PDHonline Course P150 (2 PDH)

Construction Scheduling Basics

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Table of Content

I. Learning Objective

Understanding a project schedule is a basic requirement for Owners, Engineers, Architects, and of course Contractors. This course will provide the student insight into the creation of a schedule. The student will also be introduced to the concept of basic logic and its importance in scheduling. This course will not instruct the student on using scheduling or project management software. A test of the student's aptitude is included herein.

II. Course Introduction

Owners and Engineers often require and desire different types of documentation and formats for project schedules. Although many projects are similar in the type of work, ultimately each project is unique. The schedule must be flexible in order to accommodate the specific requirements of each project while maintaining a logical sequence of events.

III. Introduction to Scheduling

Creating a good project schedule is contingent upon three factors: logic, estimation, and experience. There are numerous ways to develop a schedule. Some methods are technical while others are simplistic to the point of being practically a best guess. One feature is not only prominent but is the key to good scheduling. Scheduling does not entail creating information. Instead it incorporates, organizes, and legitimizes information already available from logical sequences, cost estimating, and prior experience.

A. Definitions

Logic is an innate ability to evaluate and make reasonable assumptions regarding the validity of the sequence of events or 'activities'. There are two types of logic: hard and soft. A brief lesson in logic is provided at the end of this course.

Estimation simply refers to the time estimated to complete the project during the bid process. Remember, incorporating the project estimate into the schedule is essential. Developing a schedule that requires more time to complete the project than was estimated during the bid process is not prudent. There is a direct correlation between profitability, scheduling, and estimating.

Experience is gained over time. Professional experience in the construction industry cannot be taken for granted when scheduling. Either someone on the project team has done it before or not. Experience can dictate when certain elements of a project should be procured, delivered, or installed. Experience can also affirm the estimated time allotted to complete portions of the work.

Activities are work tasks that are user defined and identify the major items that outline the construction sequence for the project. Creating viable activities for a schedule is necessary to achieving the project objective.

Duration is the length of time required to complete each activity in the schedule. The total of the individual durations is the amount of time needed to construct the project.

B. Getting Started

A schedule is only as good as the effort and thought put into creating it. Simply stated, the schedule is the end result of the ideas and knowledge of the people that created it. Input and involvement from field personnel is important as the schedule needs to be a useful and understandable document for them.

Start with an outline or flow chart and begin listing the work activities required to build the project. For larger projects, the work activities may be grouped into broader categories for simpler organization. Once the majority of work items are listed begin placing them into sequences based on logical assumptions made about the progression of the work. After all of the logical sequences have been determined the durations for each activity can be assigned. The assignment of durations to individual activities ultimately leads to the scheduled length of the project. The scheduled length is then compared to the estimated length for accuracy. The scheduled duration should be no longer than the estimated duration or an overrun in time and costs could occur. If this is the case and the scheduled durations are believed to be accurate, then the logical sequence of activities should be reevaluated to see if there is any way to reduce the overall duration of the project. Many times this can be done with the smart use of hard or soft logic which will be discussed later in this course.

The initial schedule is the 'baseline' and is a best guess of how the project will be constructed. But, it is important to be as realistic and accurate as possible. After all, successfully completed projects are the means by which a company builds its future.

C. A "Living" Document

The schedule should be a dynamic living document. It should adapt to modifications of the work and adjust to changes in the duration of the project. The schedule should be revised and updated to reflect changes to scope and methodology. The schedule should document all major changes to the project in order to communicate them to the owner, engineer, subcontractors, vendors or other appropriate parties. The end result is a detailed and accurate "as-built" schedule.

Project management involves planning and controlling projects by utilizing the 'dynamic, living' schedule. The schedule provides a realistic prediction of the project's progress and changes to reflect the actual progress. Decisions made by the management team affect a project and the schedule should be used to predict the effects of those decisions.

D. The Process

There are many tools available to help develop and control a project schedule. As a person becomes a more experienced scheduler, 'where to begin' and 'what to do first' become more obvious. Eventually, a good scheduler blends together the available tools and experience gained into a unique, personalized method of scheduling and project controls. However, there are key processes common to all successful scheduling techniques: planning, controlling, and managing.

Planning is the process of developing what it is that needs to get done. During this process specific work activities should be defined and coordinated. The project budget should be reviewed so that the appropriate resources can be assigned to the types of work and allocated for the timeframe specified.

Controlling is the process of keeping the project on course or steering it in the right direction. This is accomplished by tracking work progress and actual costs and comparing these to the baseline schedule and original budget established for the project. The comparison is then utilized to recommend action necessary to keep the project on track.[1]

Managing is the process of communicating the progress schedule to all parties involved. Past, present, and future progress should be displayed in some format on a regular basis.

E. Planning

Scheduling is project management. It aids with the planning and control of any type of project. The schedule provides a realistic model (plan) of a project's anticipated behavior. Hence, the schedule (plan) should involve detailed and accurate considerations of all activities required to build the project. It should also contain realistic estimates of the time needed to complete each activity and the relationships between activities. The relationships or logical sequence between activities will be discussed more detail later in this course.

Project planning should involve several questions that aid the management team with defining its goals and the goals of the project.

1. What must be accomplished?
2. When must it be finished?
3. What is the cost estimate?
4. What is the total time required to complete the project?
5. What type and quantity of equipment is needed?
6. What type and quantity of materials are required?
7. What type and size of work crews are required?

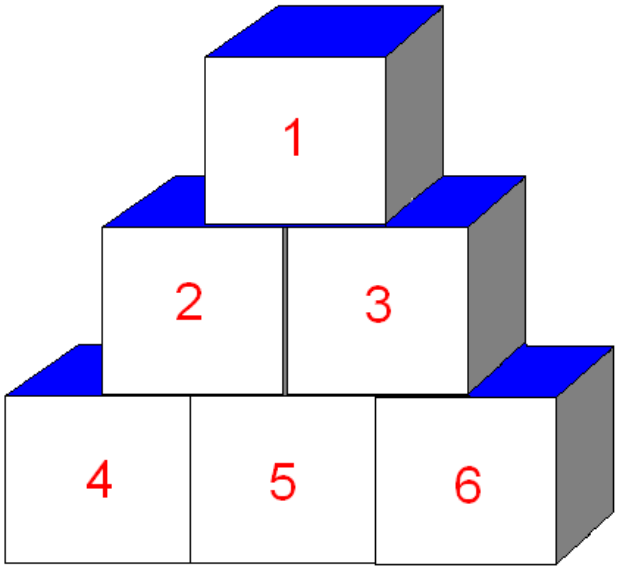
There are even more questions that can be asked pertaining to scheduling conflicts, schedule reports, schedule formats, and schedule distribution. However, these relate more specifically to the use of scheduling software and the different functions available within various software programs.[1]

F. The Tools

As mentioned previously there are many software programs available to help develop and maintain construction schedules. Construction management has rapidly become technical and dependent upon the advances in computer and software technology. Two decades ago a computerized schedule was a high-tech presentation. Today, a degree in construction management with an emphasis in computerized scheduling is real and attainable.

Such programs as Primavera and Microsoft Project give the user the power to develop schedules by inputting the basic information and allowing the software to analyze and predict the end result. Most of the software available allows the user to customize the presentation of the schedule and produce different types of reports for analysis. Regardless of the means used to produce your schedule, answering the basic questions provided in this course can be used as simple guideline for planning and creating your next schedule.

V. Introduction to Logic



Most of us would not consider children as being very logical. Logic is not a trait that humans are born with. It is a trait that is learned. Children begin to learn logic at a very early age. You (they) may not realize it, but logic is required to play many children's games.

Take a look at the picture above. This represents a stack of six blocks. Assuming the child is advanced enough to recognize the numbers, this would be an easy stack to build, or "construct". But, simple as this stack of blocks may seem, it still requires logic to complete it.

Consider the following:
Block "1" cannot be set in place until both blocks "2" and "3" are set.
Block "2" cannot be set in place until both blocks "4" and "5" are set.
Block "3" cannot be set in place until both blocks "5" and "6" are set.

It is not "logical" to try to install block "1" first. Block "1" is the top tier of the stack and is dependent upon the lower tiers to hold it up. This is so obvious that even a child can understand it. It may be obvious, but it also gives a very simplistic introduction to scheduling logic.

Look at the blocks a little closer.

Suppose we consider the setting of each block as an individual activity in constructing this project. Activities "1" "2" and "3" all need to be complete before both "2" and "3" can be completed. Activities "2" and "3" need to be complete before "1" can be

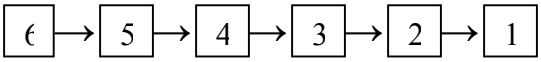
completed. This is the scheduling logic that is required to construct this project correctly and efficiently.

Let's diagram the logic involved in constructing this project.

Logic Diagram: The graphic analogy of a project which depicts the plan of action without quantitative time data. The logic diagram maps out the activities of a project in their logical sequence.

A logic diagram reads from left to right. Lines indicate relationships between activities.

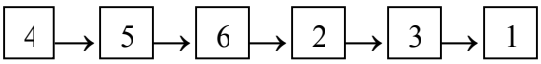
Example 1:



This is obviously a very logical sequence of activities. Block "6" is set first. Block "5" is set next, followed by block "4" and the others, one by one, as indicated. This sequence constructs the project correctly and indicates that "1" must be the last activities.

But does the project have to follow this sequence? Does activity "6" have to be first?

Example 2:



The project correctly and has activity "1" in the required last position.

The difference between the above examples brings out the concepts of "hard" logic versus "soft" logic. It is hard logic that requires activity "1" to be the last activity. There is no other logical alternative. But it is soft logic, or personal preference, that decides whether to start with activity "6" or "5". Would we prefer to work from left to right or right to left?

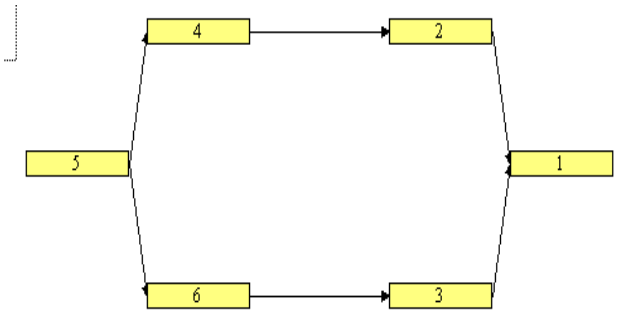
Both of the above examples also exemplify the concepts of "predecessor" and "successor" activities.

Predecessor: An activity that must logically occur before the start or finish of another activity (the successor).

Successor: An activity that must logically occur after another activity (the predecessor).

The above two definitions appear to be going in circles; like the chicken before the egg joke. Simplifying the concept, for any given activity, a predecessor occurs before it and a successor occurs after it.

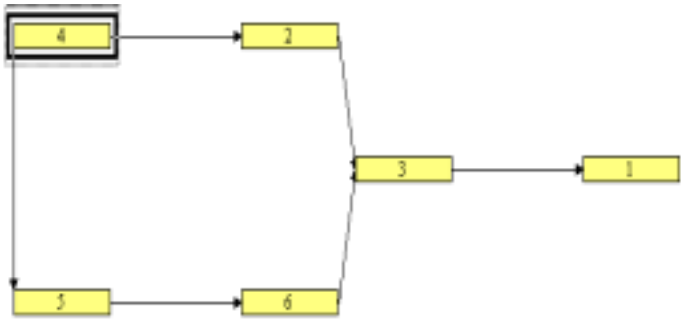
Example 3:



This example introduces the concept of "concurrent" activities. Concurrent activities can logically proceed at the same time, but are not required to do so. Activities "2" and "3" can proceed at the same time but are not dependent upon each other. Either activity could start and/or finish prior to the other one. Activity "2" is only dependent on activities "4" and "5". Activities "5" and "4" must precede activity "2". They are predecessor activities to activity "2". Activity "1" cannot proceed until both activities "2" and "3" are complete. Activity "1" is a successor activity to both activities "2" and "3"

But if we can have concurrent activities, why not use our soft logic to start the project with concurrent activities?

Example 4:



In this example, activities "4" and "5" are proceeding concurrently. The arrow at the front of the box for activity “4” indicates that “4” and “5” start at the same time, or are ‘start to start’ activities. Activity "6" is the successor of activity "5". Activity "2",

however, is the successor to both activities "4" and "5". Activity "2" cannot begin until both "4" and "5" have been completed.

You may expect that another example could have three concurrent activities: "4", "5", & "6". The example will not be given here because it brings in the concept of constraints.

Constraint: Any factor that restricts the ability to complete an activity by placing time or sequence effect upon the proposed schedule. Some examples of constraints include:
Resources - labor, equipment, materials, etc.
Influences by Others - site access, permits, complete plans, work by others.
Acts of God - inclement weather, water level, snow depth, extreme heat, etc.

Constraint discussion is better served with an explanation of PDM logic (Precedence Diagram Method) which allows three primary types of relationships between activities:

Finish to Start – using our building blocks, activity "5" could not be started until "4" was complete.
Start to Start – using our building blocks, activity "5" could not start until "4" had started.
Finish to Finish - – using our building blocks, activity "5" could not finish until "4" had finished.

PDM logic is the basic premise behind several types of scheduling software, most notably Primavera. A course on PDM logic is best suited for training and practice with scheduling software should the student desire to expand his/her scheduling knowledge and capabilities.

V. Why Logic is Important

Logic is the basic premise behind scheduling. Logically, certain activities cannot occur before others are complete. This is defined as 'hard logic'. For example, you must buy milk and chocolate and have it on hand before you make chocolate milk. Other times there may be a personal preference that dictates a work sequence. This is defined as 'soft logic'. You may prefer to put milk in the glass before chocolate when making chocolate milk or you may prefer to put the chocolate in first. The end result is the same either way – delicious chocolate milk.

Logic plays an important role in producing a viable, completed schedule. Once the planning process is complete, the data is organized and analyzed by use of hard and soft logic. It is the logic that dictates the sequence of activities, the viability, and the accuracy of the schedule. If any of the data is incorrect or the logic utilized is inaccurate, the controlling and managing processes should adapt and amend the schedule to keep the project on time and within the budget. Many of today's scheduling programs can be interfaced with accounting software to provide real-time updates and accurate projections of job costs for project control and management.

Remember, scheduling is not an exact science and depends fully on the data, logic, and experience put into it by a management team. This course is intended to give a novice scheduler or manager some basic guidelines to employ when learning how to create or analyze a project schedule.

VI. Links

www.primavera.com
www.msproject.com
www.pro-core.com
www.1sis.com
www.redfordconstruction.com

VII. Credits

1. Exerpts in Part III. Introduction to Scheduling were taken from the SureTrak 3.0 Project Manager User's Guide, copyright 1999 by Primavera Systems, Inc.