Learning Objectives

Upon completion of this unit, students should be able to:

1. Describe why a schedule is imperative to a successful project.
2. Explain the various concepts of an effective schedule.
3. Analyze the various precedence relationships and explain the role they play on project scheduling.
4. Compare and contrast the different ways to develop and display a team project schedule.
5. Discuss how a time based network is different from the AON and AOA scheduling diagrams.
6. Identify the benefits to using project scheduling software.
7. Explain the basis of critical path algorithm.
8. Describe the role the critical path algorithm can play in scheduling.
9. Discuss how working as a team to develop a schedule can benefit the overall project.

Written Lecture

Why Schedule?

This unit involves project scheduling and the tools and concepts that are involved in creating project schedules. The most important point of this chapter is that when there is no schedule, there is going to be big problems! While some problems can be easily overcome, there is the possibility that poor scheduling can result in problems that can potentially derail a project. Schedules can be extremely detailed or as simple as “to-do” lists, but a schedule is a way to clarify assignments and goals and to address possible risks. Schedules set the pace and expectations for the project.

Setting the stage: A successful project goes hand in hand with successful scheduling. There are many ways to produce a successful schedule. The textbook gives an example of a landscaping company that used a visual process to show the project flow (see Box 7.1). They also used a team based discussion, which encouraged ownership of the project and clarification of schedules, and it allowed for the team to be involved in possible changes. The second example given by the textbook (also in Box 7.1) also used a visual diagram of the expectations for the project. The time-based network gave team members the opportunity to see how the tasks would play out and what the expectation of time would be. It also allowed for the team members to see how the tasks would develop in relation with other tasks. This format also displayed when and where there was flexibility and also set concrete deadlines for the project team. The critical path is also a tool used to show the sequence of tasks that sets the timeframe, or duration of the project.
History of project scheduling methods: Line-of-balance methods and bar charts were used in manufacturing shops in the 1900s and have developed immensely over the years. The government also adopted these tools and fine-tuned them to help with project budgets and scheduling. Program Evaluation and Review Technique (PERT) was developed, which helped reign in scheduling problems and the budget for the entire program. DuPont also developed a scheduling process called the Critical Path Method (CPM) to help cut down project loss. PERT and CPM allow for project teams to present material in a parallel manner with sequential tasks and let the bottleneck, or the longest sequential path, be identified. This is the critical path that often causes the most loss of time, loss of production, or risk if it is not handled appropriately. PERT also takes notice of timing estimates, while CPM addresses the time-cost-tradeoffs. Both offer teams a visual statement to present and allow them to work toward solving potential issues. Technology has changed the way many tools are implemented. We will see how this advancement can still cause problems if the tools are not completely understood and used appropriately.

Concepts for Project Scheduling

Scheduling is not just a thrown together concept of what needs to be finished. There are many factors to consider when planning, such as how the schedule will be displayed, the amount of detail, types of logic, and precedence relationships. All of these work when completing projects, whether they are larger or small projects or whether they are completed using technology or by hand.

Schedule display formats: Keep in mind there are several ways to display schedules. Refer to Exhibit 7.5 for examples of activity-on-node and activity-on-arrow. Software programs also offer a variety of scheduling displays.

Level of detail: When deciding on schedules, it is important to know what level of detail is required. The schedule of a megaproject, or project that is a multi-year project, may not need every detail of the sub projects displayed. The project leader may want to see major steps or milestones of the project as they are completed. Details may also be broken down into phases or tasks, and each of these may have more defined schedules, which add to the megaproject’s overall schedule as layers of detail. Refer to Exhibit 7.6 for a visual example. Another way to schedule is to implement the rolling wave method. This is when scheduling details of a phase develop closer to the time of that particular phase or the project is closer to implementation.

Types of network logic: The network portion is referred to as either hard logic or soft logic. Hard logic is the sequence that MUST be followed for the project to be successful. This is the part of the project that does not allow any deviation. Soft logic is the sequence that will be followed more out of preference or routine, rather than a mandate. It is recommended that teams follow the hard logic first and foremost and allow for adjustments as needed once the resource challenges are identified.

Types of precedence relationships: There are different types of precedence relationships. Finish-to-start relationship happens when the first assignment needs to be completed before the next one can be finished. This is common when a sequenced task is being completed. A start-to-start relationship is where the second assignment is planned to start at a specified time after the first assignment in a sequence has begun. Start-to-finish requires a time frame set so that one task cannot be complete until a certain time after the previous task is complete. Finish-to-finish works similarly to start-to-finish, and both of these are not as productive as the first two we discussed.
Displaying and Interpreting Project Schedules

One of the important parts of scheduling is presenting the schedule. The activity-on-node (AON) scheduling is shown in Exhibit 7.9. As you can see, the schedule is comprised of the various milestones, wait times, and information to show the flow of the project. Activity-on-arrow (AOA) scheduling is displayed in Exhibit 7.10 and shows the same information as the AON, but it also has a dummy activity. This method allows for the project to keep on pace with the hard logic. Critical path and float charts are also a way to schedule projects based on calendar estimations. This scheduling requires close attention to the activities in order to keep the project focused. The Gantt chart is a clear and easy way to read, plan, and schedule (refer to Exhibit 7.12 for an example). This format also allows for a visual time frame to be given to various activities and tasks in relation to how they affect other portions of the project. In addition to these standard ways, there are several software programs and technological programs available to enhance the project scheduling process.

When we look at schedules for projects, we must also look at the free float and total float. Free float is the time a project can be delayed from the original start time without causing other tasks or activities, and total float is the time the task can be delayed without delaying the overall project. The critical path algorithm is a mathematical way to assess free float, total float, and the location of the critical path. This helps when trying to identify the path and float patterns and in keeping early and late start times in check. Refer to Exhibit 7.18 for an example of the critical path algorithm.

Developing the Schedule Network

When scheduling a project, it is important to involve the team. This allows for team insight, helps the team to commit to the project time frame, and helps the team have a strong understanding of the project schedule. A team based scheduling process gives the team a cohesion and a sense of ownership, as well as helps to develop a project schedule. There are several Exhibits on pages 222-223 of the textbook showing the patterns and tips for developing network schedules; refer to these for further reference.

Incorporating Probabilistic Concepts into Schedules

PERT three-point time estimates are useful to make assessments of probability. This is valuable when trying to determine project timeframes. The statistical analysis will give a realistic time period to estimate. Also, it will be able to take variables affecting this into consideration, such as completion times. It is important to note that using statistics are helpful, but they should not detract from the overall project at hand.

As discussed throughout the chapter, scheduling is a big part of projects. It is critical for a project manager to be able to set and make goals, identify milestones, understand necessary flexibility, and presents a path for the project to take. We have discussed a variety of scheduling options and ways to organize a schedule. Once the scheduling is complete, continual monitoring, adjustments and project analysis will be an ongoing process.