

Project Planning & Control

Lesson 2

Time-Cost trade-off: ABCD Example Project, Steps for Crashing

Koshy Varghese, Ph.D.

Professor

Building Technology & Construction Management

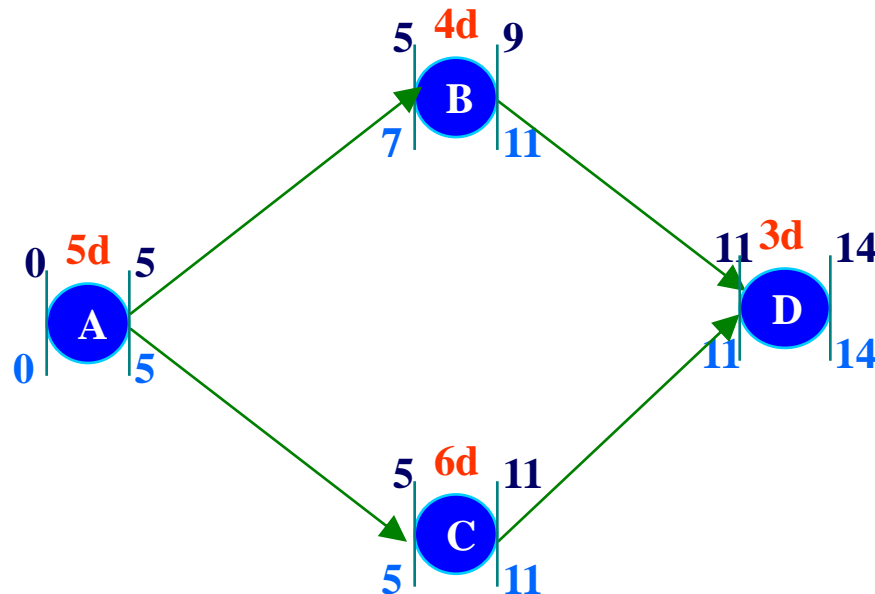
Department of Civil Engineering

I.I.T. Madras



Back to the ABCD Project

Act	ND days	Pred	CD days	NC <i>u</i>	CC <i>u</i>
A	5	-	3	250	300
B	4	A	3	300	375
C	6	A	3	350	875
D	3	B,C	2	300	350

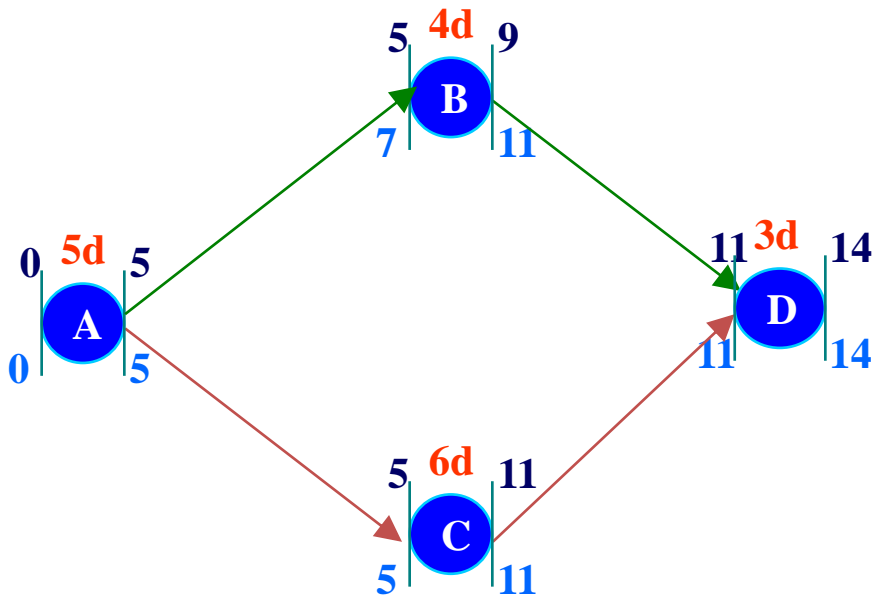


Determine Minimum Cost of Completing Project in 13, 12...8 days.²

Crashing the ABCD Project

$$CC/day = (CC - NC) / (ND - CD)$$

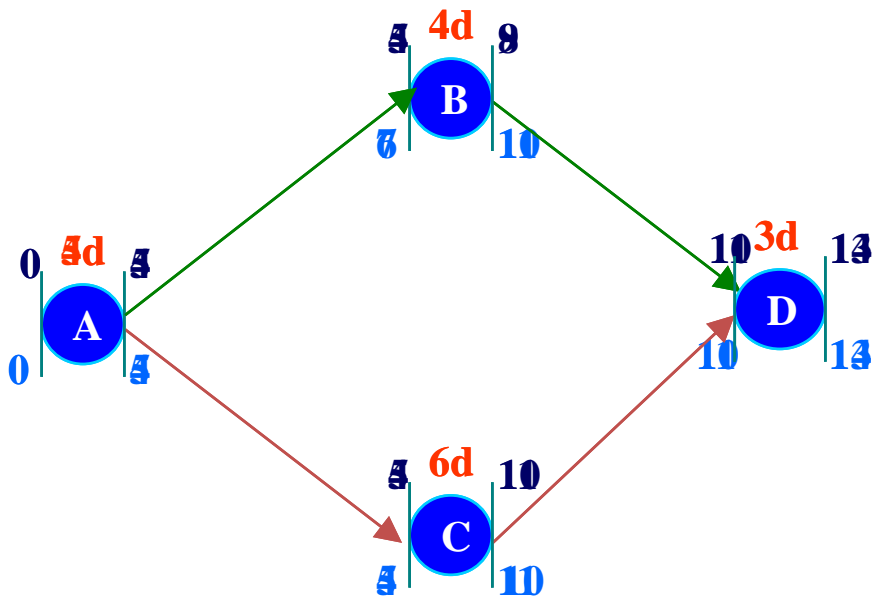
Act	ND days	Pred	CD days	NC u	CC u	Crash Days	Crash Cost / day
A	5	-	3	250	300	2	25
B	4	A	3	300	375	1	75
C	6	A	3	350	875	3	175
D	3	B,C	2	300	350	1	50



Paths : ABD – Non Critical 12 days
ACD – Critical 14 days

ABCD Project Crash Duration - 13 days

Act	ND days	Pred	CD days	NC u	CC u	Crash Days	Crash Cost / day
A	5	-	3	250	300	2	25
B	4	A	3	300	375	1	75
C	6	A	3	350	875	1	175
D	3	B,C	2	300	350	1	50



Step 1: Crash the critical path **ACD**.

Options available to crash

A= u 25 ✓

C= u 175

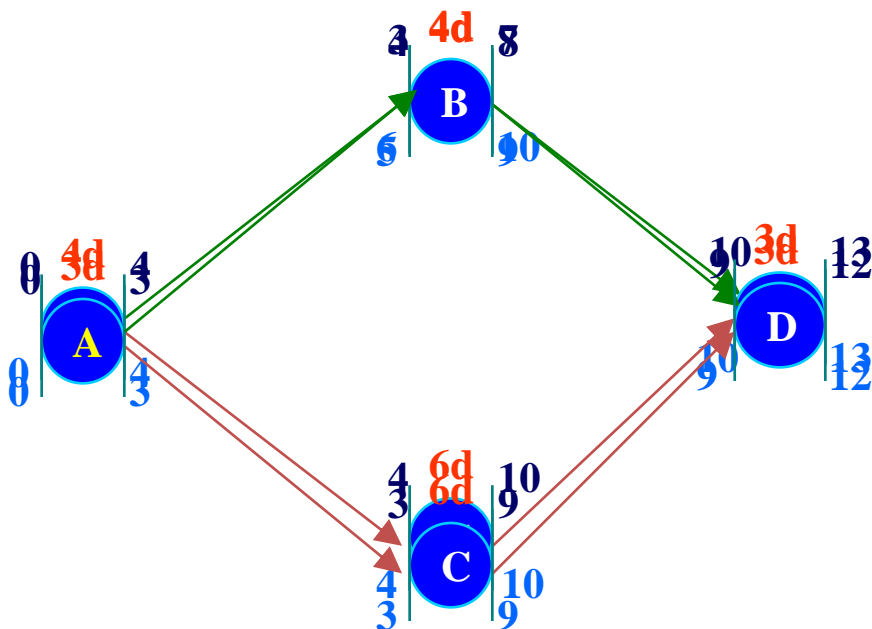
D= u 50

Crash A by 1 day: Cost = u 25

Still the critical path is ACD (13 days)

ABCD Project Crash Duration - 12 days

Act	ND days	Pred	CD days	NC u	CC u	Crash Days	Crash Cost / day
A	5	-	3	250	300	2	25
B	4	A	3	300	375	1	75
C	6	A	3	350	875	3	175
D	3	B,C	2	300	350	1	50



Step 2: Crash the critical path ACD.

Options available to crash

A = u 25 ✓

C = u 175

D = u 50

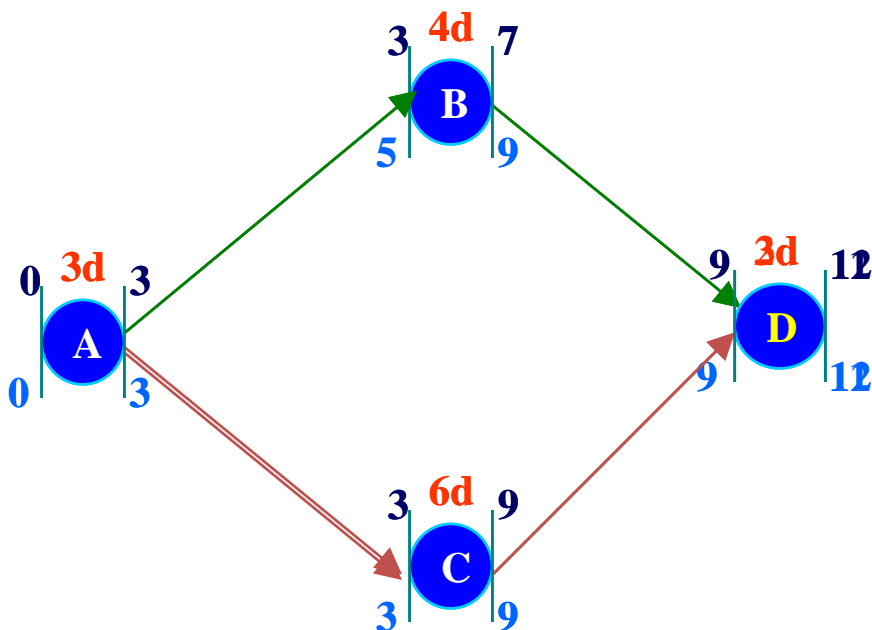
Crash A by 1 day: Cost = u 25

(A cannot be crashed any further)

Still the critical path is ACD (12 days)

ABCD Project Crash Duration - 11 days

Act	ND days	Pred	CD days	NC u	CC u	Crash Days	Crash Cost / day
A	5	-	3	250	300	2	25
B	4	A	3	300	375	1	75
C	6	A	3	350	475	1	125
D	3	B,C	2	300	350	1	50



Step 3: Crash the critical path ACD.

Options available to crash

~~A = u 25~~ (A cannot be crashed any further)

C = u 175

D = u 50 ✓

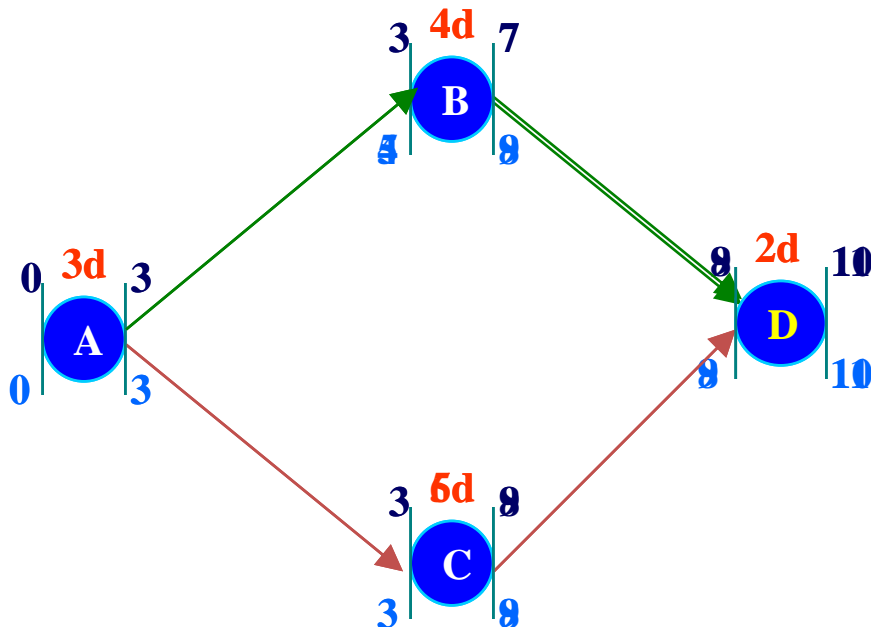
Crash D by 1 day: Cost = u 50

(D cannot be crashed any further)

Still the critical path is ACD (11 days)

ABCD Project Crash Duration - 10 days

Act	ND days	Pred	CD days	NC u	CC u	Crash Days	Crash Cost / day
A	5	-	3	250	300	2	25
B	4	A	3	300	375	1	75
C	6	A	3	350	475	1	125
D	3	B,C	2	300	350	1	50



Step 4: Crash the critical path ACD.

Options available to crash

~~A = u 25~~ (A cannot be crashed any further)

C = u 175 ✓

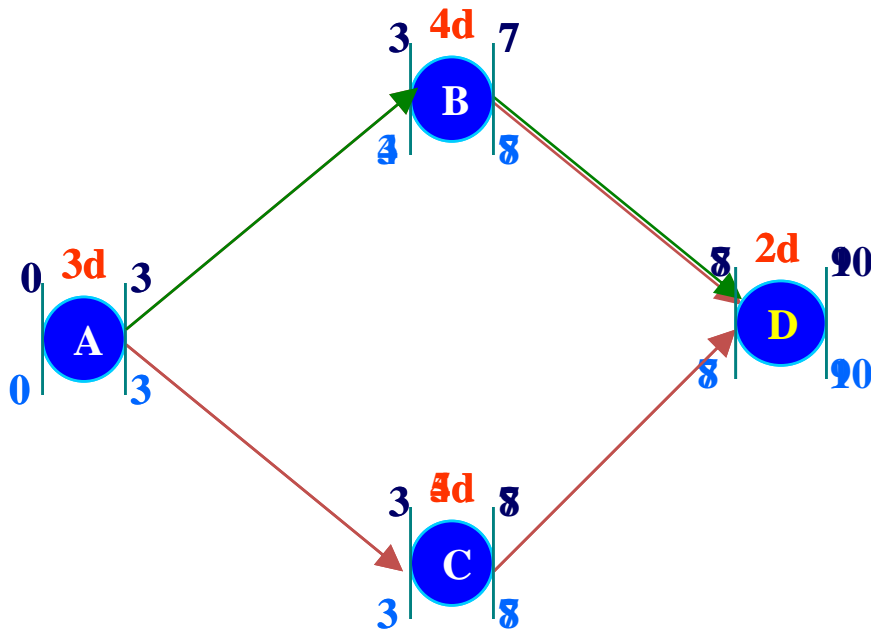
~~D = u 50~~ (D cannot be crashed any further)

Crash C by 1 day: Cost = u 175

Still the critical path is ACD (10 days)

ABCD Project Crash Duration - 9 days

Act	ND days	Pred	CD days	NC u	CC u	Crash Days	Crash Cost / day
A	5	-	3	250	300	2	25
B	4	A	3	300	375	1	75
C	6	A	3	350	475	1	125
D	3	B,C	2	300	350	1	50



Step 5: Crash the critical path ACD.

Options available to crash

~~A = u 25~~ (A cannot be crashed any further)

C = u 175 ✓

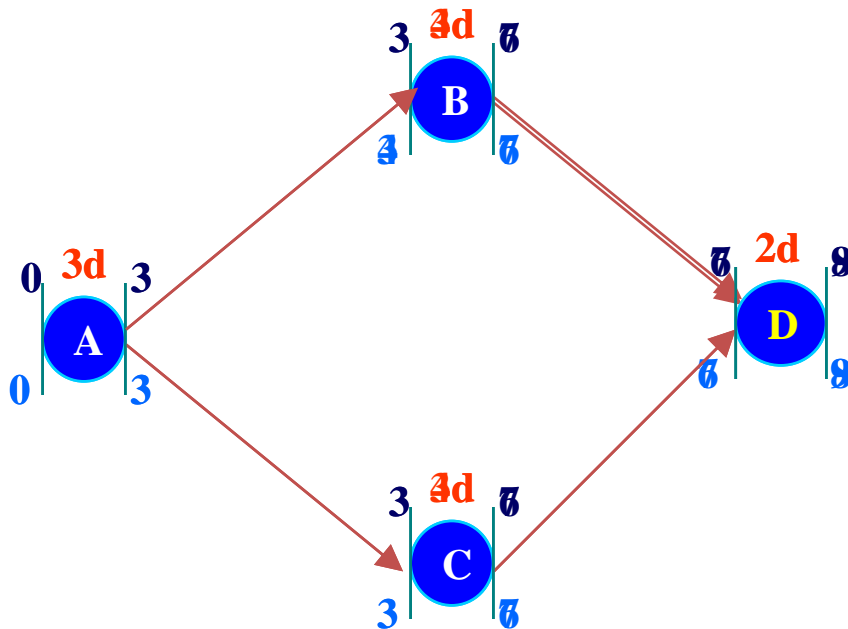
~~D = u 50~~ (D cannot be crashed any further)

Crash C by 1 day: Cost = u 175

Both ABD & ACD are Critical (9 days)

ABCD Project Crash Duration - 8 days

Act	ND days	Pred	CD days	NC u	CC u	Crash Days	Crash Cost / day
A	5	-	3	250	300	2	25
B	4	A	3	300	375	1	75
C	6	A	3	350	475	1	125
D	3	B,C	2	300	350	1	50



Step 6: Crash the critical path **ACD & **ABD**.**

Options available to crash

~~A = u 25~~ (A cannot be crashed any further)

C = u 175 & B = u 75 ✓

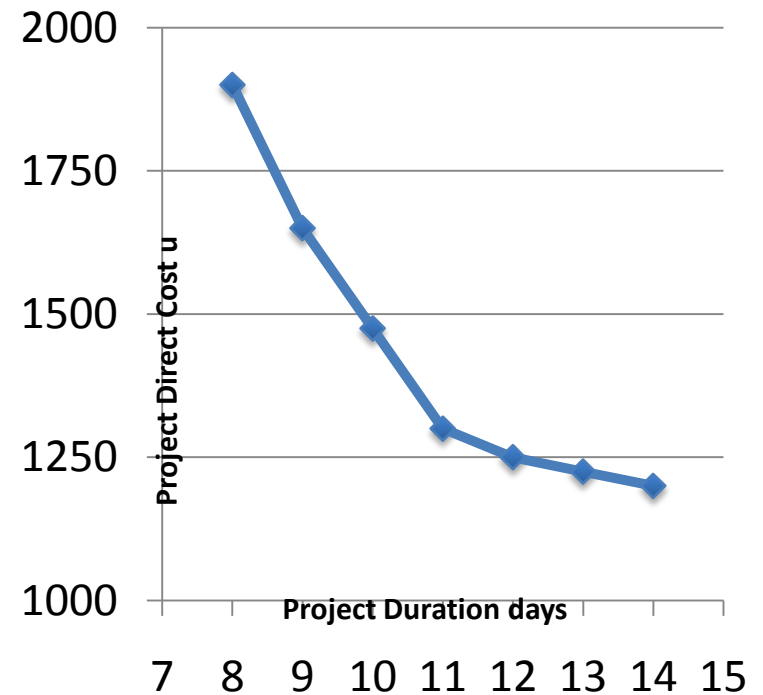
~~D = u 50~~ (D cannot be crashed any further)

Crash C & B by 1 day: Cost = u 250

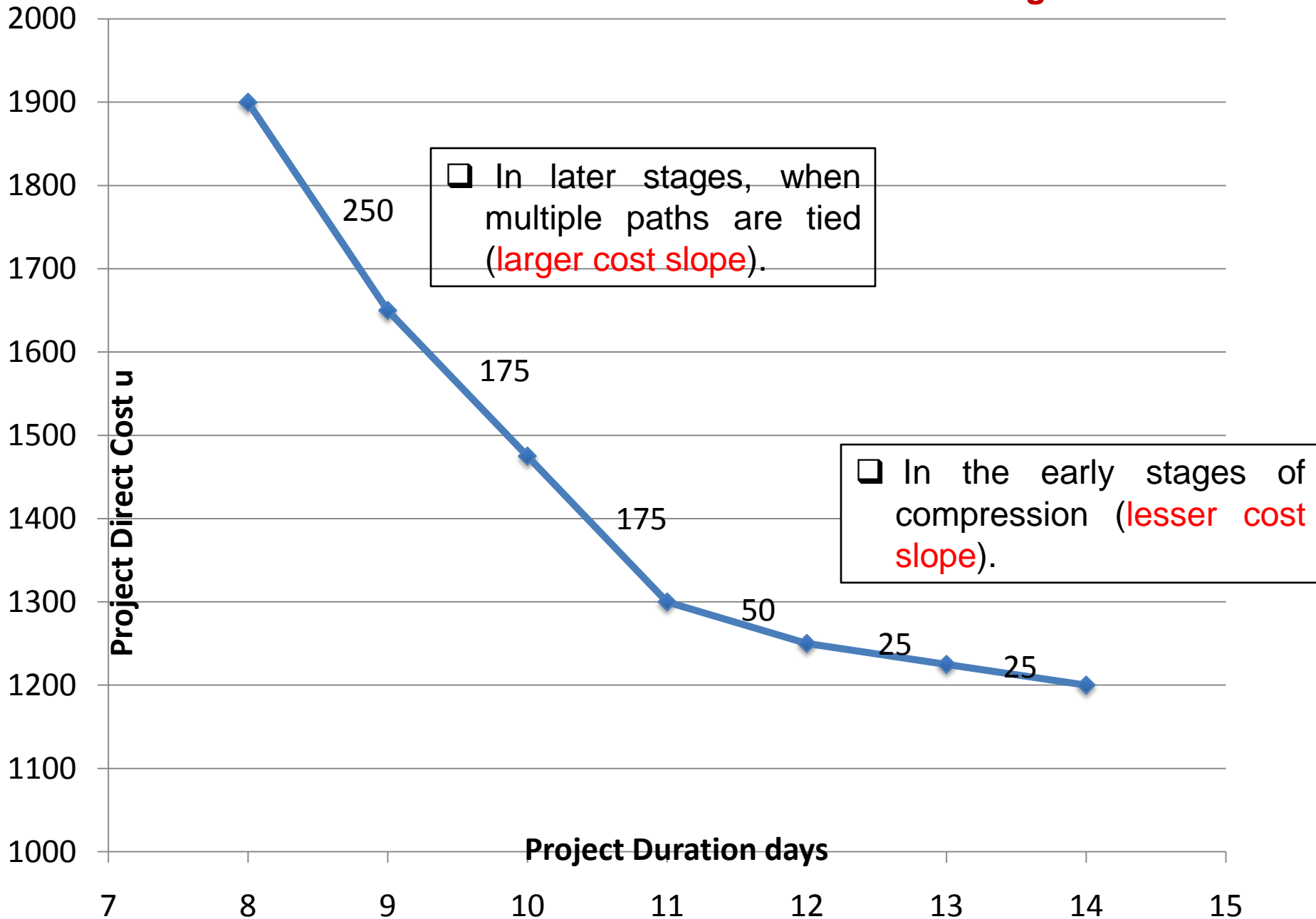
MAX CRASH

Crashing Cost - Summary

Step No.	Project Duration days	Activity Crashed	Crash Cost u	Cumulative Crash Cost u	Total Project Direct Cost u
0	14	None	0	0	1200
1	13	A by 1	25	25	1225
2	12	A by 1	25	50	1250
3	11	D by 1	50	100	1300
4	10	C by 1	175	275	1475
5	9	C by 1	175	450	1650
6	8	C & B by 1	250	700	1900



Effect of Crashing on Direct cost



INDIRECT COSTS

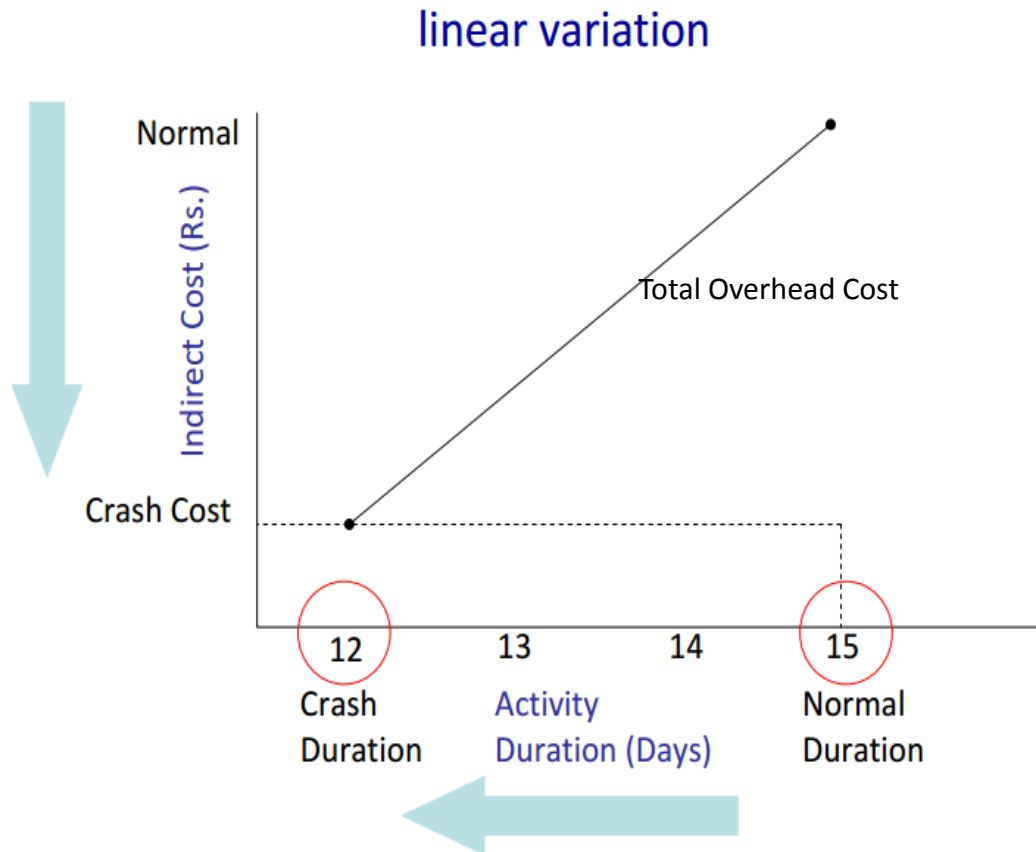
- Project overhead
 - Staff, manager, project engineer salary.
 - Office equipment and temporary utilities like electricity, phone.

- General overhead
 - Main office expenses- rent, maintenance.
 - Site equipment and vehicles.
 - Lawyers and accountants, Advertising and Social activities.

- Contingency fees
 - Additional cost allocated for unknown events.

Not directly related to activities

Effect of crashing on Indirect cost

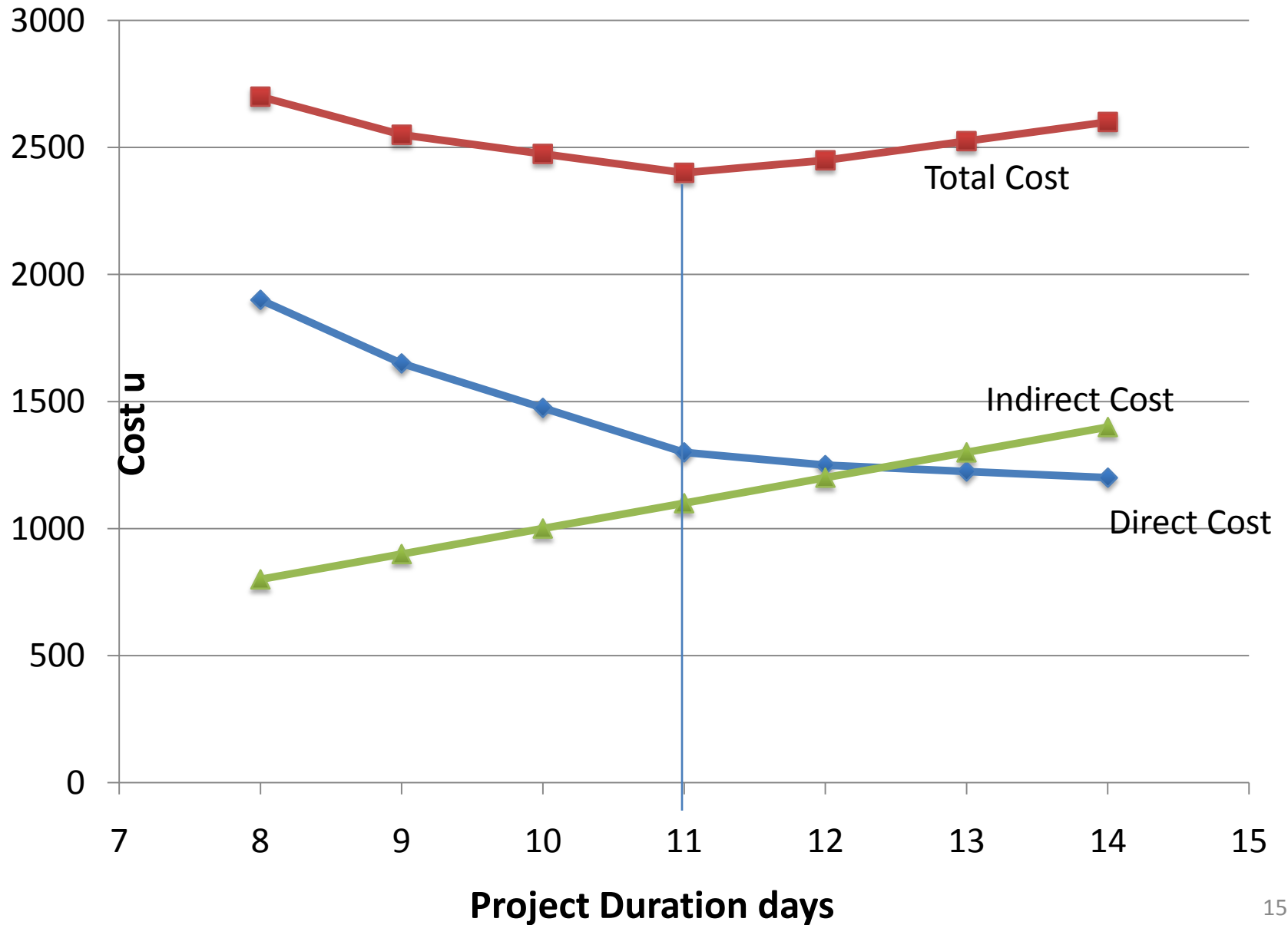


- ❑ These expenses are constant for each day of the project
- ❑ When the project duration is decreased total indirect cost will decrease

Total Project Cost – Direct + Indirect

Step No.	Project Duration days	Activity Crashed	Crash Cost u	Cumulative Crash Cost u	Total Project Direct Cost u	Indirect Cost / day	Total Indirect Cost	Total Cost (Direct + Indirect)
0	14	None	0	0	1200	100	1400	2600
1	13	A by 1	25	25	1225	100	1300	2525
2	12	A by 1	25	50	1250	100	1200	2450
3	11	D by 1	50	100	1300	100	1100	2400
4	10	C by 1	175	275	1475	100	1000	2475
5	9	C by 1	175	450	1650	100	900	2550
6	8	C & B by 1	250	700	1900	100	800	2700

Time-Cost Curve



Steps for Crashing

1

- Identify activities on Critical path(s)

2

- Compare unit cost of crashing (critical) activities/combinations available for crashing*

3

- Select activity/combination with minimum unit cost. In case of a tie activity which influences more paths.

4

- Reduce duration of activity/ combination. (*ensure no other path becomes critical if duration reduction is by more than 1 day*)

5

- Recalculate network parameters and go to Step-1.

**Repeat Steps until activity/combination cannot undergo further crashing*