Project Schedule Development

One major core of the planning process is the development of the project schedule. The project schedule is where you lay out the schedule for your project activities, determine their start and finish dates, finalize activity sequences, durations and the estimate of the resources. The development of the project schedule must use the accumulated outputs from the Define Activities, Sequence Activities, Estimate Activity Resources, and Estimate Activity Durations Processes. The project schedule, once it is approved serves as the Schedule Baseline for the project.

The first step in developing a project schedule is to determine the method or methodology that you want to use. There are basically 2 methods for developing schedules: Critical Path Method (CPM) and Critical Chain Method. CPM is the commonly used method.

Critical Path Method

CPM is a methodology for developing project schedule. You use this method to determine the Start and Finish dates of each of the project ACTIVITIES. The calculations that are performed to determine the project activities dates are done without taking resource limitations into consideration, and so these dates are theoretical.

What you're attempting to establish at this point is the time periods within which the project activities can be scheduled.

CPM determines the amount of float, or schedule flexibility, for each of the network paths by calculating the earliest start date, earliest finish date, latest start date, and latest finish date for each activity.

The critical path (CP) is generally the longest full path on the project. Any project activity with a float time that equals zero is considered a critical path task.

The critical path can change under a few conditions. When activities with float time use up their entire float, they can become critical path tasks. Or you might have a milestone midway through the project with a finish no later than constraint that can change the critical path if it isn't met.

Float time is also called slack time, and it is the amount of day that a task can be delayed. There are two types of float:

Total float (TF): Is the amount of time you can delay the earliest start of a task without delaying the ending of the project.

Free float (FF): Is the amount of time you can delay the start of a task without delaying the earliest start of a successor task

Use of CPM

1. It is used to determine the minimum project duration of the project: We said that the critical path is the longest path of a project, therefore the total durations of activities in this path is the duration of the project.
2. It gives idea of the earliest possible finish date of the project.
3. The Critical Path Network Diagram forms a basic language which can record information concisely without the need for lengthy written explanations.
4. CPM shows which activities determine total project time.

In CPM, the Early Start and Early Finish dates are calculated by the means of a Forward Pass, using a specified starting date. While the Late Start and Late Finish dates are calculated by a Backward Pass starting from a specified finish date. This specified finish date could either be the project Early Finish Date determined during the forward pass calculation or a target date.

$$EFD = ESD + D - 1$$
$$LSD = LFD - D + 1$$

To establish a meaningful Critical Path, it is necessary to develop a logic-based NETWORK of the activities, with practical and realistic durations. In this NETWORK therefore, there must not be any open ends, other than the project start and finish milestone.

There are five steps in CPM:

1. Creating a network showing the task names, durations, and precedence relationships, where the four dates are empty, except for the earliest start of the first task. (ESD, EFD, LSD and LFD)

2. Making a Forward Pass through the network, determining the earliest start and earliest finish for every task (ESD, and EFD)

3. Making a Backward Pass through the network, determining the latest start and latest finish for every task (LSD and LFD)

4. Calculating the float for every task. = (LSD – ESD) or (LFD – EFD)

5. Finding the paths that consist entirely of tasks with zero float. These paths will go from the very first task to the very last one.

CPM Analysis Steps by Example

This exercise describes the steps for doing CPM analysis for this course. I recommend that you work through the examples, so that you can follow the steps yourself when you begin to use them in practice.

Example: Activities, Precedence, and Durations

This example involves activities, their precedence (which activities come before other activities), and the Duration the activities take. The objective is to identify the critical path and figure out how much time the whole project will take.

Step 1: List the Activities

CPM analysis starts when you have a table showing each activity in your project. For each activity, you need to know two major information: **1 - Precedence** (which other activities must be done before it starts), and **2- Duration** – (how long the activity takes). Here's the example on the Wedding Arrangement in table A.

Table A

Activity	Description	Required Predecessor	Duration (Days)
1.1.1	Create Guest List	(Start)	1
1.1.2	Print the required invitations	1.1.1	7
1.1.3	Mail / Dispatch the Invitations	1.1.2	7
1.1.4	Collect the invitee responses	1.1.3	14
1.2.1	Prepare list of what to buy	1.1.3	3
1.2.2	Choose the boutique	1.2.1	1
1.2.3	Shop for Dress, Shoes & Others	1.2.2,	7
1.2.4	Tailoring the materials & fitting	1.2.3	7
1.3.1	Select the menu	(Start)	2
1.3.2	Find the Caterer	1.3.1	2
1.3.3	Mobilize the Caterer	1.1.4, 1.2.4, 1.3.2	1

Step 2: Draw the Net Work Diagram:

Draw by hand a network diagram of the project that shows which activities follow which other ones. This can be tricky. The analysis method we'll be using requires an "activity-on-node" (AON) diagram. An AON diagram has numbered "nodes" that represent stages of project completion. You make up the nodes' numbers as you construct the diagram. You connect the nodes with arrows that represent the activities that are listed in the above table.

Questions:

1. How many paths are there? =
2. Which is the critical path? =
3. How many days will it take for the completion of the project? =

Step 3: Set up the CPM Spreadsheet in table B & Calculate the ESD, EFD, LSD, LFD as shown below:

1. FORWARD PASS

   a. Set $ESD_{1.1.1} = 1$, » $EFD_{1.1.1} = 1 + 1 - 1 = 1$
   b. $ESD_{1.1.2} = 2$, » $EFD_{1.1.2} = 2 + 7 - 1 = 8$
   c. $ESD_{1.1.3} = 9$ » $EFD_{1.1.3} = 9 + 7 - 1 = 15$
   d. $ESD_{1.1.4} = 16$ » $EFD_{1.1.4} = 16 + 14 - 1 = 29$
   e. $ESD_{1.2.1} = 16$ » EFD1.2.1 = 16 + 3 – 1 =18
   f. $ESD_{1.2.2} = 19$ » $EFD_{1.2.2} = 19 + 1 - 1 = 19$
   g. $ESD_{1.2.3} = 20$ » $EFD_{1.2.3} = 20 + 7 - 1 = 26$
   h. $ESD_{1.2.4} = 27$ » $EFD_{1.2.4} = 27 + 7 - 1 = 33$
   i. $ESD_{1.3.1} = 1$ » $EFD_{1.3.1} = 1 + 2 - 1 = 2$
   j. $ESD_{1.3.2} = 3$ » $EFD_{1.3.2} = 3 + 2 - 1 = 4$
   k. $ESD_{1.3.3} = 34$ » $EFD_{1.3.3} = 34 + 1 - 1 = 34$

2. BACKWARD PASS

   NOTE:

   1. The rule is that you should set the LFD of the last activity to be the EFD of the Last activity.
   2. The $LFD_{predecessor} = LSD_{Successor} - 1$

Set $LFD_{1.3.3} = 34$, » $LSD_A = 34 - 1 + 1 = 34$

$LFD_{1.3.2} = 34 - 1 = 33$, » $LSD_{1.3.2} = 33 - 2 + 1 = 32$

$LFD_{1.3.1} = 32 - 1 = 31$, » $LSD_{1.3.1} = 31 - 2 + 1 = 30$

$LFD_{1.2.4} = 34 - 1 = 33$, » $LSD_{1.2.4} = 33 - 7 + 1 = 27$

$LFD_{1.2.3} = 27 - 1 = 26$, » $LSD_{1.2.3} = 26 - 7 + 1 = 20$

$LFD_{1.2.2} = 20 - 1 = 19$, » $LSD_{1.2.2} = 19 - 1 + 1 = 19$

$LFD_{1.2.1} = 19 - 1 = 18$, » $LSD_{1.2.1} = 18 - 3 + 1 = 16$

$LFD_{1.1.4} = 34 - 1 = 33$, » $LSD_{1.1.4} = 33 - 14 + 1 = 20$

$LFD_{1.1.3} = 16 - 1 = 15$, » $LSD_{1.1.3} = 15 - 7 + 1 = 9$

$LFD_{1.1.2} = 9 - 1 = 8$, » $LSD_{1.1.2} = 8 - 7 + 1 = 2$

$LFD_{1.1.1} = 2 - 1 = 1$, » $LSD_{1.1.1} = 1 - 1 + 1 = 1$

Step 5: Calculate the Float or Slack = (LFD-EFD) or (LSD - ESD)

Step 6: HOMEWORK:

(Present your result on a network diagram as shown below.)

ESD	DURATION	EFD
ACTIVITY NAME		
LSD	FLOAT	LFD

Step 7: End

Table B

Activity	Description	Required Predecessor	Duration (Days)	ESD	EFD	LSD	LFD	FLOAT
1.1.1	Create Guest List	(Start)	1					
1.1.2	Print the required invitations	1.1.1	7					
1.1.3	Mail / Dispatch the Invitations	1.1.2	7					
1.1.4	Collect the invitee responses	1.1.3	14					
1.2.1	Prepare list of what to buy	1.1.3	3					
1.2.2	Choose the bouquet	1.2.1	1					
1.2.3	Shop for Dress, Shoes & Others	1.2.2,	7					
1.2.4	Tailoring the materials & fitting	1.2.3	7					
1.3.1	Select the menu	(Start)	2					
1.3.2	Find the Caterer	1.3.1	2					
1.3.3	Mobilize the Caterer	1.1.4, 1.2.4, 1.3.2	1					