

Activity on Node Approach to CPM Scheduling

Module 03.03 - CPM

Modified: February 10, 2003

Purpose:

- Demonstrate a simple CPM schedule example
- Update the material in the textbook.

Learning Objectives

- Students should be able:
 1. Recognize the difference between activity on arrow and activity on node CPM diagrams.
 2. Construct a CPM diagram from a task list given the "preceded by" and "followed by" information.
 3. Determine the early start and late finish schedules
 4. Determine the Critical Path through the schedule.

Two Basic CPM Approaches

- CPM – Critical Path Method
- Activity on Node – What everyone uses now, Primavera, ABC-SIM, etc.
- Activity on Arrow – What was originally invented at du Pont about 40-years ago. Still shows up in books but

Activity on Node

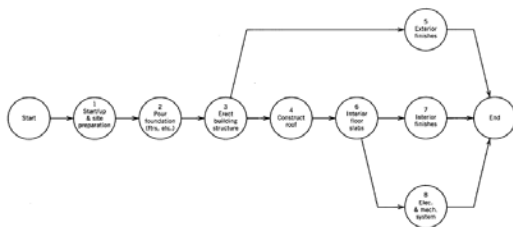


Figure 6.12 Preliminary project breakdown.

Activity on Arrow

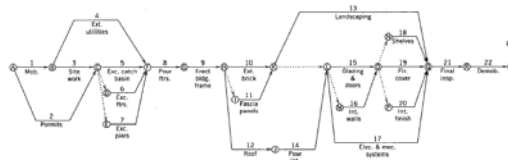


Figure 6.13 Expanded project model.

The Basic Analysis Steps

1. Decompose Project or Process into Activities
2. Develop Activity Times and Costs
3. Develop A Logical Sequence of Activities
4. Add the Activity Durations and Cost Rates
5. Compute Early Start Schedule Using the Forward Algorithm.
6. Compute Late Start Schedule Using the Backwards Algorithm.
7. Compute the Total Float and Locate Critical Path
8. Compute Free Float and Allocate Resources.
9. Develop Bar Charts & As Built S-Curves

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1. Break the Project into Activities or Work Packages:

- Methods used to place the work
- Skill needed for the work
- Crafts involved
- Critical resources
- Permits and other "Red Tape"
- Lead time for delivery
- Special considerations

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2. Develop Activity Times and Costs

- From Historical Records
- Use Judgment
- Consider Average versus Range
- R. S. Means Manual is a big help.

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3. Develop Process Flow Chart

- Precedence Logic Established by Activity on Node Process Diagram.
- Add Durations to the Activities
- Add Cost Rates to the Activities

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10

5. Compute Early Start Schedule by the Forward Pass Algorithm

- Early Finish Time (EFT) = Early Start Time (EST) + Duration for each activity.
- The EST for any activity is the greatest (latest) EFT of any preceding activity, based upon network logic.

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11

6. Compute Late Start Schedule Using the Backwards Algorithm

- Late Start Time (LST) = Late Finish Time (LFT) - Duration for each activity.
- The LFT for any activity is the least (earliest) LST of any subsequent activity, based upon network logic.

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7. Compute the Total Float and Locate the Critical Path

- Total Float (TF) is the amount of time that an activity can be delayed without delaying the total project.
- It is difference between the EFT and the LFT for each activity.
- Those activities with $TF = 0$ are on the Critical Path, by definition.

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13

8. Compute Free Float

- Free Float (FF) is either equal to Zero, or is the same as the Total Float. (According to the Text. But ... See below.)
- By definition FF exists only where the delay of an activity will affect no other activity, nor delay the total project. (Can get complex, if you look for examples.)

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14

8. Compute As-Planned Cost S-Curve

- Based upon the EST and EFT for each activity, assign the daily cost for that activity to the corresponding schedule date from start to finish.
- Sum the costs for each schedule date from start to finish.
- Determine the cumulative cost for each schedule date from start to finish.
- Plot the cumulative cost versus schedule date curve.

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Example CPM Problem

- The sequence of activities required to complete a project is shown in the table on the next Slide.
- The estimated duration and daily cost rate for activity are also shown.

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Activity	Duration- Days	Cost- \$\$/Day	Preceded By	Followed By
A	2	500	None	B, C, D
B	3	900	A	E
C	4	1,600	A	F
D	5	500	A	G
E	7	1,400	B	H
F	7	1,500	C	I, L
G	8	2,400	D	J, K
H	4	800	E	L
I	2	1,000	F	N
J	12	3,600	G	M, O
K	5	2,000	G	P
L	6	1,200	F, H	Q
M	2	900	J	N
N	2	700	I, M	S
O	6	1,800	J	R, T
P	4	1,200	K	T
Q	4	2,000	L	U
R	4	1,600	O	S
S	2	1,400	N, R	V
T	9	1,800	O, P	V
U	2	1,200	Q	V
V	3	300	S, T, U	None

Individual Exercise

- Take out a blank sheet of paper.
- Use the previous Task List to draw a CPM diagram.

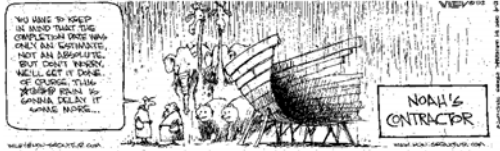
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18

The Reality of Scheduling!

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23

Convert to Bar Chart for Resource Analysis and Presentation

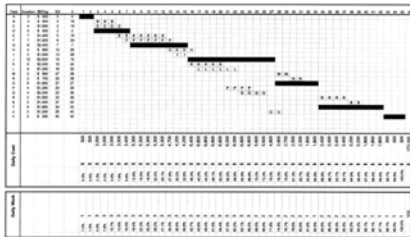
- Transfer these results to a Bar Chart layout showing early starts and finishes as well as total and free float.
- Add daily cost data to the diagram.

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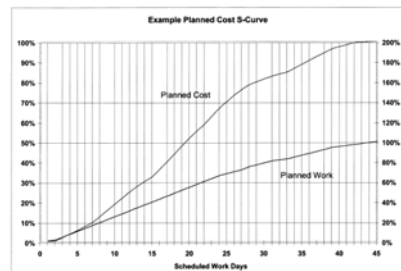
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Bar Chart based on CPM Results



As-Planned set of S-Curves based upon Bar Chart



Assessment

- Take out a sheet of paper
- Write 1 sentence on the "muddiest" part of this lecture.
- Turn in.

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27