

Chapter **1**

Introduction



Interstate 4 and 17/92 intersection in Sanford, Florida

PLANNING AND SCHEDULING

Planning and *scheduling* are two terms that are often thought of as synonymous. However, they are not. Scheduling is just one part of the planning effort. The term *planning* is used in many ways and different contexts. We commonly hear about *financial* planning, such as retirement planning and college education planning. Although this type of planning may include other aspects (such as what to do after retirement or which college to choose for your child), the main focus is on finance. Governments, as well as large corporations, have planning units or teams in almost every department. At the individual level, a young person may have plans for marriage, a career, and so forth. However, in the context of this book, the term *planning* is restricted to meaning project planning, with an emphasis on construction projects.

What Is a Project? Before we define project planning, we need to define a project. The Project Management Institute (PMI 2008) defines a **project** as “a temporary endeavor undertaken to create a unique product, service, or result” (p. 434). The key words in this definition are *temporary* and *unique*: any project must have a starting point and an ending point, and it must have a deliverable product or service that is unique. As a generic example, a secretary of education’s saying “We need to improve our students’ SAT scores” does not constitute a project. However, saying “We need to improve our students’ SAT scores by an average of 15 points in 5 years” may qualify as a project.

Some government agencies have specific but ongoing work that they call a project, such as maintenance of a certain facility or park compliance with the Americans with Disabilities Act. Technically, these are not projects because they have no well-defined deliverable product or service and starting and ending points. Each could be called a *program*, instead, with several projects inside each program. Basically, we need to distinguish among:

- **Program:** A “program” may mean different things to different people depending on the context. In project management, a program—usually—is a group of related projects and/or services intended to meet a common objective and usually managed by one entity. A program could also indicate a large and complex project that is divided into several projects for more effective management. The PMI defines a program as “A group of related projects managed in coordinated way to obtain benefits and control not available from managing them individually. Programs may include elements of related work outside of the scope of the discrete projects in the program.” (PMBOK 2008)

Programs may be:

- **Temporary/one-time programs:** For example, the City of London (UK) may have all the construction projects for the 2012 Summer Olympics under one program. Once this program culminates with the completion of its projects; by the opening of 2012 Summer Olympic Games, it will be completed and closed. The maintenance of these facilities, later on, is a different matter.

- **Ongoing (usually periodic/annual) programs:** These include projects such as road maintenance and storm water programs for a public works department in many municipalities. Many private and public institutions have maintenance programs for their existing facilities. Such a program usually has annual budget and covers numerous small projects—as many as the budget allows. The program usually lives as long the facility does.

One important note: In the UK, as well as in some other countries that use British terminology, the schedule (timeline) of the project is called program (spelled programme). This is *not* the program that we are discussing.

- **Portfolio:** This is a group of projects, not necessarily related or dependent, usually under one project manager or department. The PMI defines it as “A collection of projects or programs and other work that are grouped together to facilitate effective management of that work to meet strategic business objectives. The projects or programs of the portfolio may not necessarily be interdependent or directly related.” (PMBOK 2008)
- **Project:** Defined above.
- **Subprojects:** These are segments of the original project that are divided according to specialty, responsibility, phase, area, or other criteria. To the person in charge of a subproject, the subproject is a project, except that he/she has to consider not only the internal relationships among its activities but the external relationships as well (with activities in other subprojects in the same project). For example, in a residential or commercial development project, building the infrastructure may be regarded as a subproject. In fact, building the sewer system in the development can be a subproject (to the entire development project) or even a sub-subproject (to the infrastructure subproject).

Are Projects Unique? Some people may think of two construction projects as identical just because they have the same design. In project management, we may have similar projects, but every project is unique. Differences may come from a difference in location (soil type, weather conditions, labor market, building codes, unforeseen conditions, etc.), in management type and experience, or in circumstances (and how much Murphy’s Law is involved).

Project planning has been defined as “the process of choosing the one method and order of work to be adopted for a project from all the various ways and sequences in which it could be done” (Antill and Woodhead 1990, p. 8; Callahan, Quackenbush, and Rowings 1992, p. 2). The PMI defined the planning process in the PMBOK (4th edition, 2008) as “Those processes performed to establish the total scope of the effort, define and refine the objectives, and develop the course of action required to attain those objectives”. Project planning serves as a foundation for several related functions, such as cost estimating, scheduling, project control, quality control, safety management, and others.

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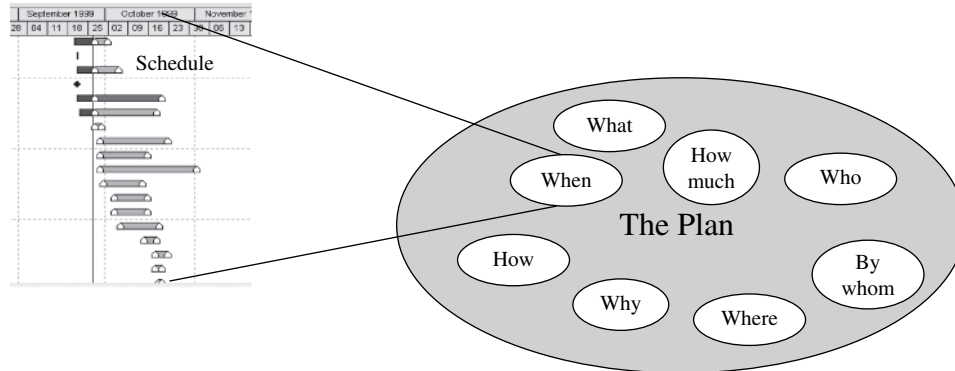


Figure 1.1 Planning and scheduling

Scheduling is the determination of the *timing* and *sequence* of operations in the project and their assembly to give the overall completion time. As mentioned previously, scheduling focuses on one part of the planning effort.

Project planning answers the questions *What* is going to be done? *How*? *Where*? *By whom*? and *When* (in general terms, the project's start and end)? Scheduling deals with *when* on a detailed level.

In fact, scholars have generally separated planning from scheduling “CPM separates planning and scheduling, and once project information is collected and expressed as a network plan and activity time estimates assigned, CPM calculations can be made. Planning ceases and scheduling starts when the first computation is performed that shows a project duration. The project duration is then compared with the desired schedule and scheduling begins.” (O’Brien and Plotnick, 2009, p. 417)

To get an idea about the relationship between project planning and scheduling, assume that you are planning a family vacation “project” for next summer. Your *plan* may include considerations such as these:

- Who will go on the trip?
- Which places do you want to visit? (You would like to visit many places, but your time and monetary resources are limited.)
- What is the time frame for the vacation (just the starting and ending dates)?
- What is the total budget for the “project” (including the contingency you did not tell other family members about)?
- What types of activities do you want to participate in during the trip (sharp differences among the family members)?
- What means of transportation do you plan to use (your car, a rental car, air, train, bus, RV, bicycles, etc.)?
- What other issues, such as accommodations, food, and clothing, need to be addressed?

The project *schedule* is simply the itinerary, such as this:

- Leave home in Tampa, Florida, on June 8, 2010.
- Arrive in Panama City, Florida, on June 8, 2010.
- Leave Panama City on June 15, 2010.
- Arrive in Atlanta, Georgia, on June 15, 2010.
- Leave Atlanta on June 22, 2010.
- Arrive in Gatlinburg, Tennessee, on June 22, 2010.
- Return home to Tampa on July 7, 2010.

Note that not only the plan and the schedule are related, but also many of the elements of the plan are interrelated. For example, most of the choices in the plan (length of stay, type of accommodations, means of transportation, type of activities, food, etc.) affect the budget. Since different means of transportation have longer time durations than others, they may affect not only the cost but the schedule as well. Clearly, a lack of clarity of scope before the project starts may lead to heated arguments and dissatisfaction. In real projects, it may lead to huge budget overruns, schedule delays, and different parties' dissatisfaction. Therefore, it is important to have a clear understanding of the project's scope (objectives), and decide who the "project manager" is. Many issues are at stake in this example, but demonstrating the concepts of planning and scheduling is our objective.

In the context of construction projects, a typical plan for an office building project may include the following:

- A *scope definition*, such as a five-story building for commercial use (offices) with a total area of about 30,000 square feet. The location is also part of the planning, although, in some cases, the exact location may be selected later or a few sites are mentioned as candidates.
- A *schematic* or *conceptual design*. This is not a must but helps one to visualize the project. The final design may later differ significantly.
- A *budget number* (e.g., \$6 million). The planner must be aware of all project-related expenses, such as the cost of land, permits, design fees, construction, and so forth.
- A *time frame* (i.e., when the project is expected to start and end).
- *Other pertinent information* that may be used to justify the project or clarify some of its aspects. If an investor is doing the planning, a **pro forma** helps predict the rate of return and helps in making the decision whether or not to build the project.

PMI defines **project management plan** as a "formal, approved document that defines how the project is executed, monitored and controlled. It may be summary or

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detailed and may be composed of one or more subsidiary management plans and other planning documents. The objective of a project management plan is to define the approach to be used by the project team to deliver the intended project management scope of the project.” (PMBOK 2008)

The project manager creates the project management plan following input from the project team and key stakeholders. The plan should be agreed on and approved by at least the project team and its key stakeholders. It is a good practice, used by professional project management and consulting firms, to have a formal project management plan approved in the early stages of the project and applied throughout the project. Many owners (clients) require the contractor to submit a project management plan and have it approved as part of the contract documents.

PROJECT CONTROL

Once a project starts, certain aspects can easily deviate or go astray. This deviation can be overspending, a schedule slippage, a departure from the objective/scope, or something else. It is of utmost importance to know—at all times—where you stand in relation to where you planned to be (the baseline). If you find yourself behind schedule or over budget, you must know why and then take corrective action to get back on track or, at least, minimize the deviation. If the deviation is positive (i.e., the project is ahead of schedule or under budget), actual performance was probably better than that expected in the baseline plan. This process exemplifies **project control**. Although the concept of project control covers all aspects of the plan (budget, schedule, quality, etc.), our main focus in this book is on schedule and budget control, which are related. (Extensive coverage of project control is provided in chapter 7.)

WHY SCHEDULE PROJECTS?

There are several parties involved in any project (stakeholders). They all need and benefit from project scheduling but from different perspectives. Following is a group of reasons for why project scheduling is needed, from two different perspectives: contractors and owners.

Contractors need project scheduling to:

1. *Calculate the project completion date:* In most construction projects, the general contractor (GC), including subcontractors and other team members, is obligated to finish the project by a certain date specified in the contract. The contractor has to make sure that his or her schedule meets this date. Some contracts contain clauses for penalties for finishing the project later than contractually required and/or incentives (financial or other) for finishing earlier. Also, the schedule may show the stage of **substantial completion**,

when the owner may start occupying and using the facility while the contractor is still doing some final touches.

2. *Calculate the start or end of a specific activity:* Specific activities may require special attention, such as ordering and delivering materials or equipment. For instance, the project manager may want special and expensive equipment to be delivered just in time for installation. Long-lead items may have to be ordered several months in advance. Delivery of very large items may need coordination or a special permit from the city so that such delivery does not disrupt traffic during rush hour. The schedule must show such important dates.
3. *Coordinate among trades and subcontractors, and expose and adjust conflicts:* In today's construction, the GC's role is mostly to coordinate among different subcontractors. The responsibility of the GC may be to allocate the time of use of a tower crane among subcontractors or just to ensure that adequate work space is available for all subcontractors. These tasks are in addition to coordinating logical relationships such as when a subcontractor's activity depends on the completion of another subcontractor's activity. For example, the drywall contractor cannot start until the framing has been done; once the drywall is installed, the painter can start painting; and so on.
4. *Predict and calculate the cash flow:* The timing of an activity has an impact on the cash flow, which may be an important factor for the contractor (or the owner) to consider. The contractor (or the owner) must know his or her total spending in any month or time period. He or she may delay the start of certain activities, within the available *float* (this term is explained subsequently) to make sure that the cash flow does not exceed a certain cap.
5. *Improve work efficiency:* By properly distributing workers and equipment and having efficient materials management (which is explained in chapter 6), the GC can save time and money.
6. *Serve as an effective project control tool:* Project control must have a solid and sound base with which current performance can be compared. Project control is achieved by comparing the actual schedule and budget with the baseline (as-planned) schedule and budget (this subject is explained in chapter 7).
7. *Evaluate the effect of changes:* **Change orders** are almost inevitable, but well-planned projects may have few or minor change orders. Change orders may come in the form of directive, that is, an order to the contractor to make the change, or request for evaluation before authorization. This change may be an addition, a deletion, or a substitution. Change orders may have an impact on the budget, schedule, or both. Cost estimators estimate the cost of change orders (including the impact on the overhead cost as a result of the schedule change), but schedulers calculate the impact of the change on the project schedule. It is the contractor's responsibility to inform the owner on such impact and obtain his/her approval on the change to the budget and/or schedule.

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8. *Prove delay claims:* Construction **delay claims** are common. Contractors must be able to accurately prove their claims against owners (or other parties) using project schedules. In most cases, only a **critical path method (CPM)** schedule can prove or disprove a delay claim, which can be a multimillion dollar one.

Project owners and developers need project scheduling to:

1. *Get an idea on project's expected finish date:* Before an owner demands that the general contractor (GC) complete the project by a certain date, he/she needs to make sure that this is a feasible and reasonable date. This date is calculated by a CPM schedule prepared either by the owner or by the designer or other consultant hired by the owner. This date is also important to the owner, even before selecting a contractor, to conduct feasibility studies and financial planning.
2. *Ensure contractor's proper planning for timely finish:* Owners may demand a project schedule from the prospective or bidding contractor, however, it is very important for the owner to review such schedule and make sure that it is reasonably accurate and realistic. Owner's approval of contractor's prepared schedule may imply a liability on the owner's side.
3. *Predict and calculate the cash flow:* The owner is obligated to make timely progress payments to the contractor and other parties along the life of the project. Failure to do so not only may delay the project and/or incur additional cost but it also may—at certain point—be deemed a breach of contract.
4. *Serve as an effective project monitoring tool:* Both owner and contractor must monitor progress of work and compare actual progress (schedule and cost) with the baseline (as-planned) schedule and budget. The contractor uses this process to detect and correct any deviation and also to prepare progress payments. The owner uses this process to verify actual work progress and contractor's payment requests.
5. *Evaluate the effect of changes:* Owners may desire or require change orders. In many instances, owners don't expect or fully appreciate the impact these change orders may have on the schedule and/or budget. It is a wise idea for an owner to find out this impact before making a decision regarding such change order. It is also recommended that owners analyze the contractor's assessment of the change order to make sure that it is fair and reasonable.
6. *Verify delay claims:* Owners use CPM schedules to analyze, verify, and/or dispute contractors' delay claims. Although most delay claims are initiated by contractors against owners, it is possible to reverse roles and have an owner's claim against the contractor, and/or have other parties involved. In either case, a CPM schedule is vital for the owner to prove his/her case.

Other parties involved in the project may also need a CPM schedule, such as the designer, project management consultant, and financial lending institution.

The need for a CPM schedule varies with several factors. In general, it increases with the increase in size and complexity of the project. For example, a home builder who has built tens or hundreds of almost identical homes may not have much need for a CPM schedule. Project control is still needed but may be conducted through simpler methods.

THE SCHEDULER

The Scheduler: A civil engineer, an architect, a computer whiz, a mathematician, a project manager, an artist, or a communicator? An increasing trend—in all industries—is to use computer software and other high-tech tools. These software packages cover the entire spectrum of all industries, including some generic types of software, such as word processors and spreadsheets that everyone uses. However, specialized software requires knowledge of both the software and the discipline. Scheduling is no exception to this rule.

Let us distinguish among three types of knowledge that a scheduler must have:

1. Knowledge of computer software (and perhaps hardware as well)
2. Knowledge of the principles of scheduling and project control (as part of project management)
3. Knowledge of the specific technical field, such as commercial building, industrial, transportation, and so forth

To efficiently operate a scheduling and control program, such as Primavera Project Manager (P6) (Primavera Systems, Inc., Bala Cynwyd, Pennsylvania, now part of Oracle), the scheduler must have the first two types of knowledge. The third type is a plus. Just because an individual knows computers and can surf the Internet does not mean that he or she can operate a scheduling and project control program. Even if the individual can operate it, he or she may not understand its language and may have problems relating to and interpreting the technical information.

Currently, many high-tech innovations such as PCs, PDAs, digital cameras and scanners, and the Internet are available. They have become useful tools and an essential part of our daily life. Nevertheless, the human factor should never be underestimated. The combination of good tools and an educated, experienced operator is the only path to success in project planning.

Certification

Several organizations now have a process and exam that lead to certification in project scheduling. The most prominent ones are:

- The AACE International's Planning & Scheduling Professional (PSP)
- The PMI's Scheduling Professional (PMI-SP)

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Usually, an applicant to a certification exam has to fulfill certain conditions:

1. Minimum education requirements
2. Minimum experience requirements
3. Pass the certification examination
4. Submit application and fees

Such certification is important in giving the confidence in the qualifications of the scheduler, particularly to a potential employer. A certification from a reputable organization, however, cannot alone guarantee good results. It is just one component in the scheduling system.

Unfortunately, the author has seen people who carried the title scheduler but lacked the fundamentals for the position. In one incident, the author met the “scheduler” with a construction company who never had education or experience relevant to his job. He was chosen for that position because of his computer skills!

The Tripod of Good Scheduling System

1. *The Human Factor*: A proficient scheduler or scheduling team that understands the concepts, definitions, and applications or project scheduling
2. *The Technology*: A good scheduling computer system (software and hardware) along with capable IT support
3. *The Management*: A dynamic, responsive, and supportive management that believes in the use of scheduling as part of the management effort

If anyone of the above three “legs” is missing, the system will fail.

SCHEDULING AND PROJECT MANAGEMENT

Planning, scheduling, and project control are extremely important components of project management. However, project management includes other components, such as cost estimating and management, procurement, project/contract administration, quality management, and safety management. These components are all interrelated in different ways. The group of people representing all these disciplines is called the **project management team**. It is usually headed by the **project manager (PM)**. In chapter 10, we discuss the relationships between scheduling and other project management components.

CHAPTER 1 EXERCISES

1. Define *project planning* and *scheduling*. Differentiate between the two terms.
2. Define a *project*. What makes planning and scheduling construction projects different from general planning? (*Hint*: Think of the key words in the definition of *project*.)

3. Define a *portfolio* and a *program* in the context of project management. Give examples of each.
4. What is *project management plan*? Give an example.
5. What is *project control*? Why is it important?
6. Think of a construction project you participated in or observed. Write down the steps involved in its planning and the steps involved in its scheduling (without much specificity).
7. List the benefits of CPM scheduling in construction projects from the contractor's perspective.
8. List the benefits of CPM scheduling in construction projects from the owner's perspective.
9. Do all construction projects have the same need for CPM scheduling? Why or why not?
10. What characteristics must a scheduler of a building project have? Can the same person be a scheduler for an industrial project? Why or why not?
11. Meet with a project manager for a construction project. Ask whether he or she uses CPM scheduling. If so, discuss the benefits obtained from such scheduling. If not, politely ask why CPM scheduling is not being used.
12. Search for an article on a CPM scheduling topic (*ENR*, *Civil Engineering*, *PM Network*, *Cost Engineering* are magazines that are good sources; avoid scholarly journals). Summarize and discuss the article.

