

## WHAT IS PROJECT MANAGEMENT?

While these fundamental ideas can form a basis for our management practices, we still have to translate them into more specific terms and actions. The tasks in the following list grow out of these concepts and are the focus of this book.

1. First, we must establish and focus on goals that will be general at first, then increasingly specific and job-oriented as we plan the work.
2. Second, we must establish an effective management process that will operate in a systematic manner.

3. Third, we must use this management process, or system, to make the best possible decisions coordinating the work of our project, and then continue planning and controlling the work throughout the life of the job.

Having defined the three major project management tasks, we can begin to focus on the more specific jobs of the project manager.

## Setting Goals

The first task of the construction project manager is establishing goals. Many goals have already been set by the project estimate and contract documents. A primary purpose of the estimate is to arrive at a cost for the project, while the contract establishes the time required for completion. Neither of these goals—cost or time—can be altered in any significant way by the project manager. However, the project manager can set intermediate goals for the construction process, goals that meet the ultimate requirements of cost and time.

## Creating a Project Management System

After setting goals for the project, the next task of the project manager is to establish control through an effective management system. There are two approaches to project management. They are: (1) proactive—aggressive management ensuring that the job proceeds as planned by the manager, or (2) reactive—spending money and reacting as events occur and letting circumstances run the job. The latter, reactive scenario tends to occur if the manager fails to set up a properly organized, thorough, and methodical management system. This approach almost certainly guarantees that a job will overrun time and budget allowances, and generally cause much grief to all concerned.

The management system should be designed to address the following elements:

**Time:** A plan of action must be established to ensure the work is done in the correct order or sequence and within the time allowed.

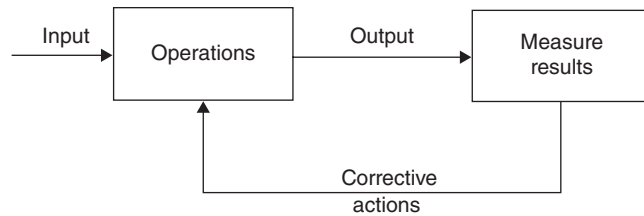
**Cost:** The work must be performed efficiently if the contractor's goals are to be met.

**Resources:** It must be determined in advance when and how much of each resource (such as particular categories of labor, equipment, or materials) is needed to do the work. One must then ensure that the resource is provided when and where needed. Resource management supports the effort to control time and cost. The information used by the project manager to perform this task is developed from the time and cost information data.

**Finances:** Ultimately, time and resources translate into dollars. Thus, the financial control function means accurately predicting the amount of cash needed to support all the work done on the job.

## Managing the Project

The third task of the project manager is to manage the project as it proceeds, using the project control system to best advantage. In the simplest terms the project



**Figure 1.1 Basic feedback loop**

manager must know if the project is heading in the right direction to meet its goals? Project control is best illustrated as a *feedback loop*, shown in Figure 1.1.

Managing the project begins with the input of data on labor, materials, and equipment—the resources used to build the project. As the work is performed, the output, or productivity, is measured to see if it is meeting the goals set for the project. If it is not, corrective action must be taken.

Project control can be illustrated by comparing it to a feedback loop used in machine control. For example, a cruise control on a car measures the speed of the car, compares it to the preset speed, and if there is a variation, either adds or reduces throttle to return the speed of the car to the preset limit. If the cruise control fails to function properly, the car either takes a long time to reach its destination or the driver gets a ticket. Using feedback to manage and control a construction project, however, requires a few more steps. The project manager must perform the following tasks.

**Plan:** Realistic, usable schedules and budgets must be established for all phases of the job. These guidelines will serve as a “blueprint” for building the job. The schedules and budgets should be based on the original estimate and contract requirements. They must reflect the commitment of the people who will have to carry them out.

**Communicate:** Once developed, the plans must be communicated clearly and effectively to the people who will be executing them. Emphasis must be placed on providing clear, usable visual displays, particularly for scheduling. It is also wise to recognize that the professionalism shown by the project manager in planning and communicating on the job site has a very real effect on employee morale and effectiveness. A sloppy plan, poorly organized and executed, gives employees the impression that they work for a slipshod organization. Pride in their work will be affected accordingly.

**Monitor and control:** After the plans have been developed and communicated, they must be carried out by project personnel. Realistically, some unexpected events could interfere with the original plan. If this occurs, the project manager must take steps to ensure that the project goals are met. This means taking action to bring the job back in line with the original plan, or revising the plan to fit the new situation.

If the project manager is to effectively deal with delays, the management system must provide him or her with the most current information. This monitoring

function involves collecting data on time and cost, and comparing this information to original projections.

Once the project manager is aware of the current job status as compared to the original plan, actions can be taken to meet the original goals. These actions can range from adding more crews to speed up sheetrock installation to completely changing the installation sequence of complex formwork.

Two other points should be made about the feedback loop. First, construction job sites can be very busy places, with many activities going on at one time. Therefore, it is important that the management system be *exception-oriented*. That is to say, the system should be designed to specifically point out those items that are at variance with the plan, and to essentially ignore those that are proceeding on schedule. Without an *exception-oriented system*, the project manager is in danger of being overwhelmed with detail, while key areas may be overlooked.

Second, the information provided must be timely, so that problems are caught and recognized early in the game. Problems on a job tend to worsen at an accelerating rate. It is important to catch them before they have a chance to become major disasters.

The key to monitoring and control by project management is making frequent checks of job status and, if necessary, taking action to ensure that the project's goals are met. Failing in either checking or acting will result in a failure to meet the project goals.

## WHY USE PROJECT MANAGEMENT?

In the previous sections, we have recommended an overall strategy for project management and control. There is still, however, some feeling in the construction industry that all these management procedures and paperwork is not really necessary—that one can monitor the job effectively enough by walking around the site to ensure on-time completion and a profit. After all, that has been the way superintendents have managed construction since the time of the pyramids. In reality, the current state of the construction industry is such that more effective techniques for control and management on the job are essential.

The recent history of some construction projects is sadly one of the reasons why old methods of project control are no longer effective. Today's construction projects are complex and very different than in the past. For example, building environmental control systems have replaced simple heating systems. Structures may now consist of high-, early-strength, post-tensioned concrete floor systems with shear walls, where we once had simple flat slabs and columns. Windows have become complete "exterior enclosure systems." This means a greater variety of jobs to be done, and a greater percentage of subcontractors. Architects and owners have a much wider range of materials and systems to choose from; thus, very few projects are the same.

The increased variety of construction materials and methods has generated more detail than can be managed effectively by one person. In the past, one individual

could carry out most of the management tasks since only the basic trades were involved, there was an architect and an owner, and the contract was straightforward. Today's project manager must coordinate specialized subcontractors and work with design specialists who are, in effect, subcontractors of the architect. Many regulatory agencies have also entered the picture. The total management work load has increased to the point that a team with a comprehensive, well-designed system of control is essential. Contractors who attempt to deal with this new situation in the same old ways have encountered enormous problems.

At the same time, owners who purchase construction services have found themselves operating in business environments that are more difficult than before. Many of them now face rapidly changing markets and have had to adopt new computer-based management systems. These companies now insist that contractors who build their projects adopt some of the same kinds of methods and show they can also operate effectively in a fast-paced environment. A contractor not using up-to-date methods is at serious competitive disadvantage. In some cases, owners have even dictated operating methods to contractors. The demands of clients provide yet one more good argument for good project controls.

Good project controls can help keep us out of the legal arena—first by making it more likely that we will perform better, thus reducing the reason for legal action—and second, by providing us with a better set of documents with which disputes may be more easily resolved.

## **THE BENEFITS**

Having reviewed today's situation and having seen the need for an improvement in management, the question arises—why use scheduling? Above all, it should be used because it has proven effective on construction jobs. In particular, the use of critical path method (CPM) scheduling (and the implementation of this method using computers programs) is clearly both workable and cost-effective.

While a computer and good control systems are not a panacea and will not do the manager's job, they are very helpful in providing a way to set up target plans, track events on the site, and examine alternate ways to correct the schedule of work in the event of deviation from the original plan. A good control system is especially helpful to the manager in pinpointing the problem areas and, therefore, helps to manage and reduce the information overload. While such an approach may not guarantee success in terms of cost and time, the intelligent use of control systems definitely increases the odds that success will follow the project manager's efforts.

## **Better Organization**

One of the benefits of using good management systems is that they encourage, or even force, better organization and planning. This is a vital influence since one of the biggest failures of managers in the construction industry is a lack of planning.



Effective monitoring and control must start with a workable plan. It has even been said that 75% of the value of creating a CPM schedule is the initial planning that must accompany the process. This statement may be an exaggeration and probably reflects the fact that people in the field sometimes tend to be less rigorous about updating and monitoring a schedule as the project progresses. Nonetheless, a well organized initial plan starts the job off right.

Using control systems also forces the manager to look at how all of the available resources will be assembled and used. It encourages better purchasing and timing, and reduces wasted motion.

## **A Good Basis for Coordination**

A major problem for many contractors is subcontractor scheduling and coordination. A big part of the solution is communication. If the project manager and superintendent maintain an up-to-date schedule and require the subs to attend regular job schedule meetings, all the parties on the job will be operating from a base of common agreement. Also, the regularly scheduled meetings encourage subcontractor participation in the scheduling process. This participation promotes a sense of commitment to the project.

In general, better coordination benefits all of the parties to a project—the owner, contractor, designer, and subcontractor. Delays are prevented rather than reacted to, costs are contained early, claims prevented or resolved earlier and more amicably. The result is a better profit for all.

## **Management by Exception**

As noted, a major challenge for today's project manager is tracking vast amounts of detail. Computers provide an advantage as they are very good clerical and record-keeping devices. Most of the computer-based management systems used today take advantage of this capability, and promote the exception-based management approach. The systems can be set up to track all work but report only those elements of job progress that deviate significantly from the original plan. This leaves the project manager free to devote his or her construction knowledge and skill to the problem areas, leaving the on-schedule areas to proceed to completion.

Another key point in a computer-based management system is providing early detection of problem areas, thus helping to prevent unpleasant surprises. This early detection is critical to correction since, as we all know, problems on construction sites never get better without attention; they only get worse.

## **Better Decision Making**

A good, up-to-date management system and the associated techniques will in all cases provide the basis for better decisions on the job. Accurate information is an absolute necessity for sound decisions. Such a system should be designed to display

the essential data and to weigh the effects of alternate plans of action. Many experts suggest that a better term for *project control systems* is *management information systems*. Regardless of the name applied, a good system properly used should result in better decisions, and thus, better results.

## VARIABLES THAT AFFECT THE PROJECT

While the benefits of project management are clear, it must be noted that a good project management system—whether manual or computerized—cannot be implemented without an investment of money and time on the part of corporate management. It is, however, an investment that brings a definite and positive return. It is certainly worthwhile to review some of the common problems associated with developing better project management. Forewarned, one can at least minimize these problems. Later chapters of this book will cover the procedures and possible pitfalls in more detail.

### Personnel

In any change, people must be the first consideration. First, the installation or development of new project management techniques must directly involve the people who will be responsible for the results. Probably the worst possible approach is to simply choose a technique or system, and say, “*you will* use this system.” The people involved should be recognized as knowledgeable, competent, and concerned about their job performance. Their professionalism will also be helpful in choosing and operating any new and better procedure. They must be brought into the decision making and changeover process.

Job-site personnel may be somewhat intimidated by new methods. For example, a superintendent may fear that a new scheduling or cost system will have the home office constantly looking over his shoulder. Or a project engineer may feel uncomfortable with a new, unfamiliar system, fearing failure due to lack of knowledge. The solution to these kinds of problems lies in: (1) dealing honestly with the persons involved, with an emphasis on team improvement and the removal of threatening elements, and (2) training, which will clearly demonstrate the company's commitment to improvement and willingness to continue investing in its employees.

### Cost and Organizational Concerns

The project manager must recognize that implementation of better management techniques will cost real dollars and will require some organizational changes and adjustment. As previously noted, the benefits justify the investment of time and money, however.

Organizational changes clearly involve people. To begin with, any improvement in the system must start with the wholehearted commitment and backing of the company's management. Without it, it is difficult for a single project manager to undertake significant improvement in techniques.

It is also important that company management approach the problem professionally. If, for example, the company president's attitude toward installing and developing a new project control system seems sloppy and half-hearted, company personnel will perceive that the president does not really care about good project control. The development of a better project control system is probably doomed from the start in this circumstance, since the people who have to carry the work out will not devote anything like their best effort to a project that they feel the president will not reward.

Another organizational concern is inflexibility, or rather the fear of it, among construction people. The personalities who do well in the construction field are traditionally self-reliant and individually competent. They prefer to work with little supervision and to be judged on results, not methods. Also, most field supervisors have more than a few good ideas themselves, which they are willing to share with upper management. A new technique or method should, therefore, be flexible enough to allow for this kind of individual approach in the field. The emphasis should be on making the burden as light as possible for the field, with the information as accessible and usable as possible.

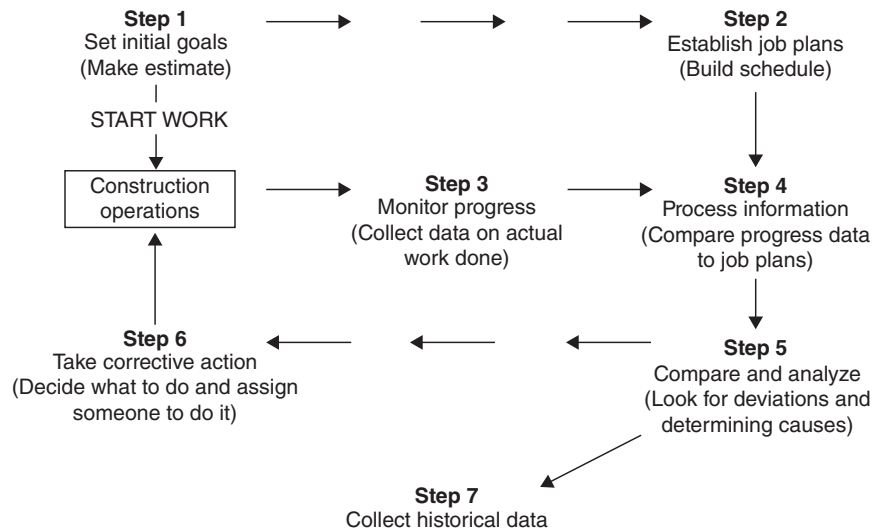
One final note concerns the importance of communications. When new procedures are being discussed and changes are in the wind, rumors are inevitable and may hurt morale and cripple the effort to change for the better. Such rumors are best countered by full and open disclosure to project personnel whose lives and professions are directly affected.

## THE PROJECT CONTROL CYCLE

So far, we have discussed planning, organizing, plus monitoring and controlling, functions that are at the heart of the project manager's job. These concepts can serve as a model for setting up the specifics of operating our project management system, including our most essential tool—the feedback loop (see Figure 1.1). This basic feedback loop does not, however, cover all of the details that must be dealt with on an actual project. The Project Control Cycle, shown in Figure 1.2 and discussed here, illustrates the practical workings of project management.

### Step 1: Set Initial Goals

The first step in the project control cycle is setting initial goals. This step typically occurs before the job is even awarded to the contractor. The initial goal is generally no more than a profit goal for the project, in the form of an estimate. Regardless of whether that estimate is conceptual or fixed, or something in between, it serves as a limiting factor, along with the time allowed in the contract documents. Simply put, no future budget for construction should exceed the costs anticipated in the estimate, nor can the time planned in a schedule exceed the number of days permitted under the terms of a contract. The detailed development of estimates is not within the scope of this book. However, using the estimate and contract documents to develop the intermediate goals and job plans is covered in subsequent chapters.



**Figure 1.2 Construction Project Control Cycle**

## Step 2: Establish Job Plans

This second step, establishing job plans, typically occurs after the job has gotten under way, and crews and equipment have moved onto the site. It may not seem advisable to start without a control mechanism completely in place. However, initial conferences will typically have been held during the period right after contract award. Information gleaned during this time may provide a good basis for initial decisions. Such decisions are later developed into detailed job plans.

Establishing job plans for scheduling is done in a three-step process. First, the overall job is broken down into workable parts or *activities*. These activities can be analyzed and planned independently for maximum efficiency. Second, the activities are strung together in a realistic order of work, which is then converted into a *logic diagram*, or network. The third and final step involves *network calculations* to determine at what time and on what dates each activity should occur. The final result is a comprehensive plan which serves the following two functions: it is a guide to action by all those involved with building the job, and it can later be used to effectively cope with the inevitable changes that will occur.

## Step 3: Monitor Progress

After the job is under way and detailed plans have been drawn up in the form of a budget and schedule, the job-monitoring system must be established and used by the project managers. The first part of this process is carried out on the construction site at regular intervals, and involves monitoring the actual events that occur on the project, to be compared with the schedule later in the cycle.

Schedule monitoring is done on an activity-by-activity basis, again reflecting the very important concept of dealing with workable-sized units of the job at all stages.

Typically, each activity is labeled with the following information: start time, duration of work, and anticipated final completion.

## Step 4: Process Information

This activity occurs throughout the monitoring and control process. A computer or manual procedure is used to manipulate the data collected during the monitoring phase. The data is set up so that it can be compared with the plans developed earlier. This processed information enables the project manager to determine whether or not the project is deviating from the planned order or rate of progress, and if that deviation is significant enough to warrant action.

The key element in this information processing phase is the management of the project control *system*, as distinct from managing the project. The processing and use of the plans and monitoring of data depends in large part on having logical and workable coding systems. Also needed is a regular, efficient, and workable procedure for quickly and accurately developing comparison reports for management.

As projects grow larger, managing the project control system becomes more and more a full time job for a specialist. However, this does not mean that a project management system cannot be operated without specialized job site personnel. The key is having a system that is appropriate for the job at hand.

## Step 5: Compare and Analyze

In Step 5, the project managers review the information developed by the system in the last stage in order to determine the actual state of the project. Report formats must be selected to best support typical job decisions, and other methods established for efficient exception reporting. The greater the efficiency, the more the project manager's efforts can be directed to those areas of the project that are most in need of management attention.

## Step 6: Take Corrective Action

Taking corrective action represents the final step—acting to rectify an aspect of the job that is not going according to plan. A complete evaluation of Step 6 would include a wide range of topics, since the project manager must deal with technical questions relative to the actual delay or cost overrun.

It is fairly common in construction for deviations from plan to be noted but not followed up on by project personnel. This is equivalent to not monitoring the job at all, and it means that not only is the effort spent in developing a project management system wasted, but the job is also likely to end up behind schedule and over cost. The project management feedback cycle must have all its parts working in order for the job to be properly run.

## Step 7: Collect Historical Data

Step 7 occurs on the expanded project control cycle but does not occur on the general feedback cycle. It involves collecting data on what has happened on the job.

Ideally, the results of the job are recorded for two purposes: first, to serve as a basis for planning future jobs, and second, to serve as a thorough record of actual events in case claims arise.

## INTRODUCTION TO CPM SCHEDULING

It is essential that construction companies maintain and use good scheduling systems so that projects can be kept on track and can be completed on time. The best available method for doing this is the critical path method.

### The Critical Path Method

The emphasis of this book is on how to use critical path method (CPM) techniques of construction scheduling. The following chapters emphasize the techniques available to a project manager. CPM has proven to be the most useful and effective means of developing and displaying the information needed to control the time variables on today's job sites. The basic CPM technique was developed in the late 1950s, primarily for the purpose of controlling large manufacturing and construction projects. It has been further developed and refined since, and has evolved into a tool that is well suited to the construction process.

Most people familiar with the construction process recognize the fact that a project is composed of tasks that are separate, yet interdependent. For example, in building a house, both foundation and stud wall are essential elements. The crew that forms and places the foundation is very different from the one that erects the stud walls. Nevertheless, these tasks are interdependent in that the walls cannot begin until the foundation is complete. The most difficult task in construction is keeping track of tasks and deciding on the correct order and timing, of a large number of these individual, yet interrelated tasks; the CPM of scheduling addresses this issue.

The CPM technique is simpler and more flexible than it might first appear. It takes the building process one step at a time and separates the project into workable subparts or activities. A plan is made for each activity to be performed in the correct sequence. The task of scheduling becomes a systematic, one-piece-at-a-time endeavor.

The basic steps, or phases, of scheduling are:

- A. Planning
- B. Scheduling
- C. Monitoring and controlling

Each of these phases has substeps. The first phase, *planning*, involves:

1. Breaking the project down into workable subtasks, commonly called *activities*
2. Deciding the order in which these activities are to be performed

The result of the planning phase is a logic *diagram*, or *network*, which is an initial graphic representation of a plan of what to do and the order in which to do it. This phase of the process is illustrated in Chapter 3.

The second phase, *scheduling*, adds a time element to the planning phase; the sub-steps for this phase are:

1. Determining a reasonable duration for each individual activity
2. Calculating the duration of the project as a whole

The product of this second phase is a series of time plans, typically presented as *planning schedules*, or *bar charts*. This type of display is shown in Chapters 4 and 5.

The last phase, *monitoring* and *controlling*, consists of:

1. Measuring the progress of the project
2. Comparing the actual progress against the schedule developed during the scheduling phase
3. Taking corrective action if the actual progress deviates significantly from the schedule

The monitoring and controlling phase is covered in detail in Chapter 6.

## Learning CPM Techniques

Many people who have tried to implement the critical path method have found it a difficult task. Most of this difficulty stems from not recognizing the basic simplicity of the process, and from being overwhelmed by the “gurus” of scheduling who have made the process seem far more complex than it really is. Much of this book is devoted to straightforward, workable techniques for CPM scheduling. As these techniques are presented, it is helpful to keep in mind the following general guidelines.

First, take the process one step at a time. The chapters of this book are presented in the same, step-by-step manner, outlining each of the major tasks that must be performed in order to achieve effective construction project management. These tasks and methods are discussed in the actual order in which they would occur on a project.

Second, recognize that the CPM technique is a way of representing what a manager intends to do; it does not require that the manager build in an unfamiliar way. Modern CPM techniques and software systems have more than enough flexibility to represent virtually any possible plan of action desired, so there is no reason to have the “tail wag the dog.”

Third, the project manager and other project personnel should recognize that using CPM effectively will require an investment of time and energy on their part. Using CPM requires skill, and no skill can be developed without some effort in learning it. To use an analogy, no one in construction would expect to use a new laser surveying system without some training and practice. CPM is like the new laser surveying system in that it is a better productivity tool but requires an initial investment of time as well as money. CPM is also like the new surveying system in that no contractor is likely to continue with an old tool when his competitors are using a new and more productive one.



Fourth, developing schedules is a creative process. It is analogous to an architect developing a set of plans for a building. No one ever created a set of working drawings without first going through a lot of sketches on tracing paper, then schematic and design development drawings, and finally, working drawings. Those developing a CPM schedule should be prepared to do a lot of erasing and rewriting as decisions are made and altered, and the plan of action develops.

## Potential Pitfalls of Using CPM

First and foremost among CPM's potential pitfalls are those related to the human element. It is very common, for example, for a contractor to require the use of CPM for scheduling projects, and to use schedules that are developed and presented by professional schedulers. These professional schedulers have no stake in the outcome of the project, and they may fail to consult the project manager and other project personnel. The result is a schedule that frequently does not reflect reality, and certainly not the project manager's reality. In this situation, those who are responsible for the performance of the project are, in effect, being told how to run the job, and may, quite understandably, be resentful. As a result, the schedule may be largely ignored by field personnel and become useless as a monitoring tool. In this case, the job as a whole suffers, and the management of the company is unable to monitor progress until it is too late to correct the overruns.

The best way to avoid an unrealistic schedule is to provide project management with the tools and training to develop and use CPM effectively, and for top management to require its use in tracking and reporting progress. This is the ideal, in which every field manager regards good scheduling as an essential part of his or her job, and has the skills to use it properly. In the real world, the company's management must be sure that any schedules developed by others reflect the thinking of the field personnel, and that field personnel see the schedulers and the schedule as serving them and not as an imposed duty. If the schedule does not reflect the thinking of the people who have to live with it, it will not have their commitment, and cannot be effective.

Second among potential pitfalls is too much complexity. This problem can usually be identified when the schedule reports tend to gather dust rather than fingerprints. The schedule may be particularly susceptible to this problem when a "sophisticated" computer system is used. The problem brought on by complexity is that the schedule does not serve the project managers, but rather becomes an end in itself, and is ultimately ignored. The computer's capacity for generating large amounts of paper seems to be very difficult to resist, and quite often one or more of the following occur.

- Huge volumes of reports are generated that are so complex and bulky that it is difficult to read them all, much less pick out the important ones.
- The reports are confusing or are in an inappropriate format, and do not concentrate on the problems at hand, that is, they do not promote management by exception.
- The project manager is flooded with detailed reports when, in fact, summary reports are needed, or vice versa.
- There is a severe lack of flexibility in the reports or in the schedule itself.



## INTRODUCTION TO THE SAMPLE BUILDING PROJECT

Now that we have discussed—in general terms—the main steps that are performed in the scheduling and controlling process, we can begin to look at them in detail and explore techniques for actually running a project. Subsequent chapters develop these ideas and tools step by step, using a sample office building project, which is included in this chapter. The goal is to provide the reader with a demonstration of what real scheduling would be like. The reader is, therefore, invited to become familiar with the sample project, just as he or she would on a real project, and then follow the process through as the chapters unfold. Ideally, at the end of the book, the reader will then have some real skills in scheduling and a sense of how the process proceeds.

The sample project is a hypothetical corporate vehicle maintenance facility, and is “designed” to contain features that are typical in small-scale commercial buildings.

The contract itself is assumed to be a fixed-price, fixed-scope arrangement between an owner and a general contractor. All code and zoning approvals have been obtained, and construction can begin immediately upon receipt of the notice to proceed. Contract time allowed is 270 calendar days.

The site is located on a city street in an industrial park. The existing slope of the site is minimal, and bringing the site to finish grade does not require large amounts of excavation. The site plan contains a large parking lot to allow for vehicle parking and movement during servicing. The paving is asphalt over graded aggregate base with concrete curb and gutter, and runoff is handled by catch basins and 18-inch corrugated metal pipe storm drains.

The building itself contains two main areas, which are a high bay space for actual vehicle servicing, and an attached office and training area. The structure of both spaces consists of CMU walls with steel joist roof structures, with concrete floors.

The vehicle servicing area is designed for handling pickup trucks and light vans. It has four service bays with roll-up doors at both ends, and a service pit under two of the bays which allows easier access to the underside of vehicles. Also, the servicing area contains vehicle lifts, oil and lube, coolant and air conditioning service equipment, as well electrical and pneumatic power outlets. Heating of this space is done with suspended gas-fired heating units. Compressed air is provided by an air compressor located in a adjacent room

The office and training area is finished space, with steel studs and gypsum wall partitions, suspended ceilings, and varied floor finishes. In addition to finished office and classroom space, this area contains restrooms, a locker room, and an employee break room. All doors are hollow metal with standard commercial hardware, with the exception of the front entrance, which is commercial storefront.

The heating and cooling of the office areas is done using two systems, each consisting of exterior condenser unit, plus air handling units in a dedicated room, and ductwork mounted above the suspended ceiling. In addition to standard power and

lighting, the building has modern voice and data systems, as well as a wired fire alarm system.

Finally, the plans provided in the text are not fully detailed in part because of the limitations involved in printing what would typically be Architectural D or E size drawings in a 8-1/2 inch by 11 inch format. Some details must necessarily be left out in order for the drawings to be readable in the smaller format; however, the plans are sufficiently detailed to provide all the information needed for a complete CPM schedule.

In reality, such a building would require many more sheets of plans, though construction schedules are often developed from schematic or design development drawings of a similar level of detail as these sample drawings. A set of specifications would also be included with an actual set of plans. However, for purposes of illustrating scheduling principles, these drawings provide sufficient information. Assumptions have been made for items not shown in the sample drawings that would normally be included in the plans and specifications for a building of this type.

## SUMMARY

In this first chapter, we outlined the underlying general management concepts, and the more specific project management ideas that we need to apply to run our construction projects. Also, we covered in some detail the specific steps of the Project Control Cycle, which is the underlying concept behind all the actions and steps a project manager must perform to properly control the schedule of a construction project. If, as the reader continues through the book, learning the actual tools and concepts of scheduling, he or she refers back to the appropriate step in the cycle, the logic behind the tool or action will be clearer. The reader can understand the total process, rather than simply learning to apply a series of steps in isolation. Also, we work with a sample project, which will serve as an illustrative device for teaching the specific tools. This hypothetical project will be introduced in the next chapter along with the beginning steps in the scheduling process. If the reader can become thoroughly familiar with this hypothetical building, he or she will more easily understand each step and can more easily translate the ideas to his or her own projects. In the next chapter, we will start describing the actual process of scheduling, beginning with the preliminary information gathering, which should precede any actual work planning.

## REVIEW QUESTIONS

1. What are the four key functions of management? Define each one in your own words.
2. What is a “process” in management? Why is it important?
3. What is the difference between “management” and “project management”?
4. Diagram a feedback loop. Name a place other than in construction where you would use a feedback loop.

5. Why are goals important in project management?
6. What is a “system” in process management? Why is it important?
7. Why is communication so important in management?
8. Has the project management performance record of the construction industry been mainly good or mainly poor over the last 50 years? Cite examples and specifics of actual projects to make your case.
9. What is meant by “coordination” in project management?
10. What is “management by exception”?
11. Diagram the project control cycle, and describe each step.
12. Why is the CPM method so well suited to construction?
13. Who invented CPM? Why?

