

Project Planning & Control

Lesson 5

Incorporating Factors such as Bonus and Penalty; Problem- 4

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Bonus & Penalty on Projects

- Contract may specify bonus and/or penalty depending on owners requirements
- Specification can vary widely but it is typical to based in on a per day within/excess of normal duration
- It is an incentive/disincentive for contractor for early/completion

Problem-4

- Develop a network diagram and determine least cost duration for project given
 - Indirect Cost. = u400/day
 - Bonus Penalty –
 - » Normal Duration **u0 (No bonus / No Penalty)**
 - » Each Excess Day **u300/day (Penalty)**
 - » Each Reduced Day **u300/day (Bonus)**

Activity	Preceded by	Normal duration (ND) (days)	Crash duration (CD) (days)	Normal cost (NC) (u)	Crash cost (CC) (u)
A	-	120	100	12,000	14,000
B	-	20	15	1,800	2,800
C	B	40	30	16,000	22,000
D	C	30	20	1,400	2,000
E	D,F	50	40	3,600	4,800
F	B	60	45	13,500	18,000

Activity Direct Cost Slope

Activity	Preceded by	Normal duration (ND) (days)	Crash duration (CD) (days)	Normal cost (NC) (u)	Crash cost (CC) (u)	Cost Slope u/day
A	-	120	100	12,000	14,000	100
B	-	20	15	1,800	3,800	400
C	B	40	30	16,000	22,000	600
D	C	30	20	1,400	2,000	60
E	D,F	50	40	3,600	4,800	120
F	B	60	45	13,500	18,000	300
			Total Cost	48,300		

Cost table : Direct, Indirect, Total cost
Indirect @ u400/day
 (Bonus/Penalty not included)

Duration (days)	Change Made	Direct Cost Change (u)	Direct cost (u)	Total Indirect cost (u)(@400/day)	Total Cost (u)
140	Normal Duration	0	48,300	56,000	104,300
130	Reduce D to 20 days	$60 \times 10 = 600$	48,900	52,000	100,900
120	Reduce E to 40 days	$120 \times 10 = 1200$	50,100	48,000	98,100
115	Reduce A to 115 & B to 15 days	$500 \times 5 = 2500$	52,600	46,000	98,600
105	Reduce A to 105, C to 30 & F to 50 days	$1000 \times 10 = 10,000$	62,600	42,000	103,600

Cost table : Direct, Indirect, Total cost

Indirect @ u400/day

Penalty @ u300/day exceeding 140 days

Bonus @ u300/day finishing before 140 days

Duration (days)	Change Made	Direct Cost Change (u)	Direct cost (u)	Total Indirect cost (u)(@400/day)	Bonus Penalty	Total Cost (u)
150	Delay	0*	48,300	60,000	3000	111,300
145	Delay	0*	48,300	58,000	1500	107,800
140	Normal Duration	0	48,300	56,000	0	104,300
130	Reduce D to 20 days	600	48,900	52,000	(-)3000	97,900
120	Reduce E to 40 days	1200	50,100	48,000	(-)6000	92,100
115	Reduce A to 115 & B to 15 days	2500	52,600	46,000	(-)7500	91,100
105	Reduce A to 105, C to 30 & F to 50 days	10,000	62,600	42,000	(-)10,500	94,100

Questions | Discussions

Summary

- Time-Cost Trade-off procedure

- Tabular Approach for calculation

Activity	Paths requiring time reduction			Cost Slope (u/day)	Available Crash time (ND-CD)	Iteration		
	ABCF GI	ABDI	ABE HI			1	2	3
	ABCFI	ABCF	ABCFEI					
X A	1	1	1	300	1	1	1	0
B	1	1	1	500	2	2	2	2
C	1	0	0	425	2	2	2	2
D	0	1	0	200	1	1	1	1
E	0	0	1	150	1	1	1	1
F	1	0	0	250	2	2	1	1
X G	1	0	0	0	0	0	0	0
H	0	0	1	600	1	1	1	1
X I	1	1	1	200	1	0	0	0
Initial Path length	41	38	40	Iteration	Action			It
Path Length	41	38	40	0	-			
	40	37	39	1	Crash I by 1 day			
	39	37	39	2	Crash F by 1 day			
	38	36	38	3	Crash A by 1 day			

- Incorporating factors such as bonus/penalty