CE 4990 - Construction Scheduling

Time Cost Trade-off

March 14, 2012

Definitions

The goal is to develop a least cost/least duration project schedule based on the underlying priorities and trade-offs that the stakeholders are willing to make.

Direct costs

Costs associated with materials, equipment, labor and subcontracts. Typically material and subcontract costs are considered to be fixed, unless there is a significant change order. Equipment and labor costs tend to be variable, particularly if production rates are over-estimated and/or site conditions are not completely accounted for.

Indirect costs

Costs incurred on site whether or not productive work is completed - not typically related to a specific work item.

Overhead costs

Cost of conducting business.

Profits

Net monetary gain from a project. Also consider viewing it in terms of return on investment and opportunity cost.

Assumptions

- Increasing or decreasing an activity duration increases direct cost for that activity
- Decreasing a projects duration leads to lower indirect costs
- A projects duration can be decreased by decreasing duration of one or more activities on the critical path
- Delta difference between increasing direct cost and reducing indirect cost: the optimal time and cost

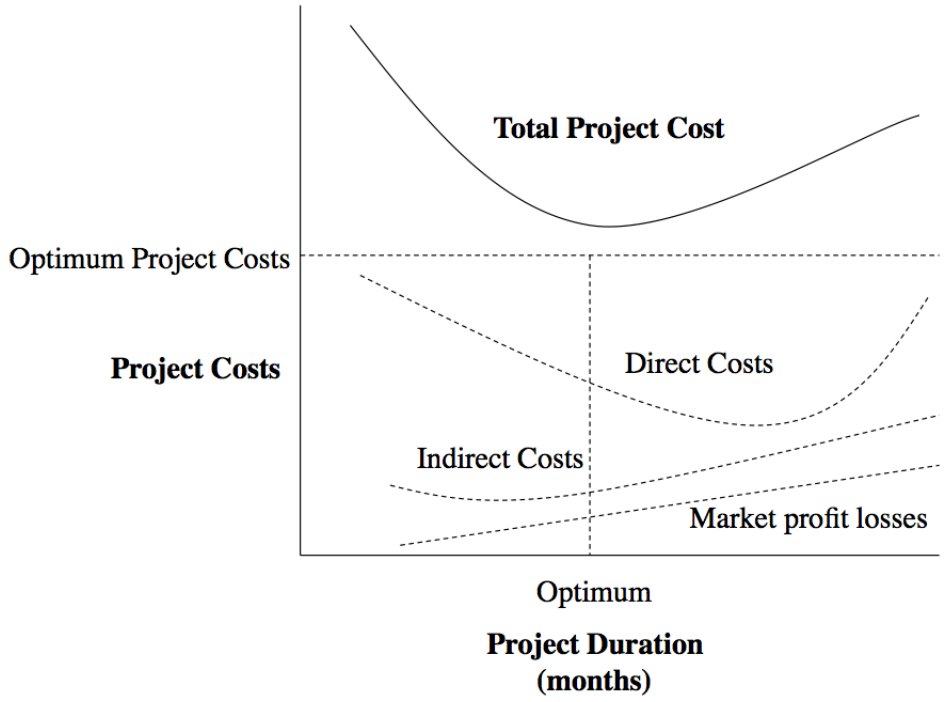
Possible network solutions

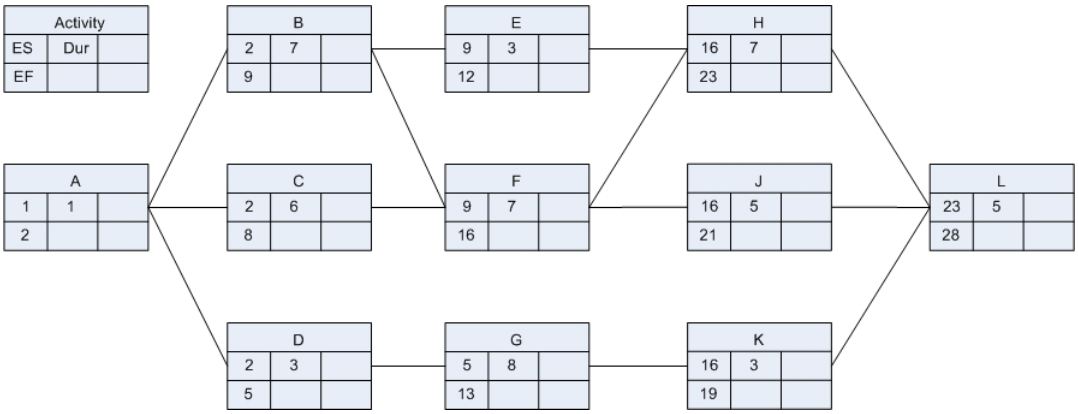
- All normal: The baseline network - all activities being performed "normally"
- Least cost: A project duration less than the "normal" case that minimizes total cost by paying more to decrease the duration of a critical activity but recouping the savings in indirect costs.
- Least time: A further reduction in project duration but the trade-off lies in an increased direct cost, in spite of reduced indirect costs. The activities on the critical path cannot be possibly shortened beyond this duration.
- All crash: Every activity is "crashed" as far as possible. The duration is same as the least time solution but total cost is higher as all activity durations have been reduced to their shortest possible duration. This is rarely the most optimal solution.

Steps to Reducing Project Duration

1. Compute all early start and early finish times
2. Compute all link lags
3. Consider all duration reduction decisions based on cost duration per day (not per cycle).
4. Identify the activity on the critical path with the lowest cost per day for duration reduction.
5. When shortening an activity duration for each cycle consider the *Network Interaction Limit (NIL)*, i.e. the smallest link lag that the reduction affects. The NIL constrains how many days an activity can be reduced as a link lag value cannot become less than 0.
6. Reduce duration of the activity in question by the lesser of the number of days an activity can be shortened and the NIL.
7. Update network after reducing the duration of an activity. Note: new critical paths might emerge.
8. Repeat steps 4-7.

Consider solving the problem on page 4.


Total Project Cost
Optimum Project Costs
Project Costs
Direct Costs
Indirect Costs
Market profit losses
Optimum
Project Duration
(months)



Activity #	Normal Duration	Crash Duration	Normal Cost	Crash Cost	Days to Shorten	Cost per Day
A	1	1	$ 800	$ 800	0	—
B	7	4	1,000	1,600	3	$200
C	6	4	300	500	2	100
D	3	2	400	800	1	400
E	3	1	100	200	2	50
F	7	5	500	800	2	150
G	8	4	200	1,400	4	300
H	7	6	350	600	1	250
J	5	3	700	850	2	75
K	3	2	500	1,000	1	500
L	5	4	450	800	1	350
			5,300			