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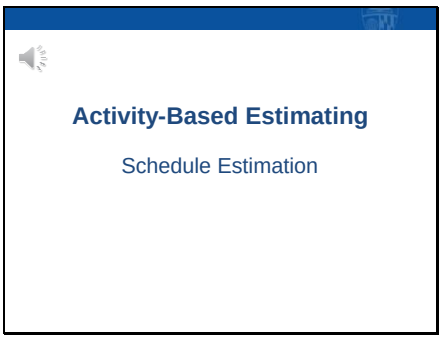

In this lecture we'll discuss the schedule estimation process in the activity-based estimation technique.

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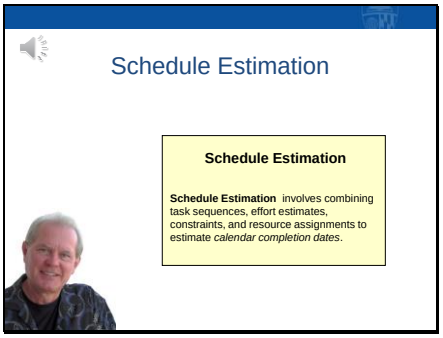

Schedule estimation involves taking the task dependencies, effort estimates, project constraints, and resource assignments and estimating the calendar completion dates for key project tasks and the overall project completion date.

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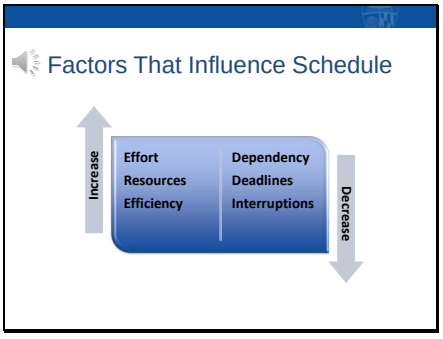

There are a number of factors that can influence a project's schedule…and by influence I mean that they help determine the calculation of a schedule and also impact the schedule in terms of helping to make it shorter or longer.

Effort…measured, say, in person-days…is a no brainer. More effort, often…but not always…translates into a longer schedule.

Task dependencies influence project schedule in a very significant way, as we'll see later on in this lecture.

Resources available to be assigned to a project can also influence schedule. If I have limited resources I may not be able to break up work tasks into sub-tasks that can

be worked on in parallel. As a result, fewer staff will need more calendar time to complete the same total effort.

Project deadlines can also play a major part in determining a project's schedule. When we have real…and not perceived…project deadlines that can't be changed, we often need to work backwards from those deadlines when calculating the schedule, and sometimes find that deadlines can't be met for a given scope of work or a fixed pool of available resources.

Other more individual factors that impact schedules include the fact that people don't always work at peak efficiency, even though effort estimates may have assumed that they do. Frequent work interruptions…either planned, as in multi-tasking, or unplanned, can also be an important driver in determining schedules. As an example, anyone who has ever worked on programming tasks and been temporarily reassigned to other things knows very clearly that there is what I like to call a "ramp up" time when they return to their original tasks. They have to re-orient themselves and get back up to speed before they can restart being productive.

All of these factors must be taken into account when estimating a project's schedule…or the schedule will not be very realistic.

4

One thing that is extremely important in project planning…but is overlooked more often than I like to see…is that effort, measured say, in person-days, rarely maps directly into project schedule. For example, a task that is estimated to take 20 person-days is not going to be completed in 20 calendar days. That should be obvious, but in my experience it very often isn't…so it's worth mentioning.

So…why doesn't effort map one-to-one with calendar time? There are numerous reasons. Let's take the example of a 20 person-day effort. If that project can be broken up into some tasks that are worked on in parallel, the project may actually be able to be completed within 20 calendar days.

On the other hand, if there's one person assigned to the project, it will take longer than 20 calendar days. Working overtime might shorten the schedule, but rarely will in practice. If that person is multi-tasking, working on other projects as well, it's definitely going to take longer than 20 calendar days. Even if the person is assigned full-time, there will be other non-project activities that will consume a portion of the person's time during the work day…things like meetings and interruptions, for example. As a reading assignment for this course unit, you'll read a short story called The Realistic Person Year that calculates how long in calendar time a person-year of effort really takes a person to complete. I think you'll find it interesting.

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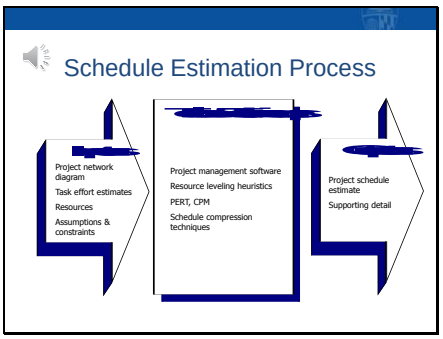

Here's an input/output model for the schedule estimation process.

On the input side, we have a project network diagram, effort estimates for at least the major work tasks, a list of available resources…namely people or job categories that will be assigned to the project. Sometimes a project manager will know the specific people who will be assigned to the project and sometimes not, so general job categories are used. This is a risk item, by the way, since two individuals can have very different productivity rates. What one software engineer can accomplish in one week might take another two weeks. And finally, we have a set of assumptions and constraints. Having a clear understanding of any assumptions that are being made…and documenting those assumptions…is crucial to arriving at a realistic schedule estimate.

On the output side is a project schedule estimate, which would typically contain an estimate of the project completion date, and usually estimated completion dates for key project tasks and milestones. In addition, supporting detail that documents any assumptions and constraints.

Tools and techniques used to arrive at the schedule estimate consist primarily of project management software applications…like Microsoft Project or similar products…at least for medium to large projects. For smaller projects it's not uncommon to use something like a spreadsheet tool. The advantage of using real project management software is that you can input task dependencies, effort estimates, resource availability, work calendars, holidays, and project constraints…and the schedule estimate is automatically calculated by the software. This is invaluable for medium to large projects…in which calculating estimated completion times is not an easy thing to do. Project management software can also be used to generate reports and to assist in project tracking and control. Many project management tools can also do something called resource levelling, which utilizes mathematical algorithms to match a resource pool to

project tasks in some optimal manner.

Project managers may employ special project planning techniques like PERT, which stands for Program Evaluation and Review Technique, and CPM, which stands for Critical Path Method. PERT in particular, can be used to help account for project risks and even develop probabilistic schedule estimates. PERT is useful when estimating task effort or duration is difficult…like in software projects or never-done-before projects. PERT was actually developed in the 1950s to be used on the U.S. Navy's Polaris Missile program. CPM is useful when effort or duration can be accurately estimated, but task dependencies are critical…like in complex manufacturing or chemical production processes. PERT and CPM are incorporated into some project management tools to varying degrees.

Schedule compression techniques may sometimes be used to evaluate ways an estimated project schedule might be able to be compressed. Two well-known techniques are "project crashing" and "fast tracking"…the details of which are beyond the scope of this course.

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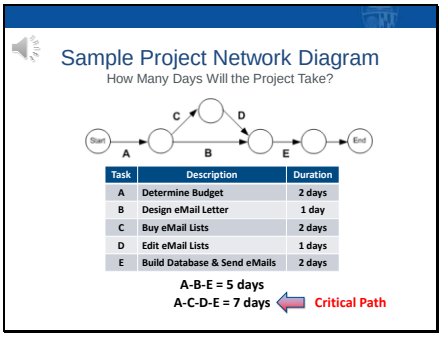

What I'd like to do now is to illustrate some basic scheduling fundamentals using the seminar marketing campaign example I introduced in an earlier lecture. The task descriptions for that project, and the project network diagram, are illustrated here. The task durations are stated in terms of calendar days.

Now…given this information…the question is…how many calendar days will it take to complete the project? When I've shown this example to real-world managers in my project management courses some of them are challenged with coming up with the correct answer.

Here's where the project network diagram becomes valuable…because in this case it is the combination of task durations and task dependencies that determines

how long the project will take.

Here's an easy way to calculate the answer. Just enumerate each unique path of tasks from the start node to the end node, and add up the task durations. We have two paths in this project network diagram: A-B-E and A-C-D-E. The duration for A-B-E is 5 days, and the duration for A-C-D-E is 7 days. That's the longest path through the diagram and that's the project completion time. It will take this project 7 calendar days to complete. The longest path through the project network diagram determines the project completion schedule…and in professional project management lingo is called the project's critical path.

A project's critical path is very important to the project manager, because any slippage associated with the tasks on the critical path will extend the project schedule. As an example, if task D took 2 days instead of 1 day, the project would take 8 days instead of 7.

Tasks not on the critical path can have some slippage and not impact the project completion date. For example, if task B took an extra day it wouldn't impact the completion date at all.

In professional project management lingo, we say that the tasks on the critical path have zero slack or float…meaning they can't have any slippage. If they start later than expected or take longer than expected then the project completion time is affected. Here's some project management trivia for you…float and slack mean the same thing. The term "slack" was coined as part of the PERT methodology, and "float" was developed as part of the CPM methodology.

Some or all of the tasks on the non-critical paths will have "slack", meaning they can take longer than estimated or can start later than expected…up to a point…without affecting the project completion time.

A good project manager will give careful attention to monitoring and managing the critical path tasks in order to keep a project on schedule. By the way, a

project can have more than one critical path, and the critical path can change as a project progresses…so careful tracking is essential.

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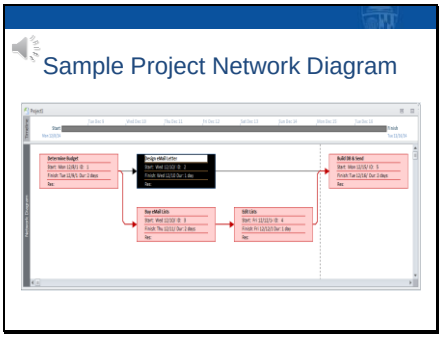

Here's a project network diagram for my email marketing campaign that was produced by Microsoft Project. The critical path tasks are automatically highlighted in pink. It's got some other useful information as well, like the task start and completion dates, and it has a timeline at the top that indicates the project start and finish dates.

Just for purposes of illustration, I decided to schedule the project to start on December 8, which is a Monday. Remember that the critical path duration that we calculated manually is seven days. One of the many advantages of using a tool like this is that it can factor in work schedules and work calendars. In this example, the default work calendar is Monday through Friday, so the project is scheduled to complete on Tuesday, December 16…which is seven working days from its start.

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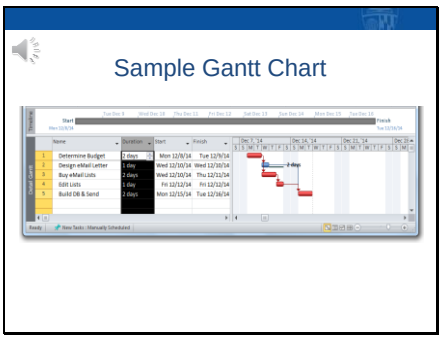

Another very popular diagram that is often used to visually depict schedule is a Gantt chart. Here's a Gantt chart for my email campaign project that was generated in Microsoft Project. The Gantt chart is more frequently used for planning, managing, and communicating schedule information than the project network diagram.

Again, one of the nice things about using a tool is that you can have it display the project schedule information in different ways. It took me two mouse clicks to switch between the project network diagram view and the Gantt chart view.

As you can see, the critical path tasks are highlighted in red, and the 2-day slack time for the second task is shown as well. This particular Gantt chart also shows the task dependencies, but they are not as easy to interpret as the project network diagram.

Not all tools may show the task dependencies…and I find that to be problematic, since I have seen project managers try to adjust schedules by manipulating the bars associated with the tasks. This can be disastrous if the dependencies are ignored, particularly in large projects.

I always advise clients to start with the project network diagram and have a tool generate the Gantt chart to ensure that the task dependencies are accounted for.

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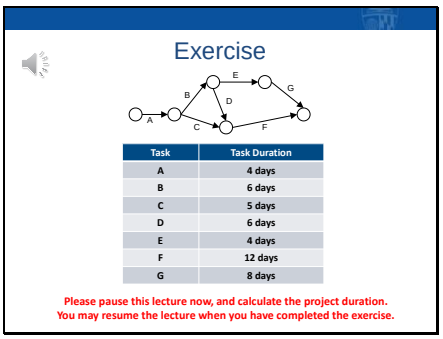
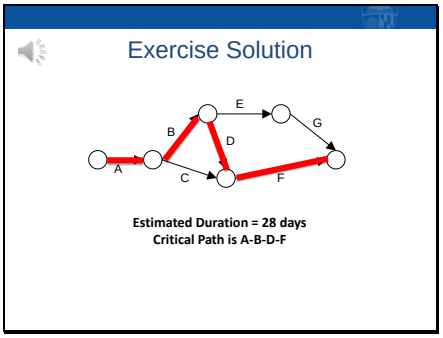


At this point, I'd like you to do an exercise. Here is the project network diagram that we constructed as an exercise in an earlier lecture. I've added durations to each of the tasks…and I'd like you to calculate the duration of the project.

Please pause this lecture now, and resume it when you have completed the exercise.

10



The estimated project completion schedule is 28 days. The easiest way to determine that is to calculate the path of tasks that has the longest duration…and that path is A-B-D-F. That path is also the project's critical path.