#7 Project Cost

PMBOK 5 Ed. – DEI-

KEEP CALM AND SAVE MONEY

The process required to manage the project on budget and get the profit

PROJECT COST MANAGEMENT

“Cost estimating, budgeting, and control should be ***the concern of everyone”***

IT change initiatives in almost 1,500 projects and reported an average cost overrun of 27 percent! (harvard,2011)


How to get the profit and the budgets stay on the track?

The answer is...

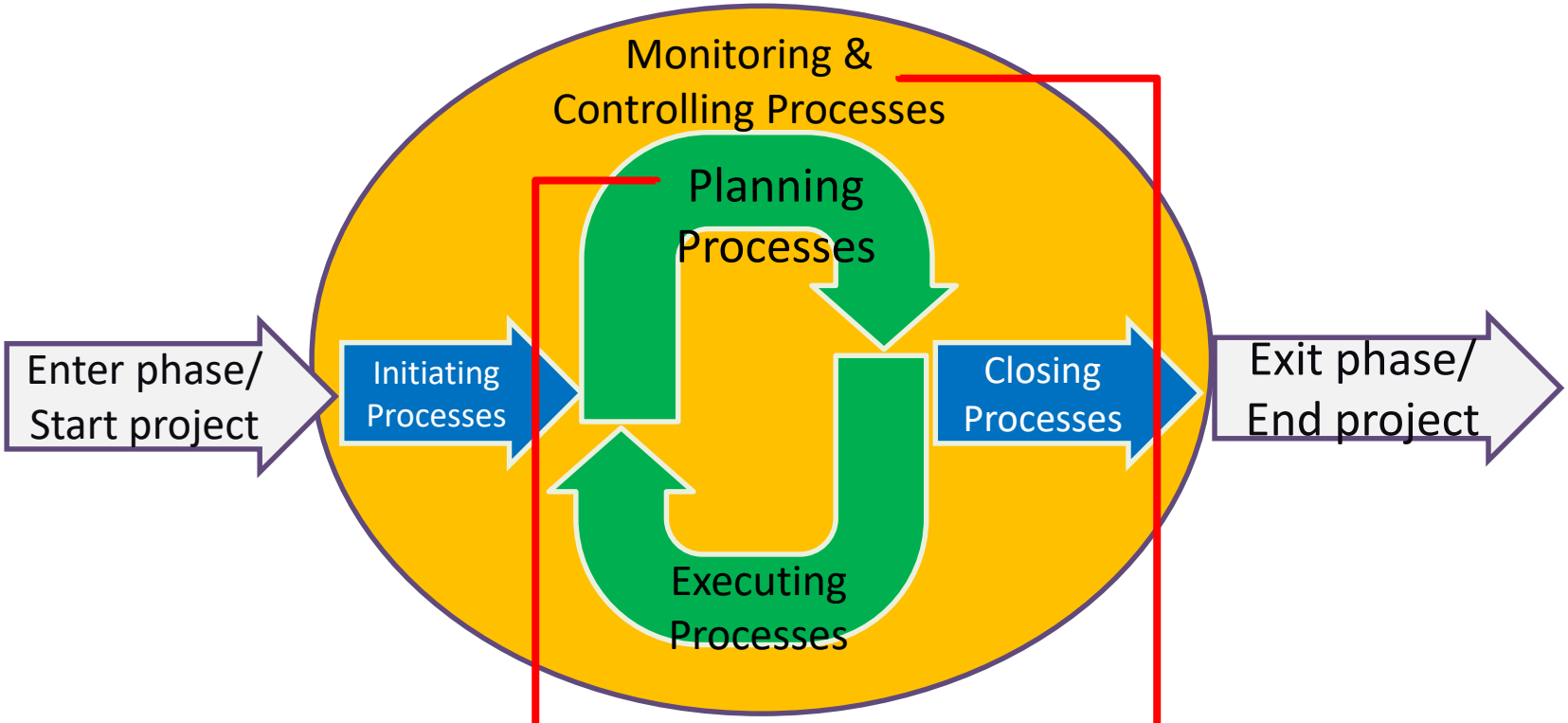
"Someone is sitting in the shade today because someone planted a tree a long time ago."
- Warren Buffett

Plan cost

Estimate Cost

Determine Cost

Control Cost

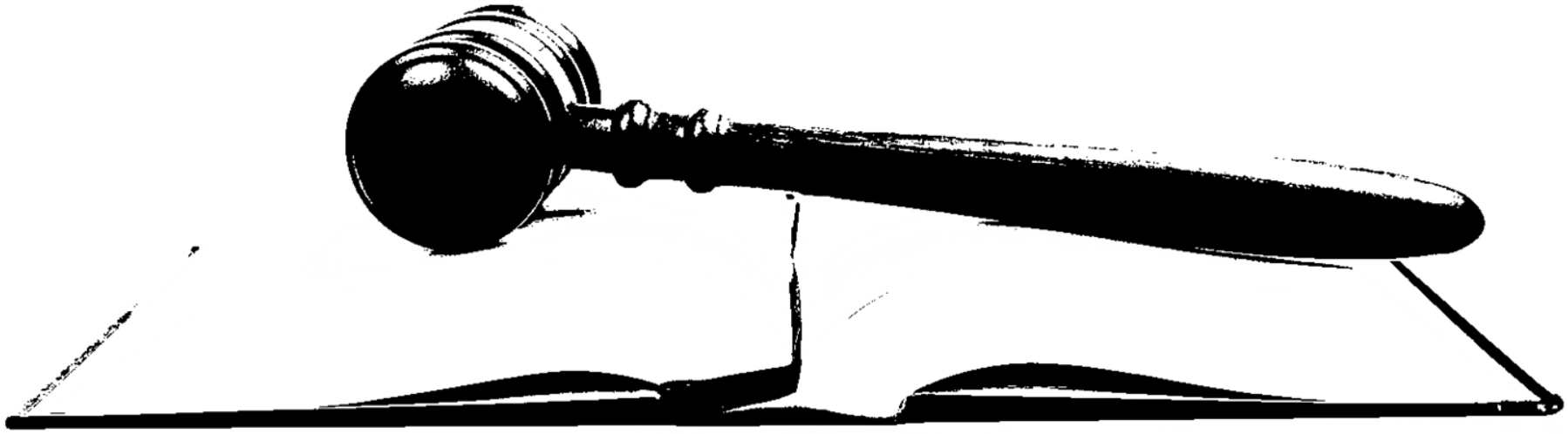


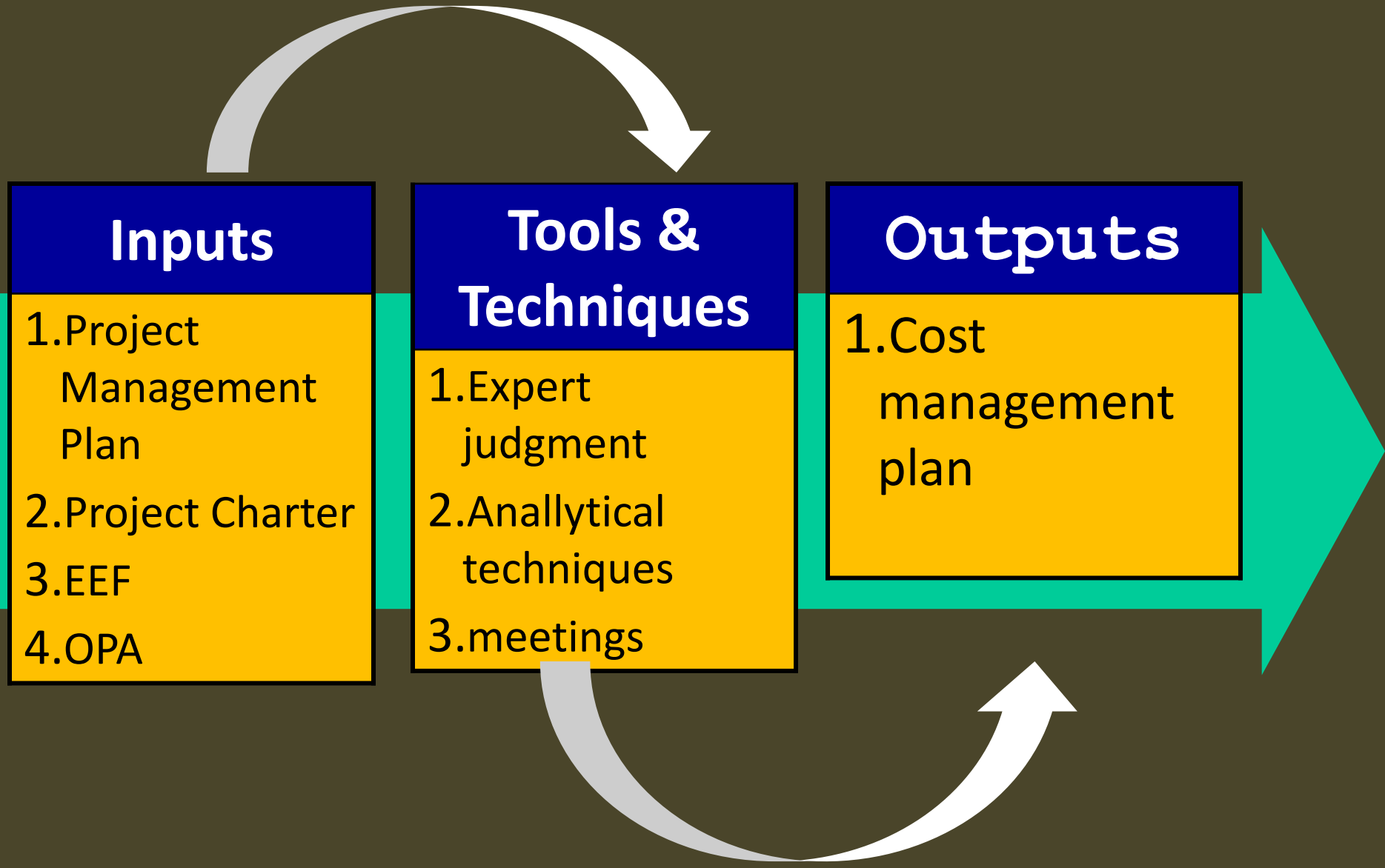
Knowledge Area	Process				
	Initiating	Planning	Executing	Monitoring & Control	Closing
Scope		**Plan Cost** **Cost Estimating** **Cost Budgeting**		**Control Cost**	

- **Cost estimates, budgets, WBSs, and schedules** are interrelated.
- When the cost cannot be estimated because it **is too complex**, **the task is broken down** further until it can.

Plan Cost

"Determining the policies, procedures, and documentation to manage budget"




Inputs
1.Project Management Plan
2.Project Charter
3.EEF
4.OPA
Tools & Techniques
1.Expert judgment
2.Anallytical techniques
3.meetings
Outputs
1.Cost management plan

Level of accuracy

Unit of measure

Organizational procedure

Control of threshold

Rules of performance

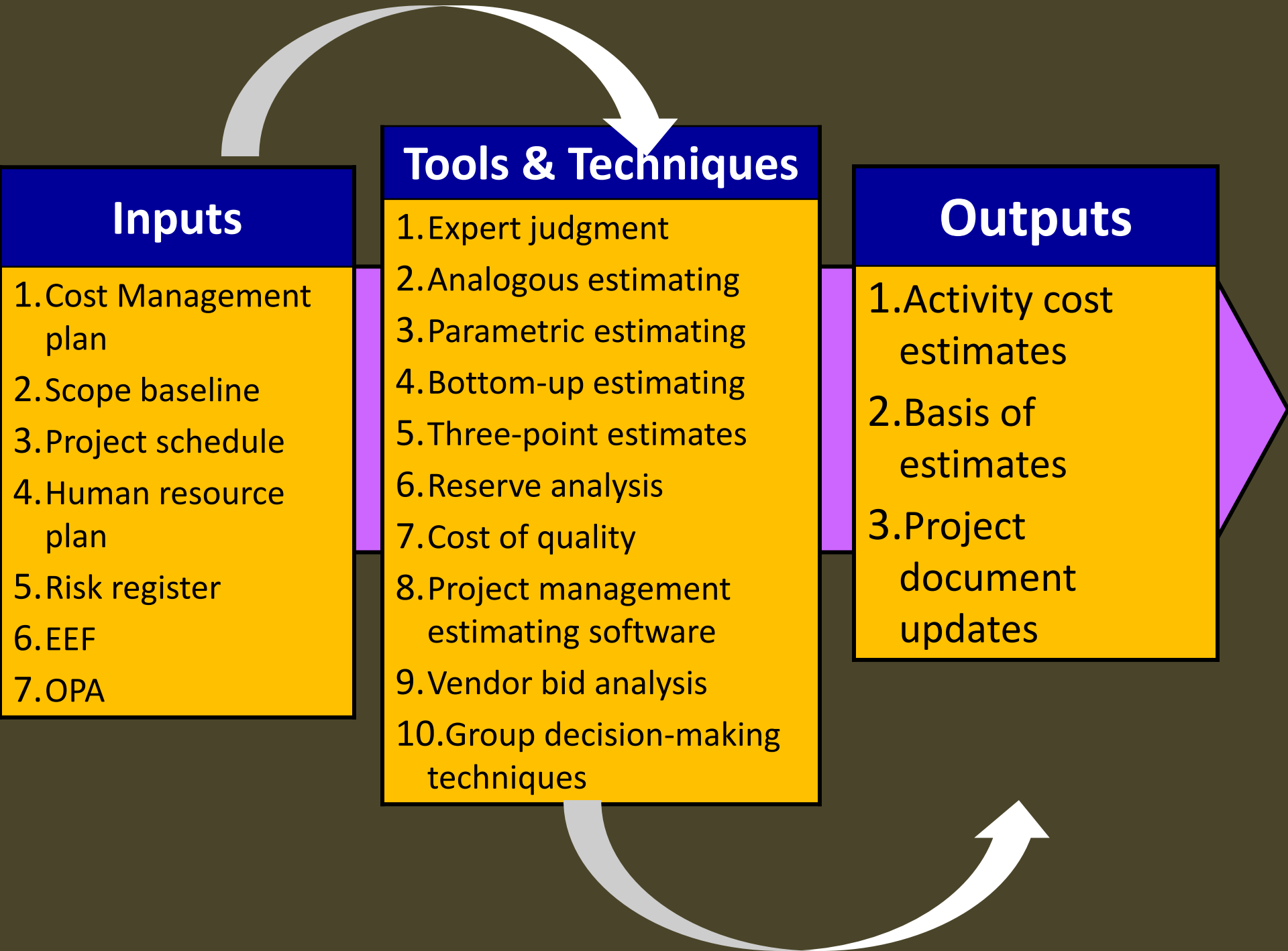
Reporting Format

Process Description

COST MANAGEMENT PLAN

Estimate Cost

The process of developing approximation of the monetary resources needed to **complete project activities**


Inputs
1. Cost Management plan
2. Scope baseline
3. Project schedule
4. Human resource plan
5. Risk register
6. EEF
7. OPA
Tools & Techniques
1. Expert judgment
2. Analogous estimating
3. Parametric estimating
4. Bottom-up estimating
5. Three-point estimates
6. Reserve analysis
7. Cost of quality
8. Project management estimating software
9. Vendor bid analysis
10. Group decision-making techniques
Outputs
1. Activity cost estimates
2. Basis of estimates
3. Project document updates

Types of Cost

- **Variable Costs**
  - –Change with the **amount of production/work**
  - –e.g. material, supplies, wages
- **Fixed Costs**
  - –**Do not change** as production change
  - –e.g. set-up, rental

Types of Cost

- **Direct Costs**
  - **Directly attributable** to the work of project
  - e.g. team travel, recognition, team wages
- **Indirect Costs**
  - **overhead or cost incurred for benefit** of more than one project
  - e.g. taxes, fringe benefit, janitorial services

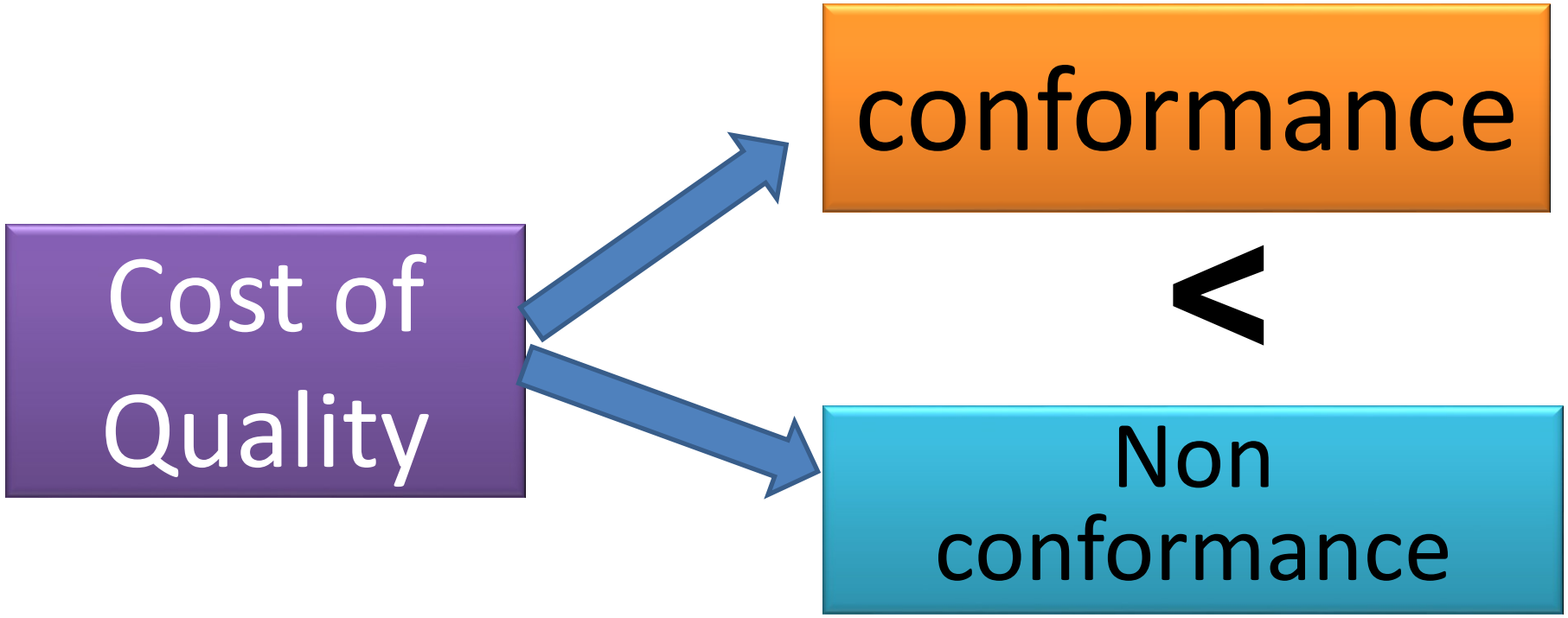
Quality/Accuracy of Cost Estimation

Estimate	Accuracy
Rough Order of Magnitude (ROM)	-25% +75%
Budget Estimate	-10% +25%
Definitive Estimate	-5% 10%

- Most difficult to estimate as **very little project info is available**, made during **initiating process**
- **Project selection decisions.**
- Very early in the project life cycle**, often 3–5 years before project completion**

- **allocate** money into an **organization's budget.**
- Used to finalize the **Request for Authorization (RFA),** and establish commitment, made during **planning phase**
- **Early, 1–2 years out**

- Used for making **many purchasing decisions**
- **Estimate actual cost, during the project** and refined
- Later in the project, **less than 1 year out**


conformance
Cost of Quality
<
Non conformance

Conformance

Money spent during the project to avoid failure. Prevention cost & Appraisal cost

Non-Conformance

Money spent during and after the project because of failure. internal cost & external cost

Contractor's / seller's Estimate Cost example:

Surveyor Pro Project Cost Estimate Created October 5

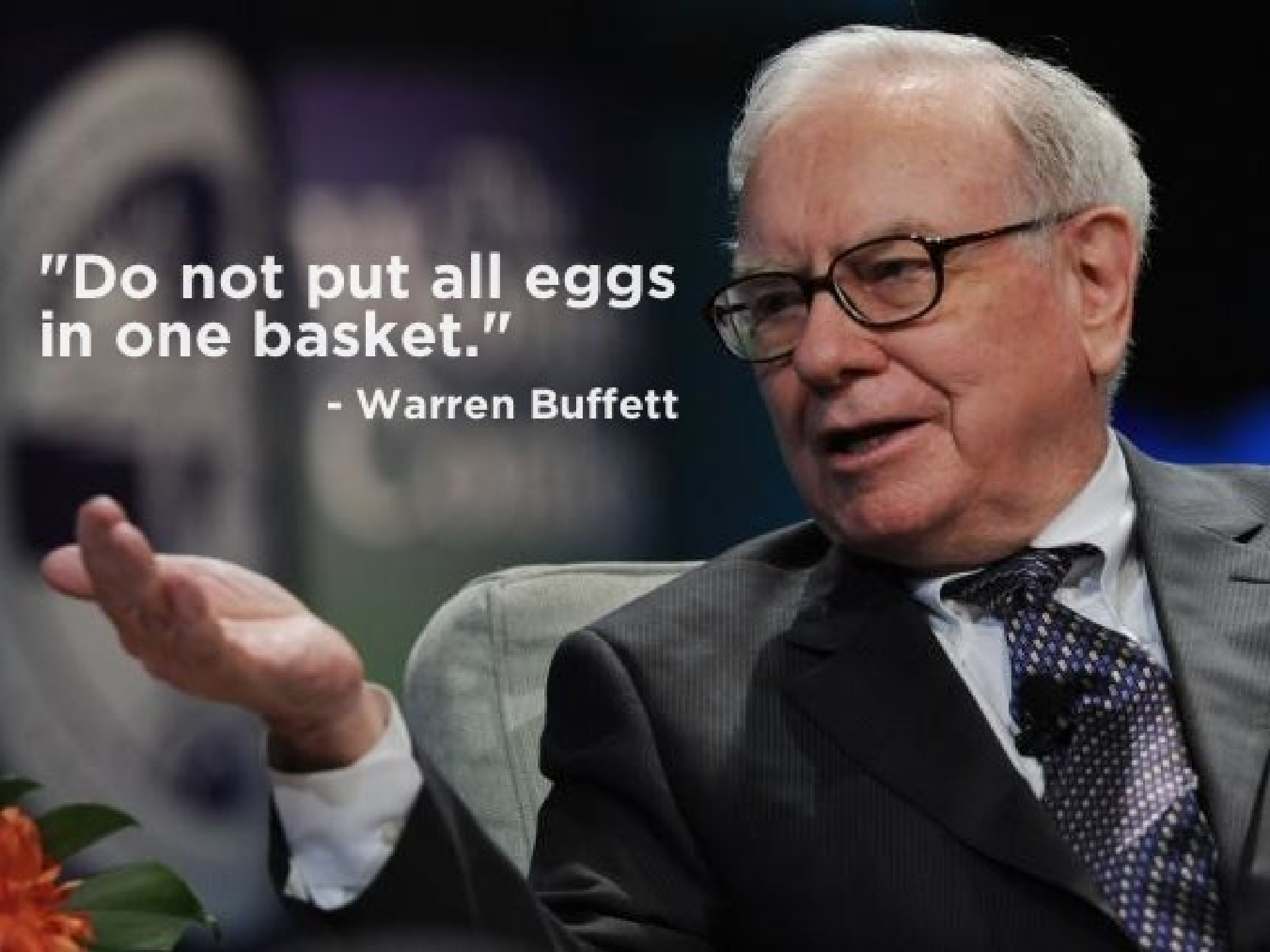
	# Units/Hrs.	Cost/Unit/Hr.	Subtotals	WBS Level 2 Totals	% of Total
WBS Items					
1. Project Management				**$306,300**	**20%**
Project manager	960	$100	$96,000		
Project team members	1920	$75	$144,000		
Contractors (10% of software development and testing)			$66,300		
2. Hardware				**$76,000**	**5%**
2.1 Handheld devices	100	$600	$60,000		
2.2 Servers	4	$4,000	$16,000		
3. Software				**$614,000**	**40%**
3.1 Licensed software	100	$200	$20,000		
3.2 Software development*			$594,000		
4. Testing (10% of total hardware and software costs)			$69,000	**$69,000**	**5%**
5. Training and Support				**$202,400**	**13%**
Trainee cost	100	$500	$50,000		
Travel cost	12	$700	$8,400		
Project team members	1920	$75	$144,000		
6. Reserves (20% of total estimate)			$253,540	**$253,540**	**17%**
Total project cost estimate				**$1,521,240**	

*See software development estimate.

Surveyor Pro Software Development Estimate Created October 5

1. Labor Estimate	# Units/Hrs.	Cost/Unit/Hr.	Subtotals	Calculations
Contractor labor estimate	3000	$150	$450,000	3000*150
Project team member estimate	1920	$75	$144,000	1920*75
Total labor estimate			**$594,000**	Sum above two values
2. Function point estimate**	Quantity	Conversion Factor	Function Points	Calculations
External inputs	10	4	40	10*4
External interface files	3	7	21	3*7
External outputs	4	5	20	4*5
External queries	6	4	24	6*4
Logical internal tables	7	10	70	7*10
Total function points			**175**	Sum above function point values
Java 2 languange equivalency value			46	Assumed value from reference
Source lines of code (SLOC) estimate			8,050	175*46
Productivity×KSLOC^Penalty (in months)			29.28	3.13*8.05^1.072 (see reference)
Total labor hours (160 hours/month)			4,684.65	29.28*160
Cost/labor hour ($120/hour)			$120	Assumed value from budget expert
Total function point estimate			**$562,158**	4684.65*120

**Approach based on paper by William Roetzheim, "Estimating Software Costs," Cost Xpert Group, Inc. (2003) using the COCOMO II default linear productivity factor (3.13) and penalty factor (1.072).

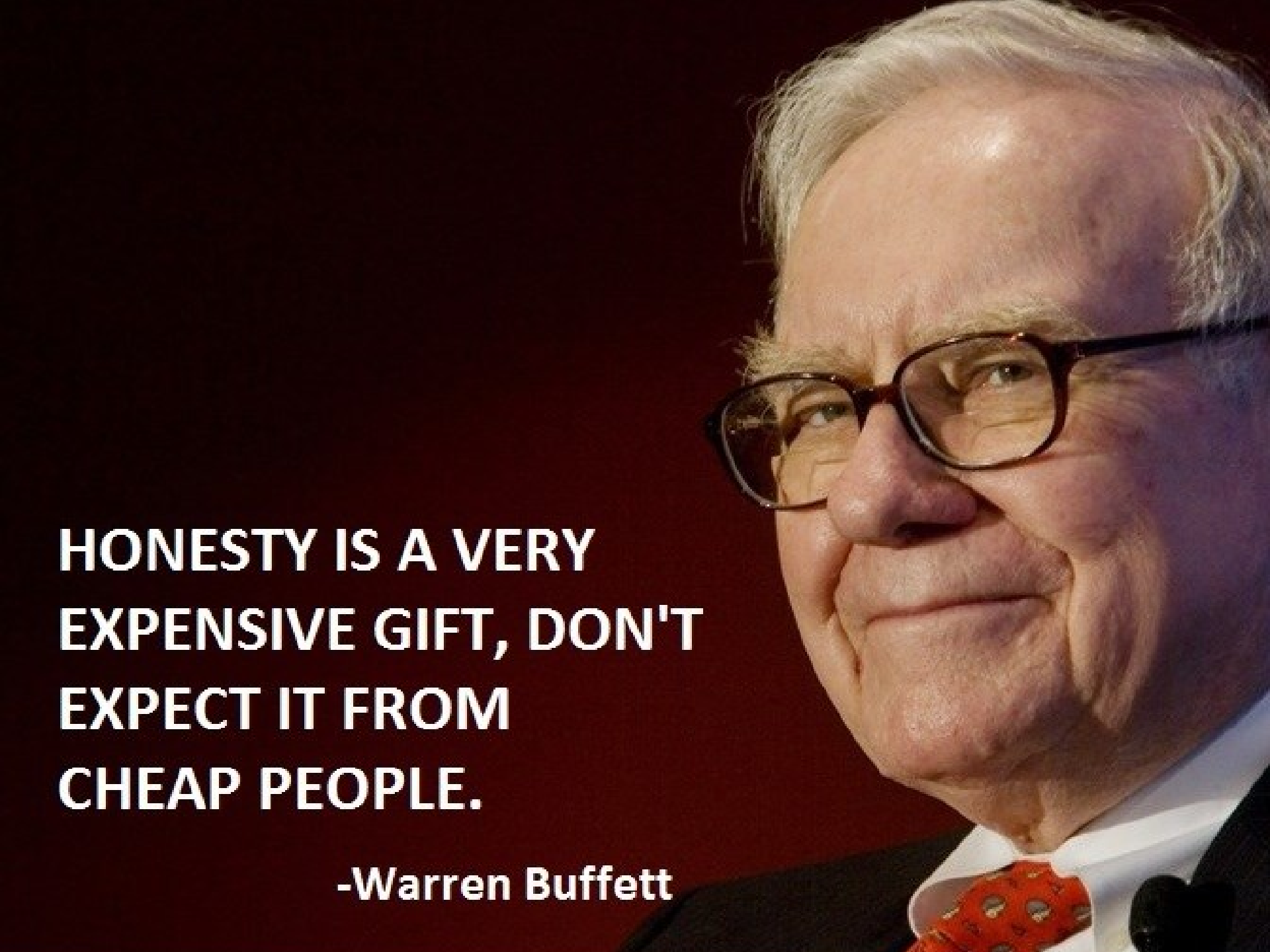

"Do not put all eggs
in one basket."
- Warren Buffett

Problem in estimating cost

Estimates too quickly

Large project→big effort


People lack estimating experience.
Capability, cumulative experience, training

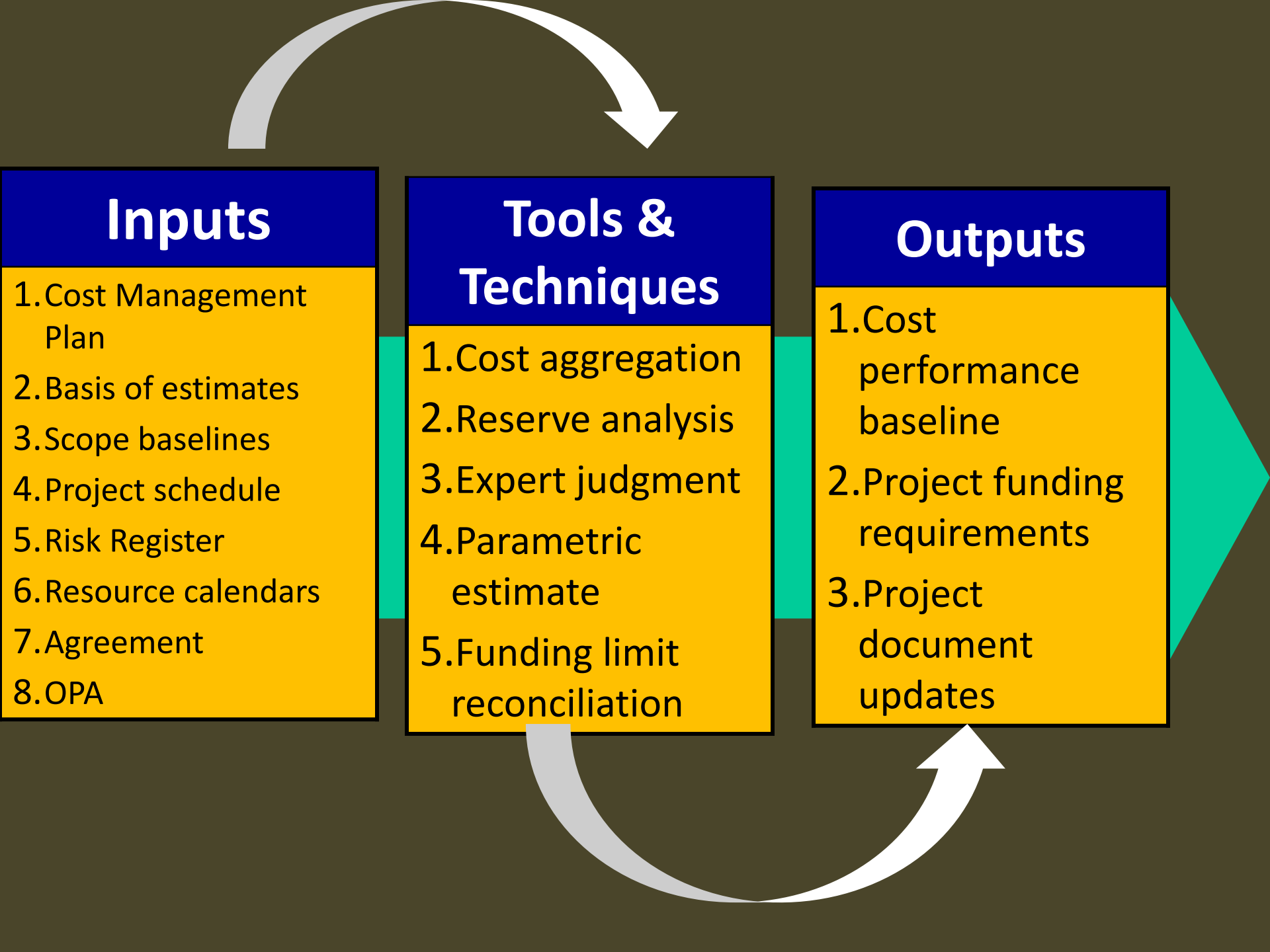

HONESTY IS A VERY EXPENSIVE GIFT, DON'T EXPECT IT FROM CHEAP PEOPLE.
-Warren Buffett


Human beings are biased toward underestimation.
Senior vs junior

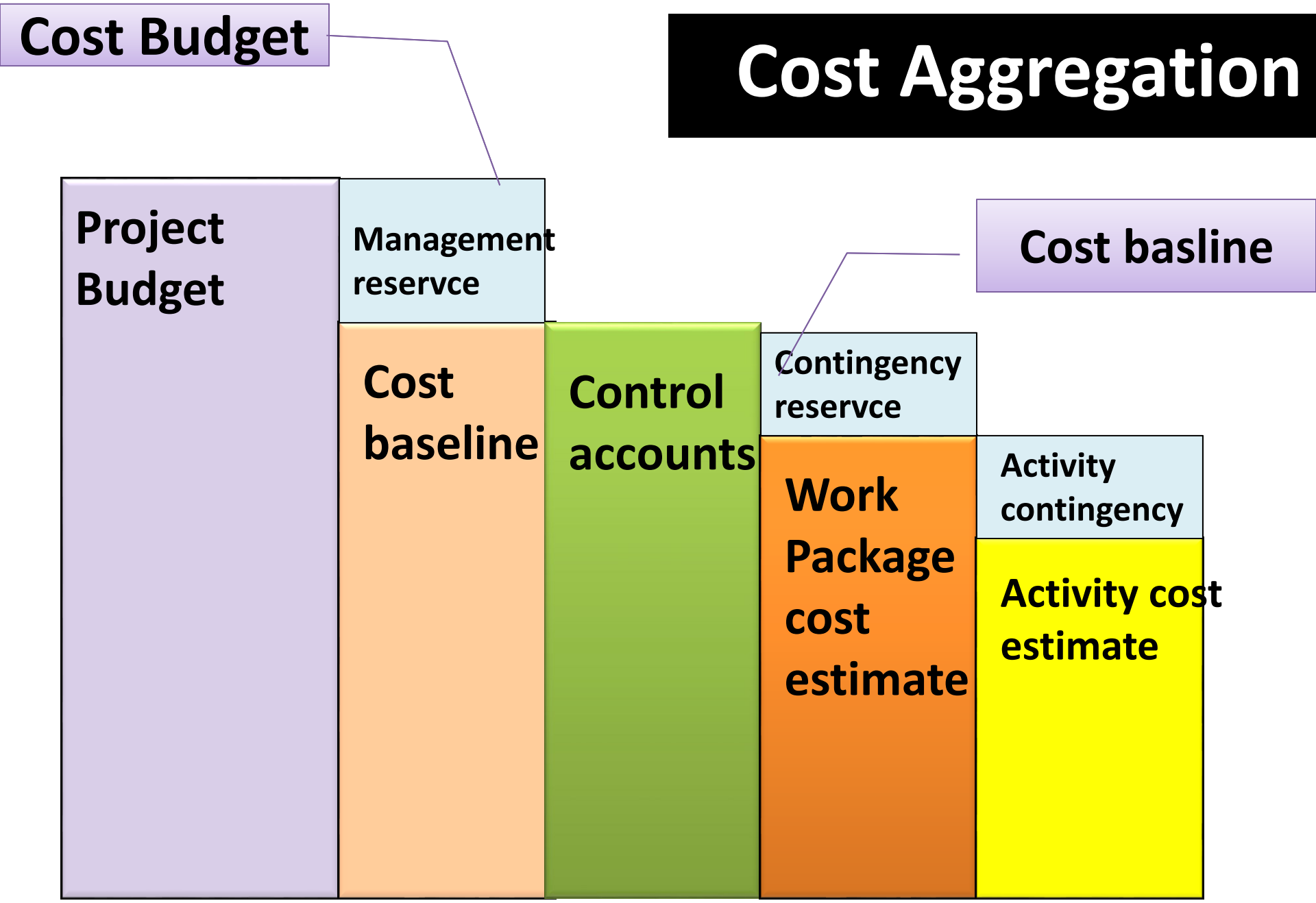

Management desires accuracy.
Shorter time→negotiate

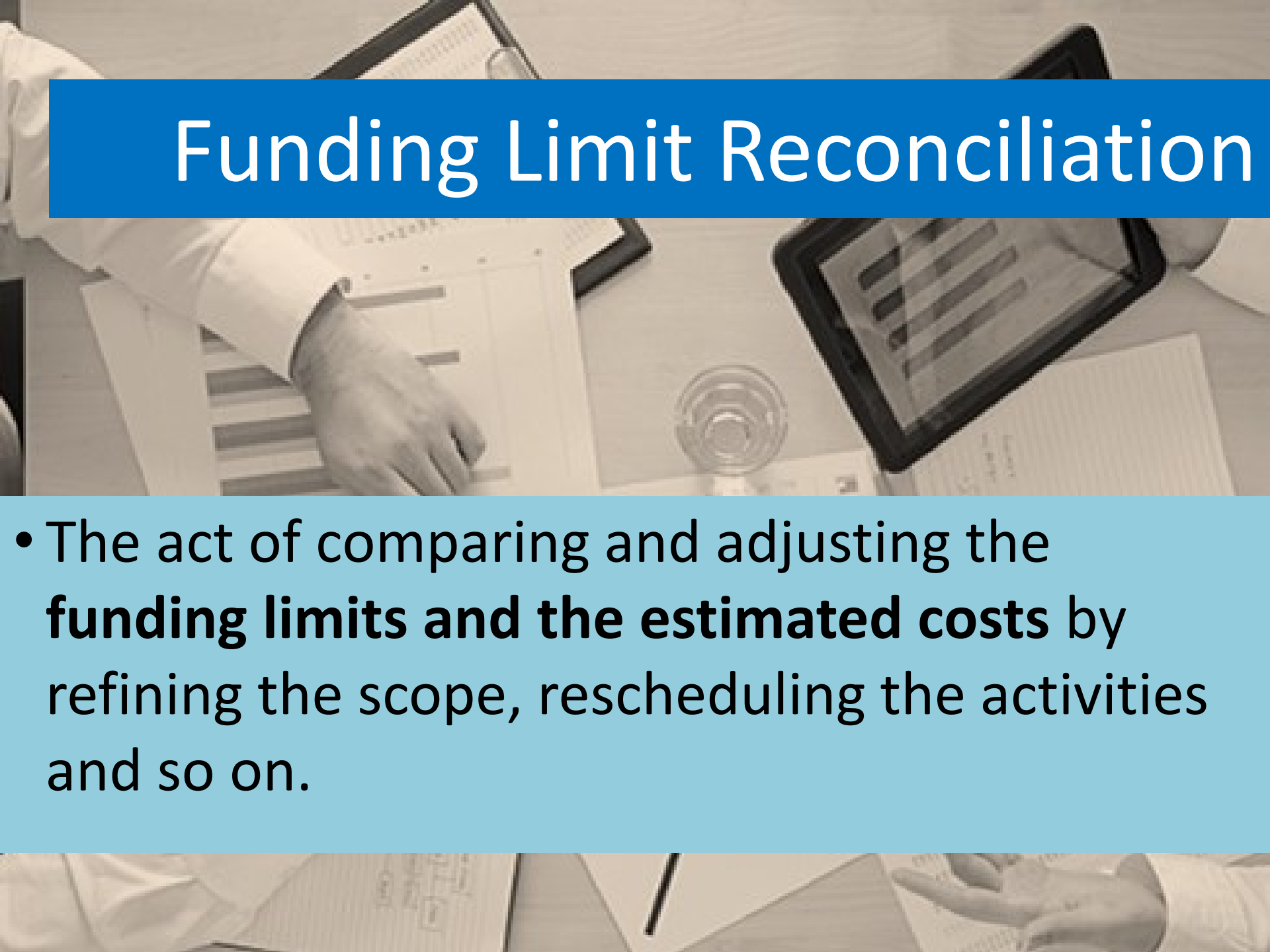
Determine Budget

Aggregating the estimated cost of individual activities or work packages


Inputs
1. Cost Management Plan
2. Basis of estimates
3. Scope baselines
4. Project schedule
5. Risk Register
6. Resource calendars
7. Agreement
8. OPA
Tools & Techniques
1. Cost aggregation
2. Reserve analysis
3. Expert judgment
4. Parametric estimate
5. Funding limit reconciliation
Outputs
1. Cost performance baseline
2. Project funding requirements
3. Project document updates

Cost Aggregation





Funding Limit Reconciliation

- The act of comparing and adjusting the **funding limits and the estimated costs** by refining the scope, rescheduling the activities and so on.

Cost aggregation example:

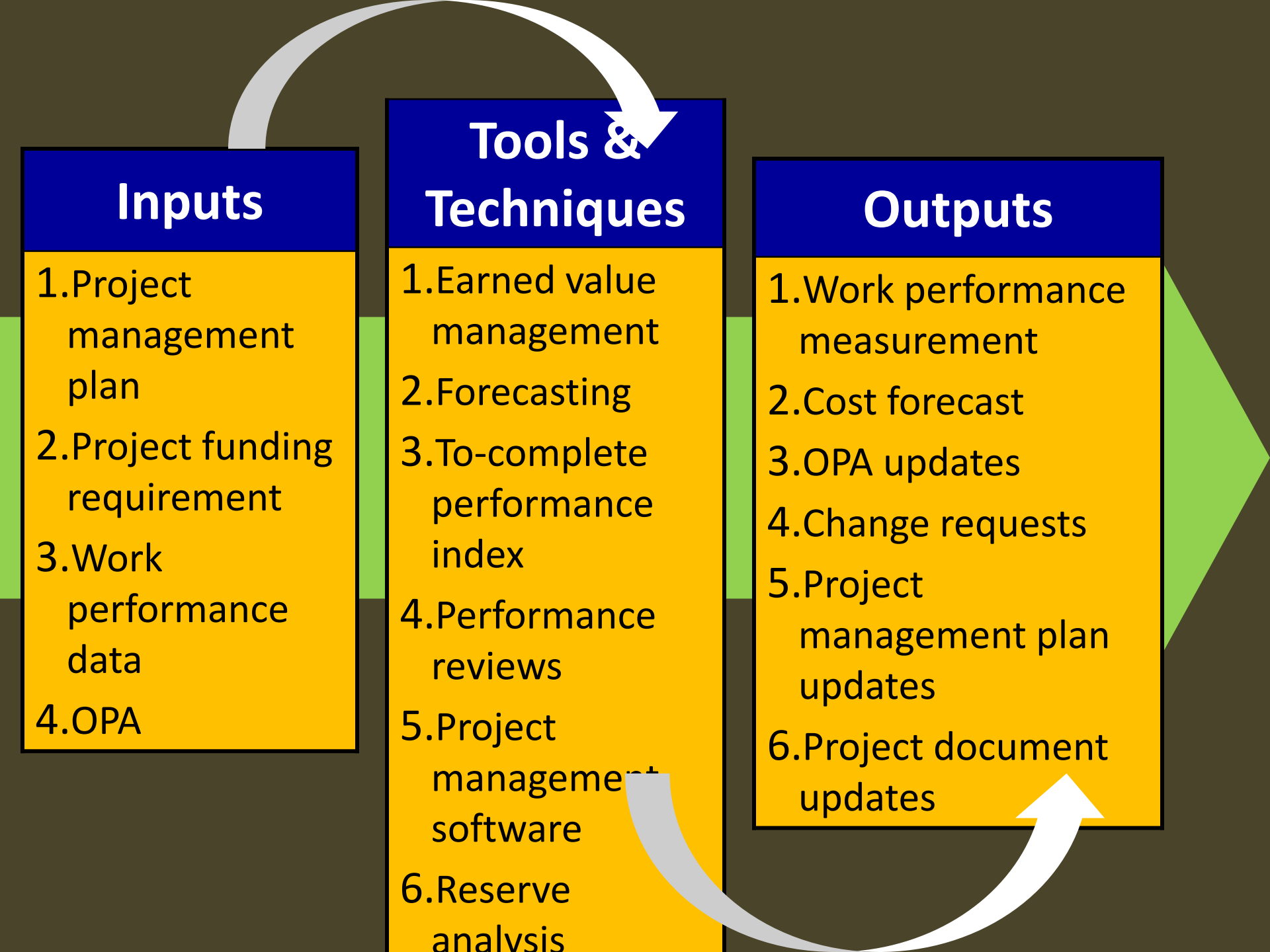
Surveyor Pro Project Cost Baseline Created October 10*

WBS Items	1	2	3	4	5	6	7	8	9	10	11	12	Totals
1. Project Management													
1.1 Project manager	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	96,000
1.2 Project team members	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	144,000
1.3 Contractors		6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	66,300
2. Hardware													
2.1 Handheld devices				30,000	30,000								60,000
2.2 Servers				8,000	8,000								16,000
3. Software													
3.1 Licensed software				10,000	10,000								20,000
3.2 Software development		60,000	60,000	80,000	127,000	127,000	90,000	50,000					594,000
4. Testing			6,000	8,000	12,000	15,000	15,000	13,000					69,000
5. Training and Support													
5.1 Trainee cost									50,000				50,000
5.2 Travel cost									8,400				8,400
5.3 Project team members							24,000	24,000	24,000	24,000	24,000	24,000	144,000
6. Reserves				10,000	10,000	30,000	30,000	60,000	40,000	40,000	30,000	3,540	253,540
Totals	20,000	86,027	92,027	172,027	223,027	198,027	185,027	173,027	148,427	90,027	80,027	53,567	1,521,240

*See the lecture slides for this chapter on the companion Web site for a larger view of this and other figures in this chapter. Numbers are rounded, so some totals appear to be off.

Control Cost

Monitoring the status of the project to update the project budget and managing changes to the cost baseline


Inputs
1.Project management plan
2.Project funding requirement
3.Work performance data
4.OPA
Tools & Techniques
1.Earned value management
2.Forecasting
3.To-complete performance index
4.Performance reviews
5.Project management software
6.Reserve analysis
Outputs
1.Work performance measurement
2.Cost forecast
3.OPA updates
4.Change requests
5.Project management plan updates
6.Project document updates

How to control cost?

- Follow the Cost Management Plan
- Look at any OPA that are available
- Manage change: record, prevent, ensure, manage, measure

Earn Value Management

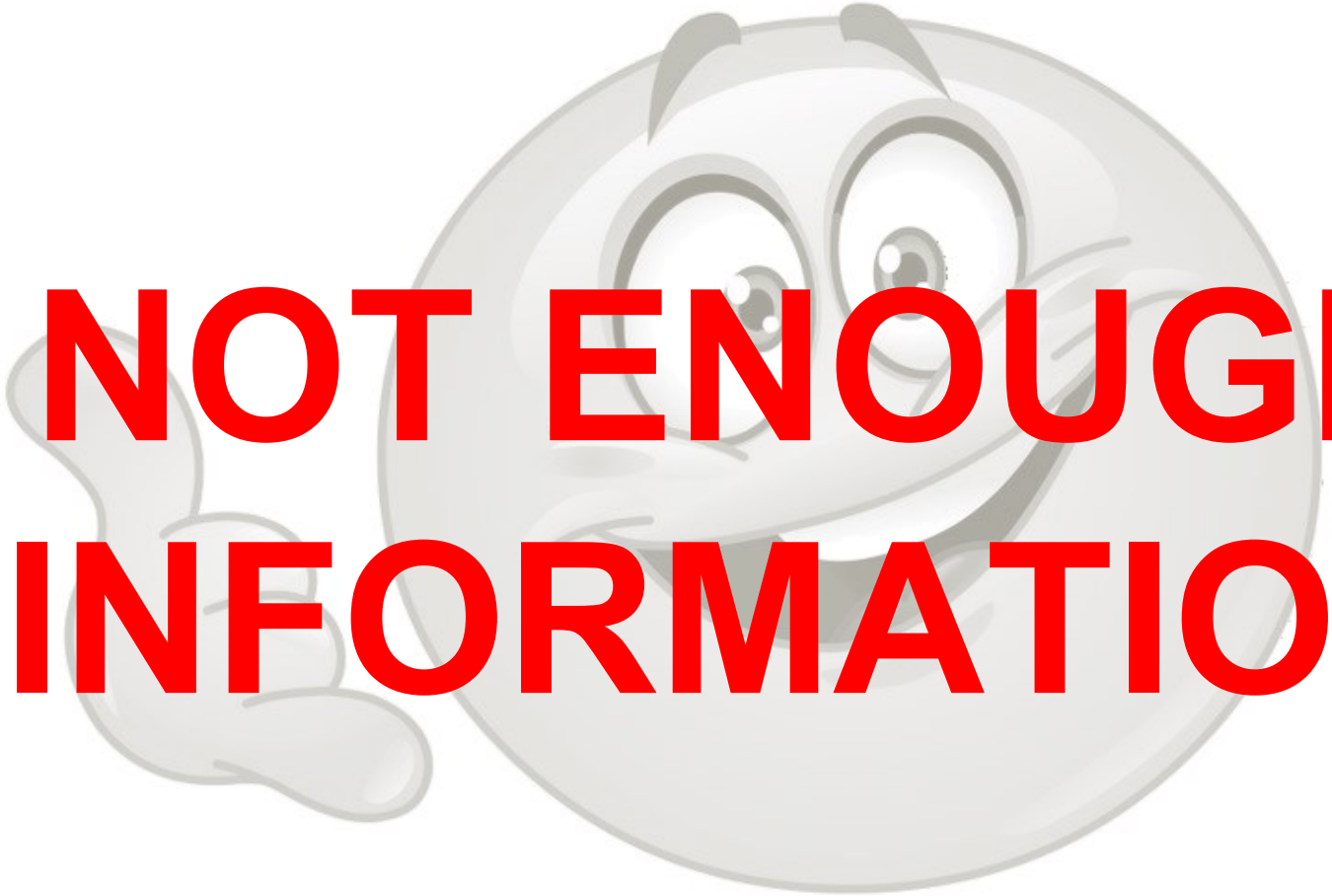
- Measure the health of a project
- to communicate the progress of the works.
- Measure in monetary terms

Earn Value Management

Plan cost (Plan Value)	100.000
Actual Cost	80.000

Cost efficiency???

Earn Value Management



NOT ENOUGH INFORMATION

Earn Value Management

Plan cost (Plan Value) = 100.000 (100%)

Actual Cost	80.000 (50%)

Cost efficiency???

The actual cost should be 50.000

Earn Value Management

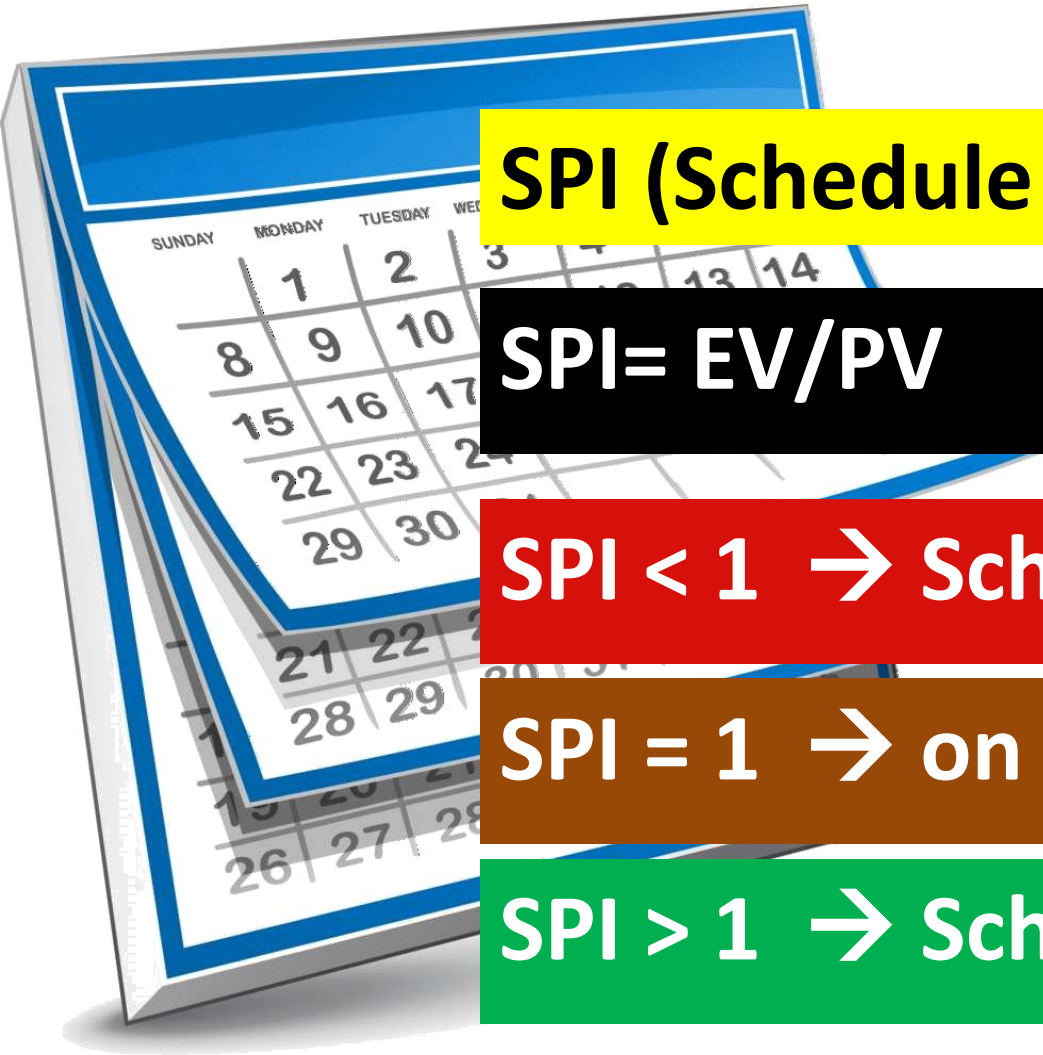
Plan cost (Plan Value/ PV) or BCWS
Budgeted Cost Work Scheduled

Actual Cost (AC) or ACWP
Actual Cost Work Performed

Earn Value (EV) or BCWP
Budgeted Cost Work Performed

PV x % work

Earn Value Management



SPI (Schedule Performance Index)

SPI= EV/PV

SPI < 1 → Schedule overrun

SPI = 1 → on time

SPI > 1 → Schedule underrun

Earn Value Management

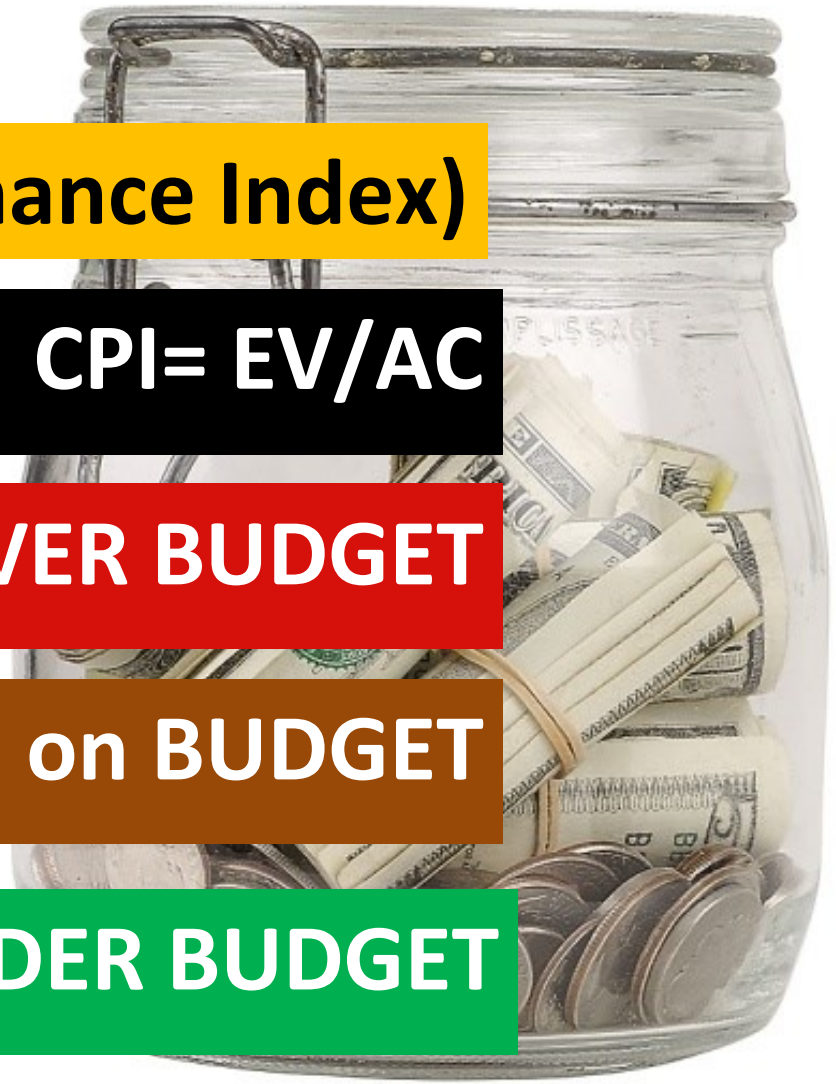
CPI (cost Performance Index)

CPI= EV/AC

CPI < 1 → OVER BUDGET

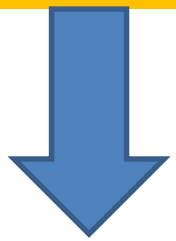
CPI = 1 → on BUDGET

CPI > 1 →UNDER BUDGET



Earn Value Management

Variance Analysis



Cost Variance (CV): EV-AC
Schedule Variance (SV): EV-PV


“Price is what you pay.
Value is what you get.”
Warren Buffett

Exercise:

Ten houses will be built **within 12 months**. The cost of each houses is **Rp 100 milion**. The project condition after **5 months** are :

- The cost already used **Rp.310 milion** whereas the plan value until fifth month is estimated at **Rp. 360 Milion.**
- The overall performance of the project, converted to money, equals to **Rp. 250 Milion**.

Answer:

- ***cost variance*** **(CV)=** EV-AC= Rp. 250 - Rp 310= -6, overbudget 6 milion
- ***Schedule Variance*** **(SV)**= EV-PV = Rp250 - Rp360 = -11, schedule overun equals to 11 Milion.
- ***Cost Performance Index*** **(CPI)=** EV/AC = Rp 250/Rp 310= 0,806 (overbudget, actual>planned)
- ***Schedule Performance Index*** **(SPI)**= EV/PV=RP 250/ Rp.360= 0,694 (schedule overrun, actual > planned)

Answer:

Forecast Cost to Complete (FCTC)

FC TC= Actual + EAC (Estimate at Completion)

- *EAC = Remaining budget (BAC-EV)*/CPI
- FCTC= Rp. 310 + (1000-250)/0,806= Rp 1240

Estimate Complete Duration (ECD)

ECD = (remaining time / SPI) + used time)

•ECD= (12-5)/0,694 +5 = 15,086 months

To-Complete Performance Index (TCPI)

- $$TCPI = \frac{\text{Work Remaining } (BAC - EV)}{\text{Funds Remaining } (BAC - AC) \text{ or } (EAC - AC)}$$

the efficiency that must be achieved on the remaining work for a project to meet a specified endpoint, such as BAC or the team's revised EAC

To-Complete Performance Index (TCPI)

- TCPI = (1000-250)/ (1000-310) = 1,08 **or**
- TCPI * = ((1000-250)/ {(1000-250)/0,806}-310} = 1,2

the efficiency that must be achieved on the remaining work for a project to meet a specified endpoint, such as BAC or *the team's revised EAC

Task	Budget	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		6	6										
1	12												
			8	12	16	12							
2	48												
						7	21						
3	28												
								18					
4	18												
								4	8	10	6		
5	28												
												8	8
6	16												
Σ	150	6	14	12	16	19	21	22	8	10	6	8	8
CUM	-	6	20	32	48	67	88	110	118	128	134	142	150
PV	48	6	14	12	16	19	21	22	8	10	6	8	8
CUM		6	20	32	48	67	88	110	118	128	134	142	150
EV	32	6	14	12	0	0	0	0	0	0	0	0	0
CUM		6	20	32	32								
AC	40	6	14	12	8	0	0	0	0	0	0	0	0
CUM		6	20	32	40								

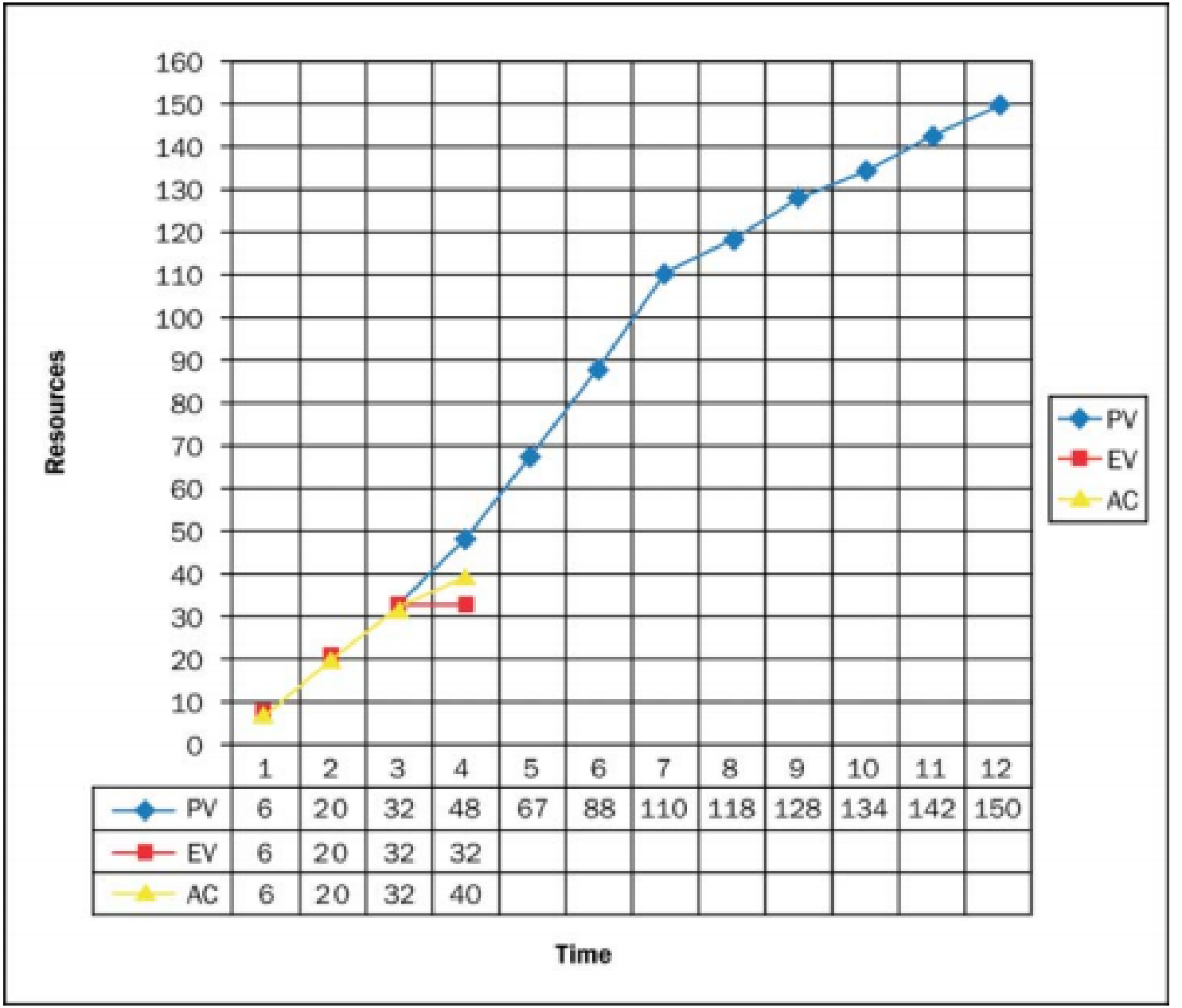
Work Plan and Status for Project EZ (As of April 30)

S-CURVE

EARNVALUE

S-CURVE

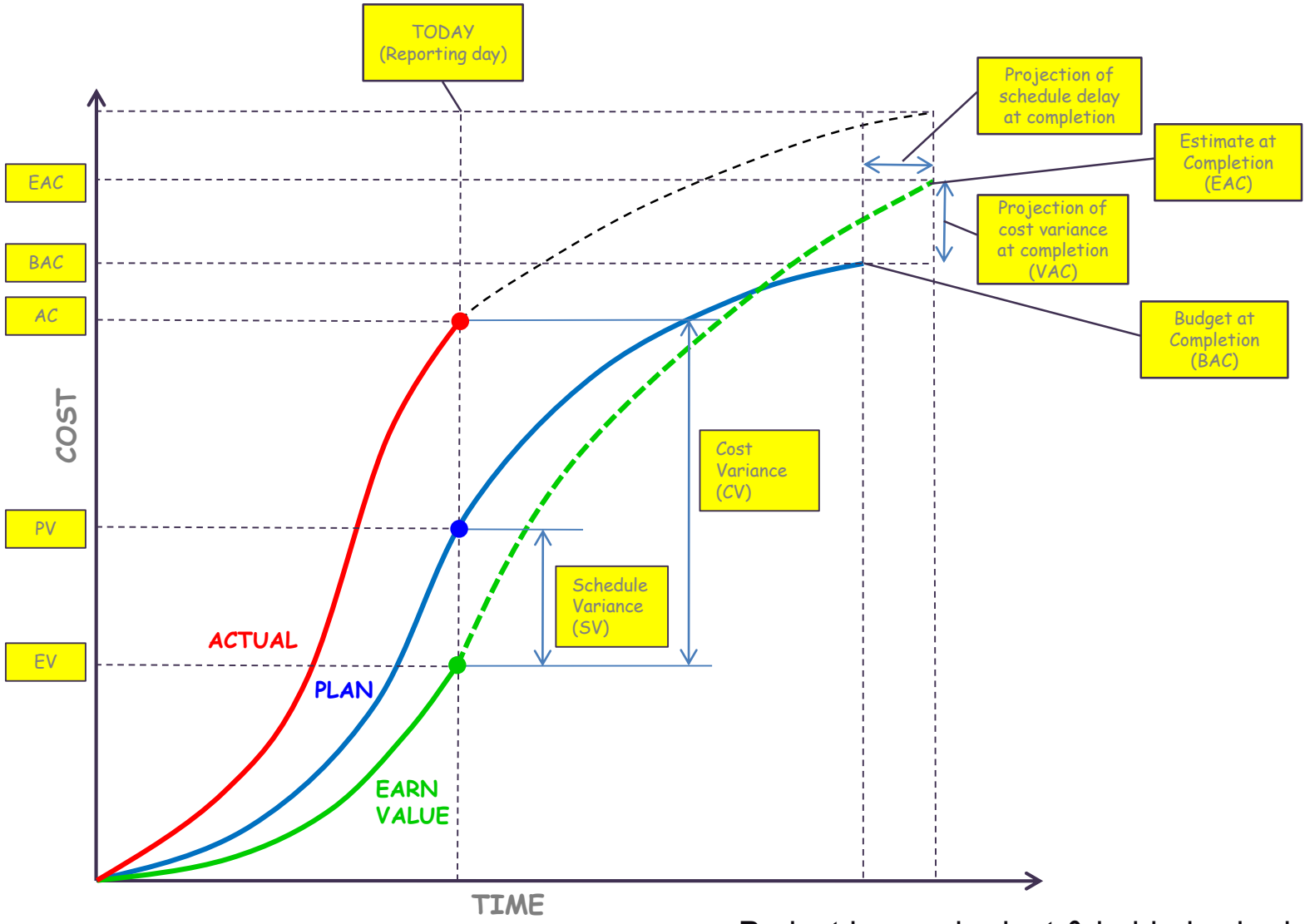
EARNED VALUE



	1	2	3	4	5	6	7	8	9	10	11	12
PV	6	20	32	48	67	88	110	118	128	134	142	150
EV	6	20	32	32								
AC	6	20	32	40								

Cumulative Planned Value, Earned Value, and Actual Cost for Project EZ
(As of April 30)

Earned Value: Graphical Representation



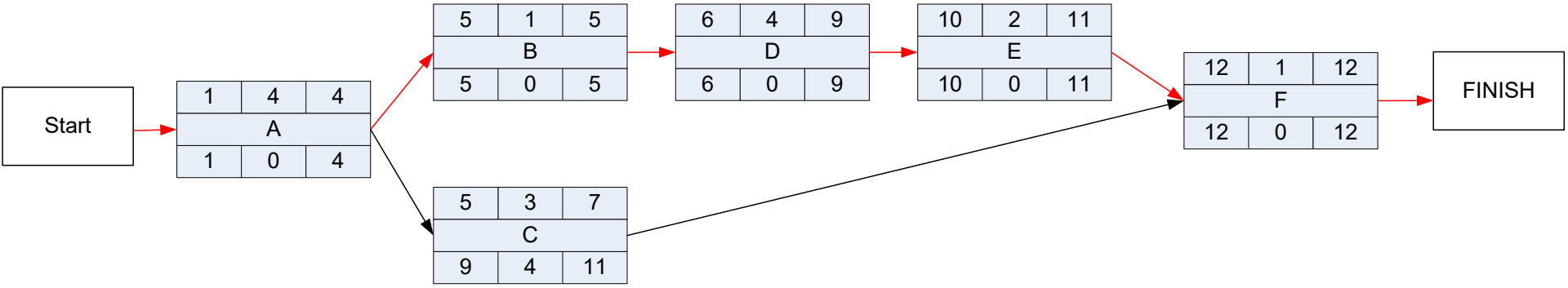
Project is over budget & behind schedule

example

activity	predecessor	resource	duration
A	-	6	4
B	A	2	1
C	A	2	3
D	B	7	4
E	D	3	2
F	E,C	1	1

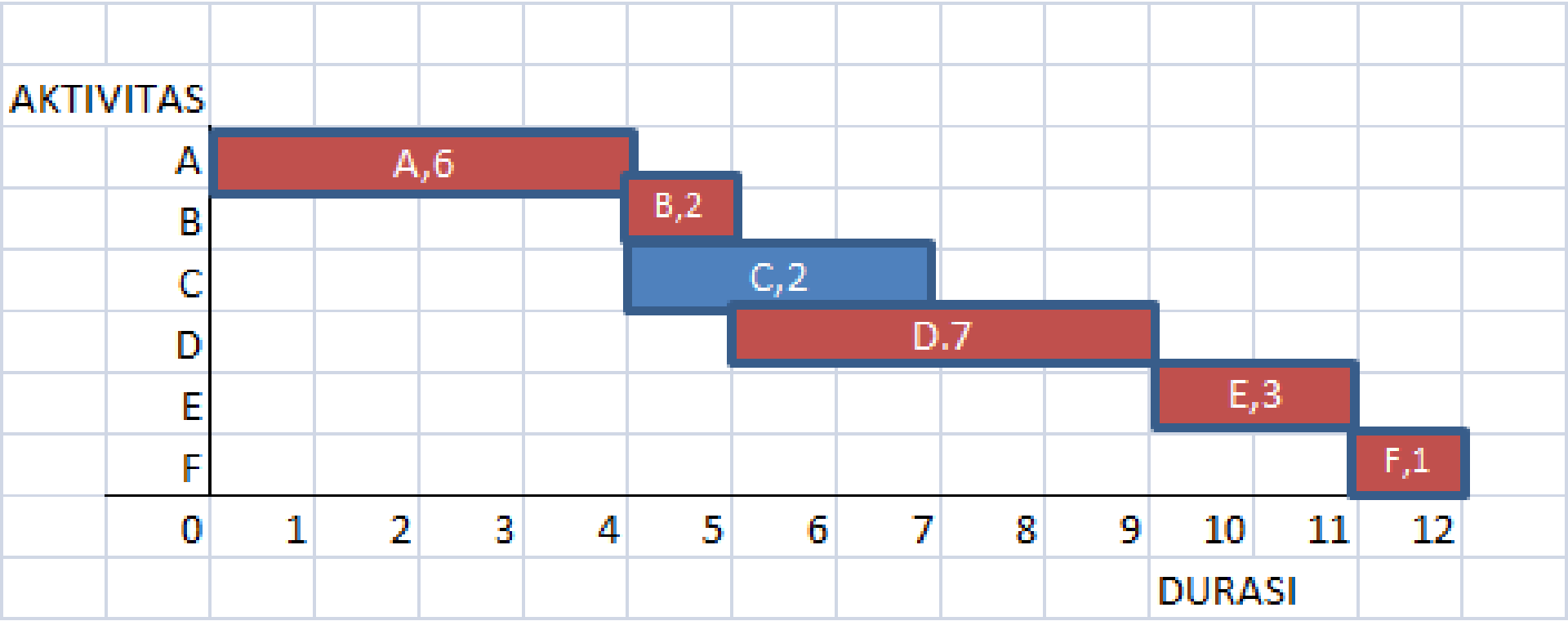
Resource limit is set at 8 man

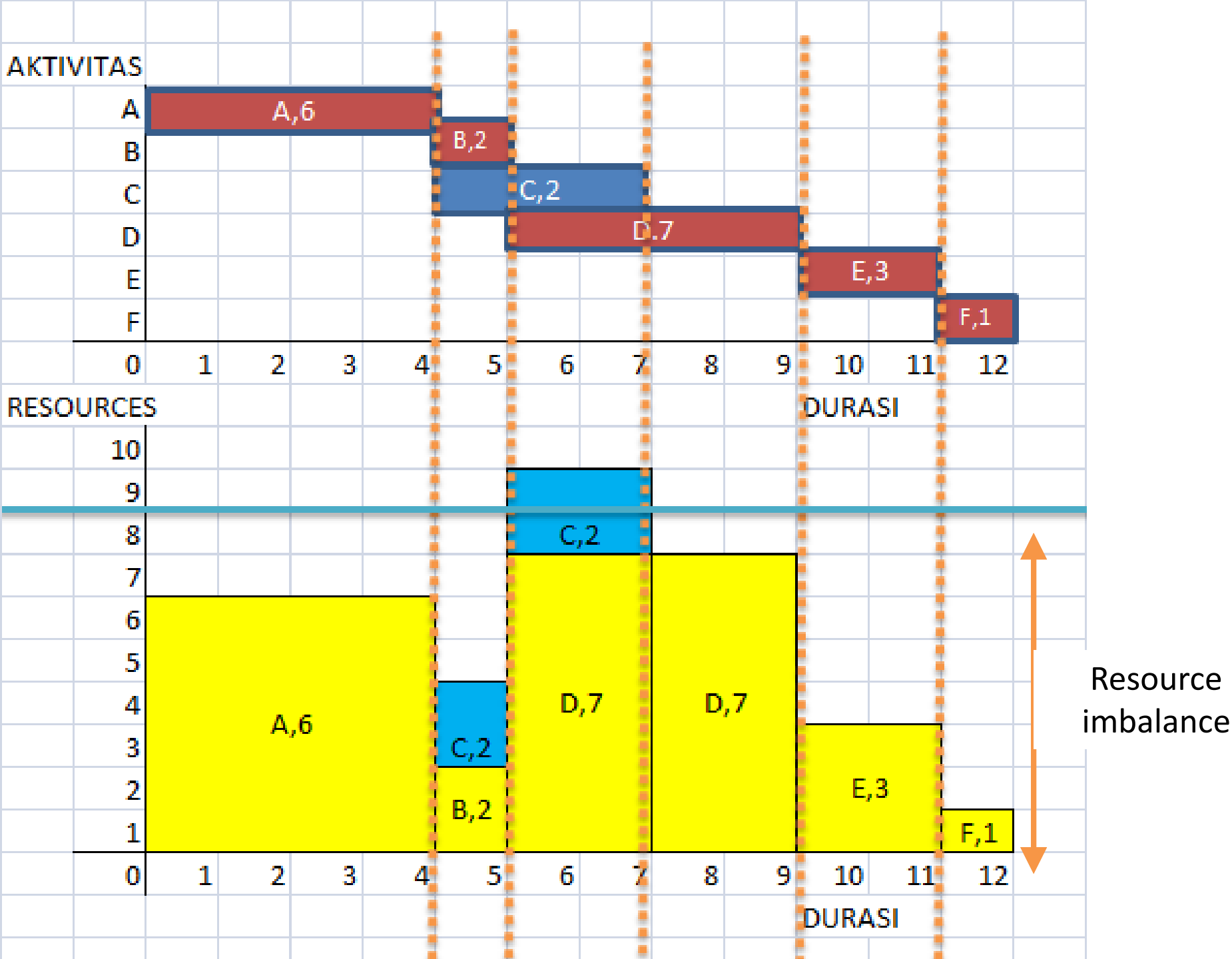
Draw project network



Plot into Gantt chart

- Using dependency and interdependency diagram




AKTIVITAS
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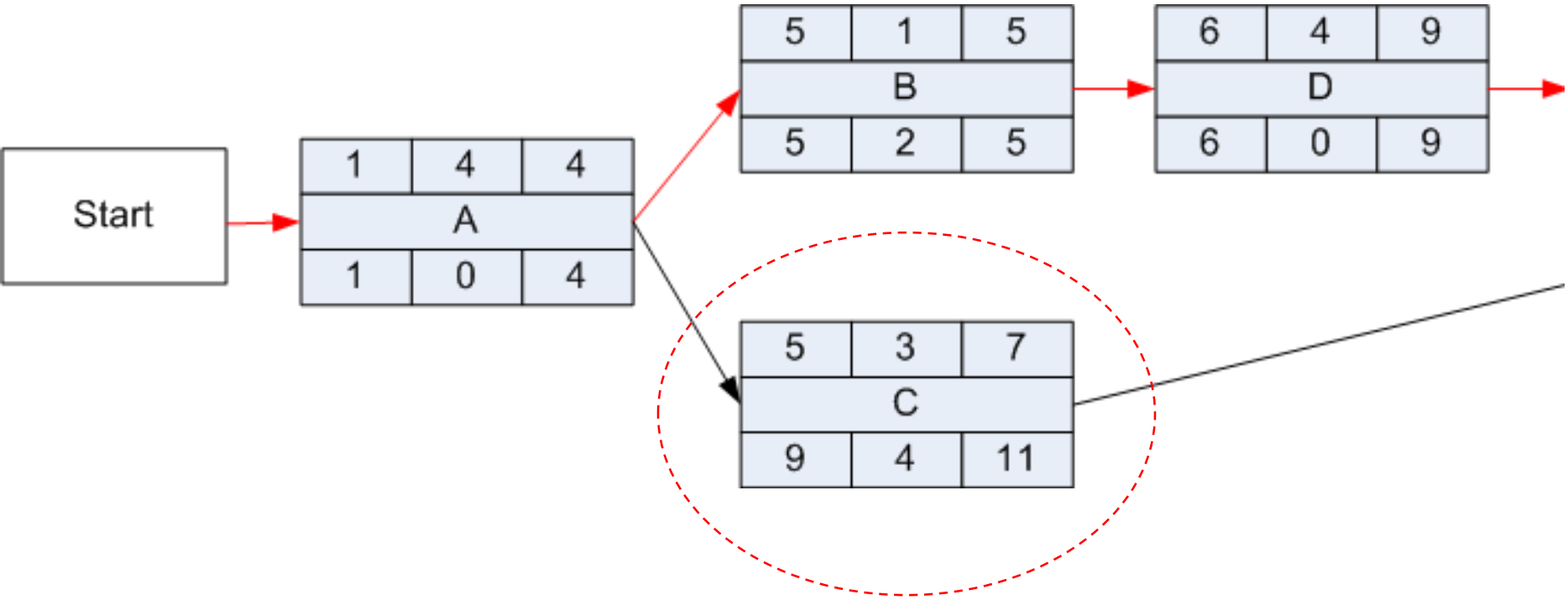
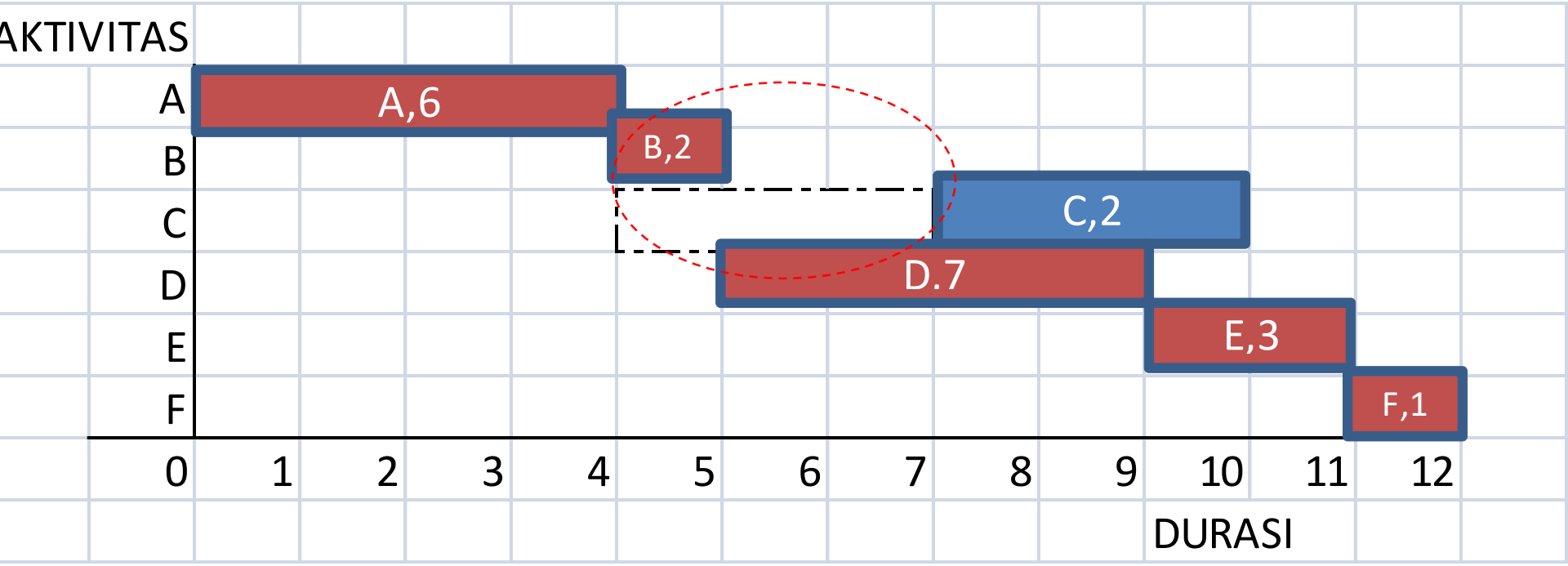
DURASI
Resource imbalance



TF C= 4 DAYS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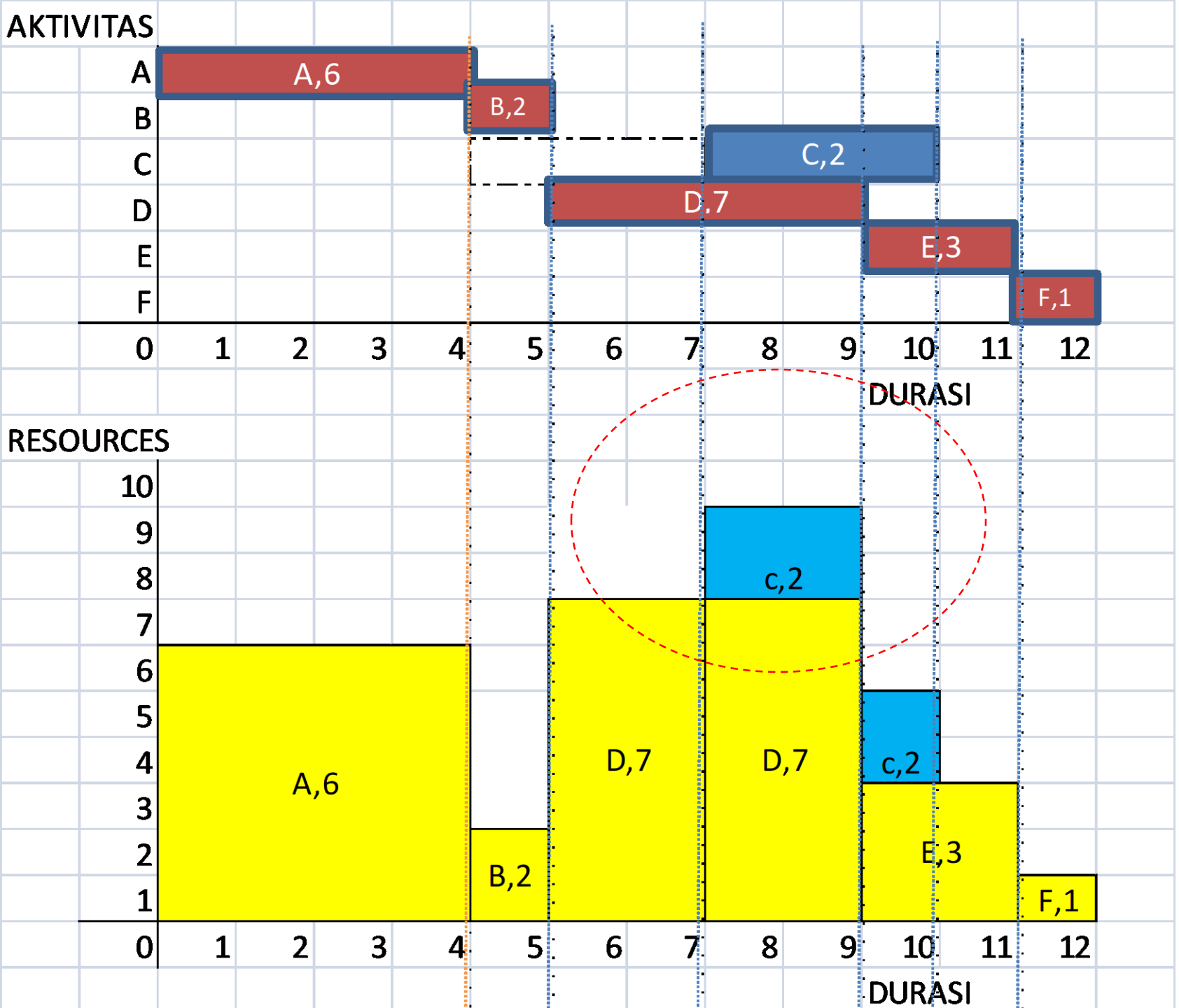
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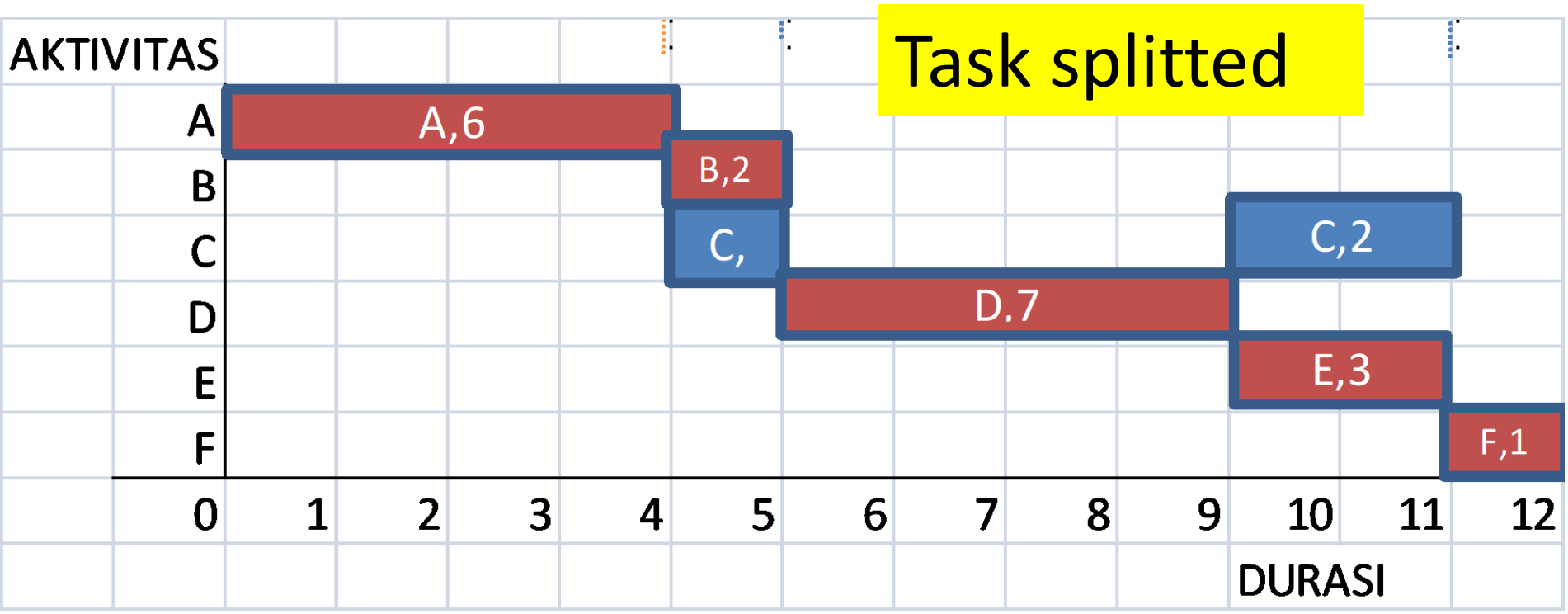
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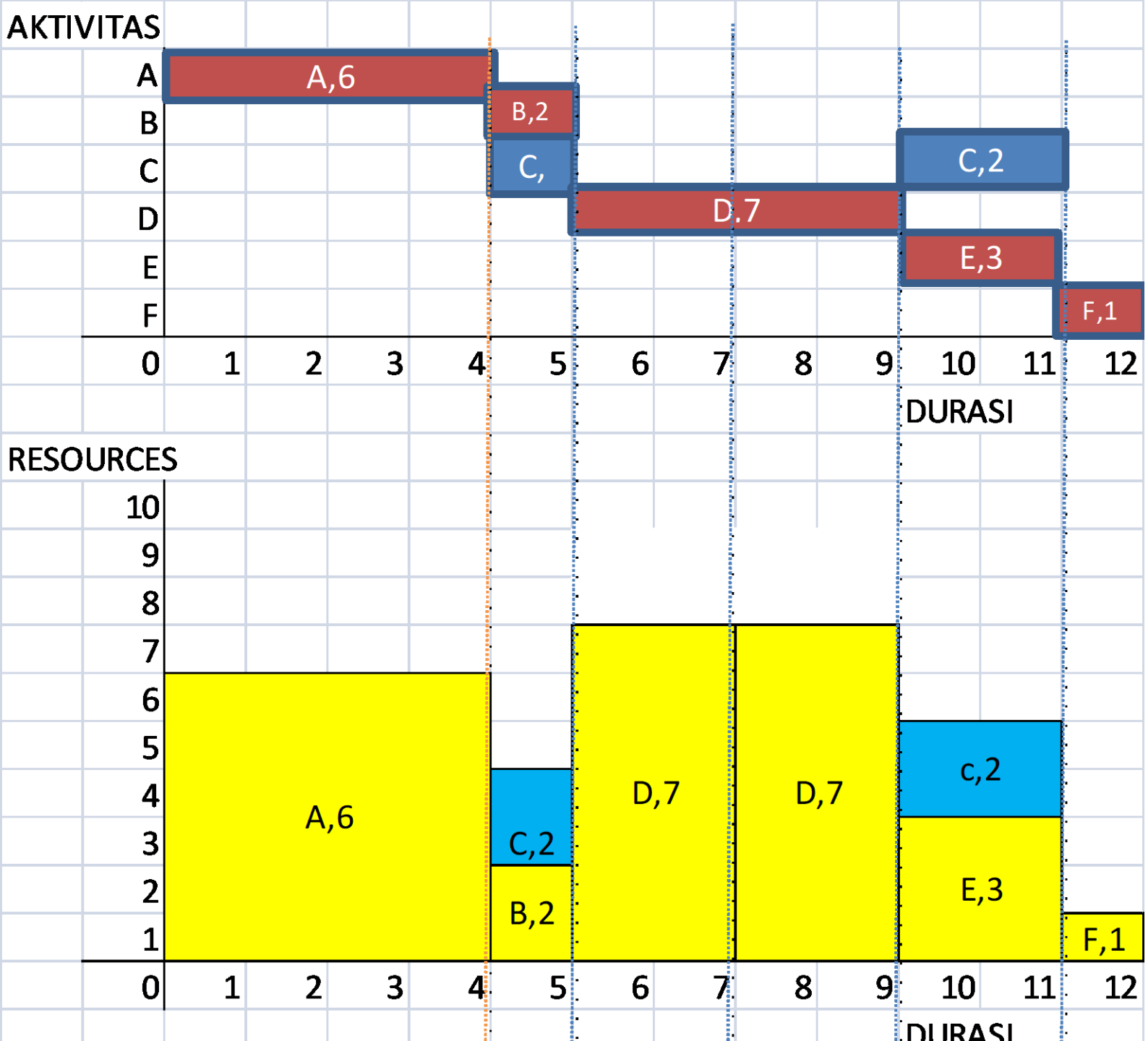
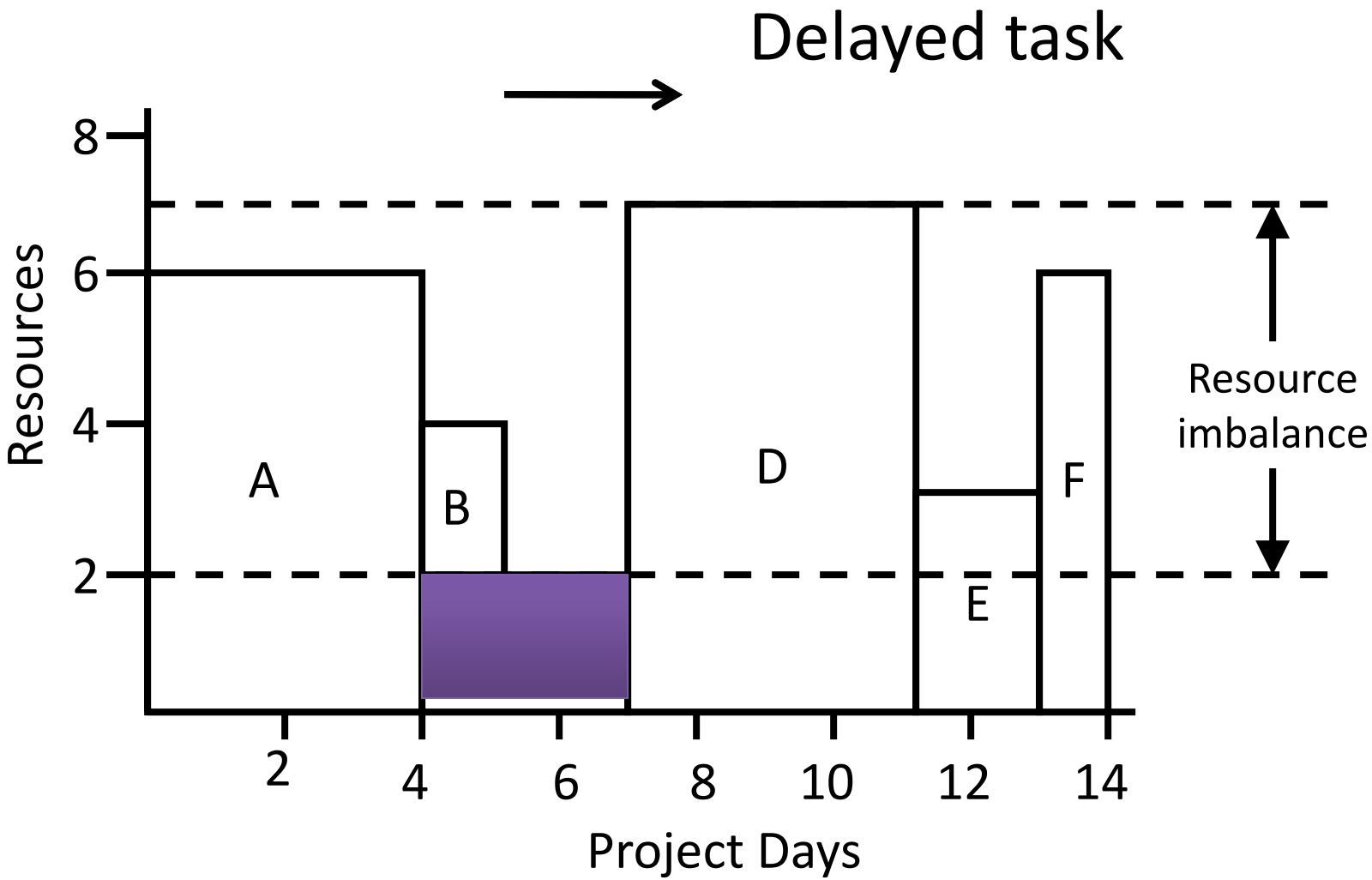
12
DURASI


AKTIVITAS
A
B
C
D
E
F
A,6
B,2
C,
C,2
D,7
E,3
F,1
0 1 2 3 4 5 6 7 8 9 10 11 12
DURASI
RESOURCES
10
9
8
7
6
5
4
3
2
1
A,6
C,2
B,2
D,7
D,7
c,2
E,3
F,1
0 1 2 3 4 5 6 7 8 9 10 11 12
DURASI

Summary

Period	Resource requirement	levelling
0-4	6	6
4-5	4	4
5-9	9	7
7-9	7	7
9-11	3	5
11-12	1	1

Resource Loading Chart



Recruitment at the early period

Period	levelling
0-4	6
4-5	4
5-9	7
7-9	7
9-11	5
11-12	1

Recruitment cost = $10/man

Idle cost= $5/man

Wages= $15/man

Recruitment at the early period

Period	levelling	Cost
0-4	6	1) 7 x $10= $70 2) 6 x $15= $90 3) 1 x $5= 5 total= $165
4-5	4	1) 4x $15= $60 2) 3 x $5= $5 total= $ 65
5-9	7	7x $15= $90
7-9	7	7x $15= $90
9-11	5	5x $15= $85
11-12	1	1x $15= $15

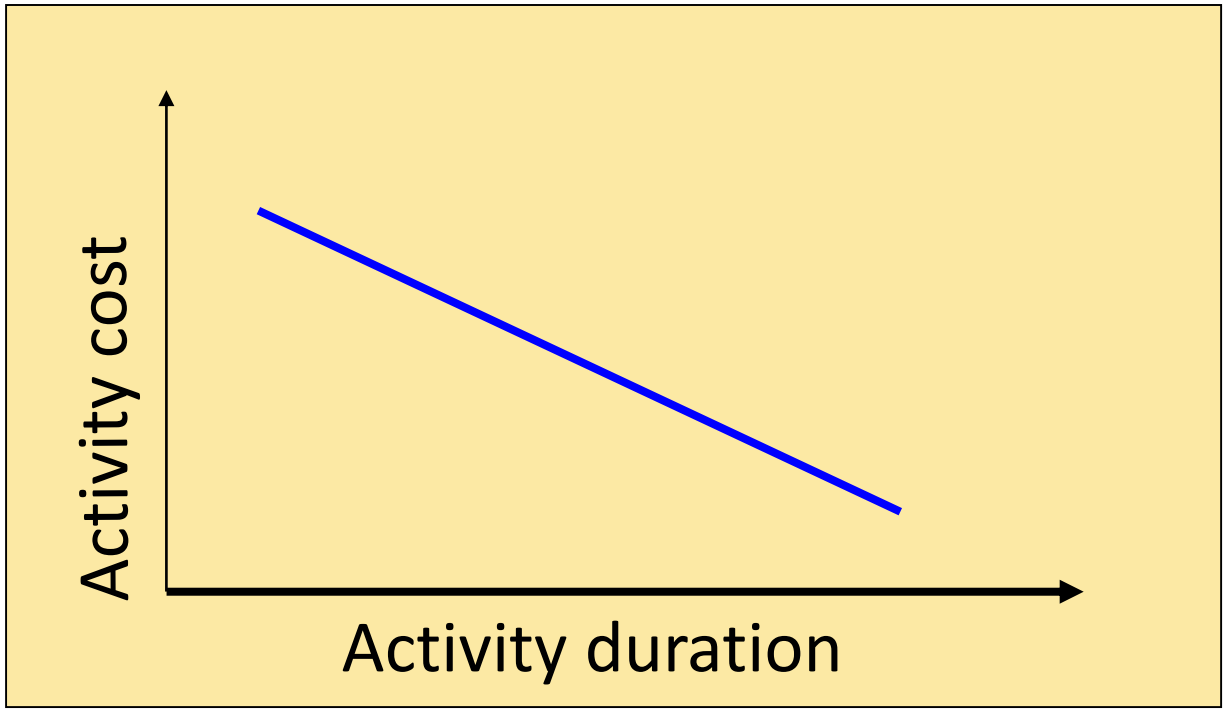
Recruitment cost = $10/man

Idle cost= $5/man

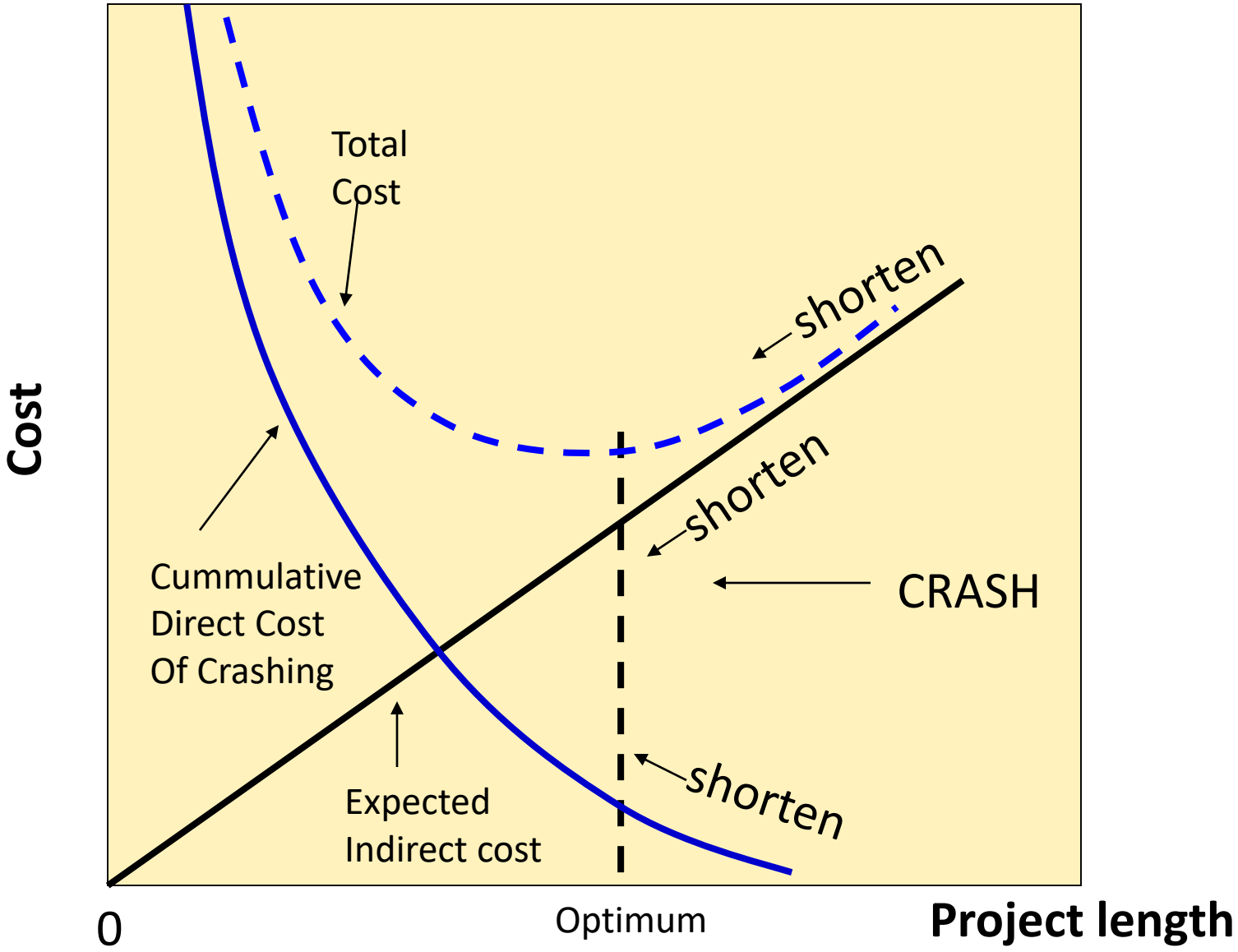
Wages= $15/man

Total cost= 510

Crashing Program

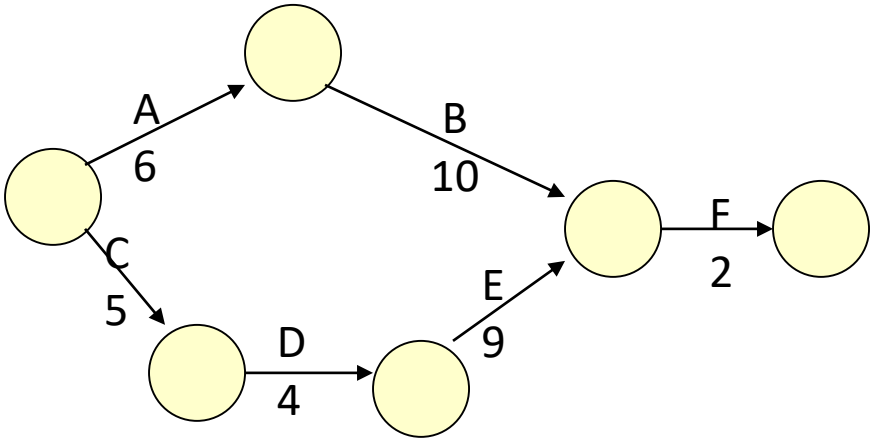


1. **Normal Activity** duration at normal cost, utilizing the normal quantity of resources
2. A shorter **Crash Activity** duration at crash cost, utilizing **additional** resources


Cost
Total
Cost
shorten
shorten
shorten
CRASH
Cummulative
Direct Cost
Of Crashing
Expected
Indirect cost
0
Optimum
Project length

Contoh soal crashing :

act	normal time	crash time	normal cost	crash cost/day
A	6	6	200	0
B	10	8	300	500
C	5	4	100	300
D	4	1	500	700
E	9	7	400	600
F	2	1	600	800



Kembangkan optimal cost, dimana indrect cost per hari = $ 100

a. Tentukan aktivitas yang kritis, durasinya dan waktu lintasannya.
b. Buat ranking lintasan kritis tsb dan crashing berapa hari yang bisa di Crash dengan cost rendah
c. Buatkan rencana crashnya.

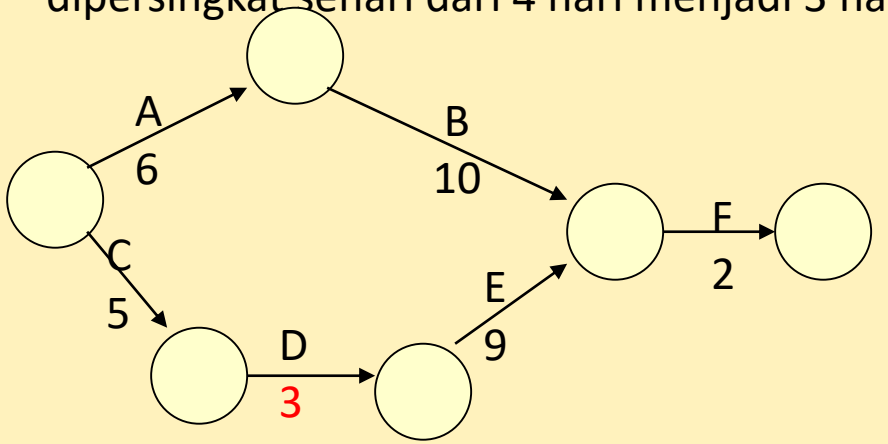
a. Lintasan yang ada adalah :

A-B-F = 6 + 10 + 2 = 18 hari

C-D-E-F = 5 + 4 + 9 + 2 = 20 hari → Lintasan Kritis.

act	normal time	crash time	normal cost	crash cost/day	cost slope
A	6	6	200	0	0
B	10	8	300	500	100
C	5	4	100	300	200
D	4	1	550	700	50
E	9	7	400	600	100
F	2	1	650	800	150

b. Kandidat utama adalah yang memiliki cost slope terkecil yaitu D sebesar 50, aktivitas D dipersingkat sehari dari 4 hari menjadi 3 hari



Total direct cost **= 200 +300 +100 +550 +400 + 650** = 2200 + **50**

=2250

A-B-F = 6 + 10 + 2 = 18 hari

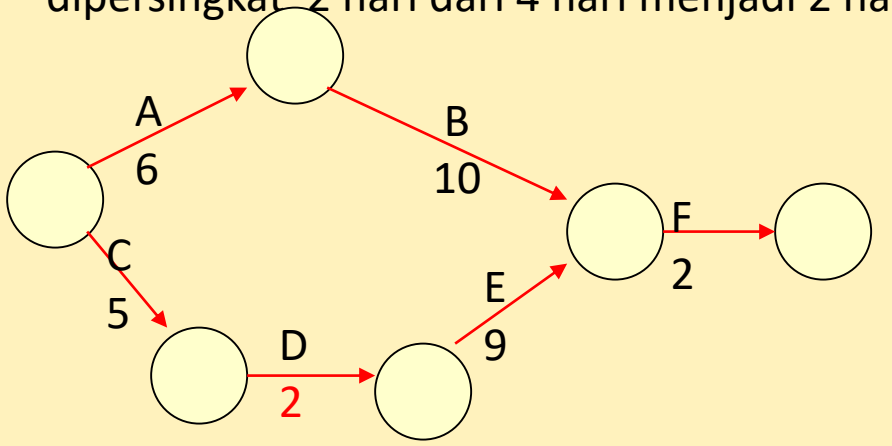
C-D-E-F = 5 + 3 + 9 + 2 = 19 hari

→ Lintasan Kritis.

C-D-E-F masih lintasan kritis, cost slope terendah masih di D

act	time	crash time	normal cost	crash cost/day	cost slope
A	6	6	200	0	0
B	10	8	300	500	100
C	5	4	100	300	200
D	4	1	550	700	50
E	9	7	400	600	100
F	2	1	650	800	150

Kandidat utama aalah yang memiliki cost slope terkecil yaitu D sebesar 50, aktivitas D dipersingkat 2 hari dari 4 hari menjadi 2 hari



Total direct cost **= 200 +300 +100 +550 +400 + 650** = 2200 + **50 + 50 =2300**

A-B-F = 6 + 10 + 2 = 18 hari

C-D-E-F = 5 + 2 + 9 + 2 = 18 hari

menjadi ada 2 lintasan kritis

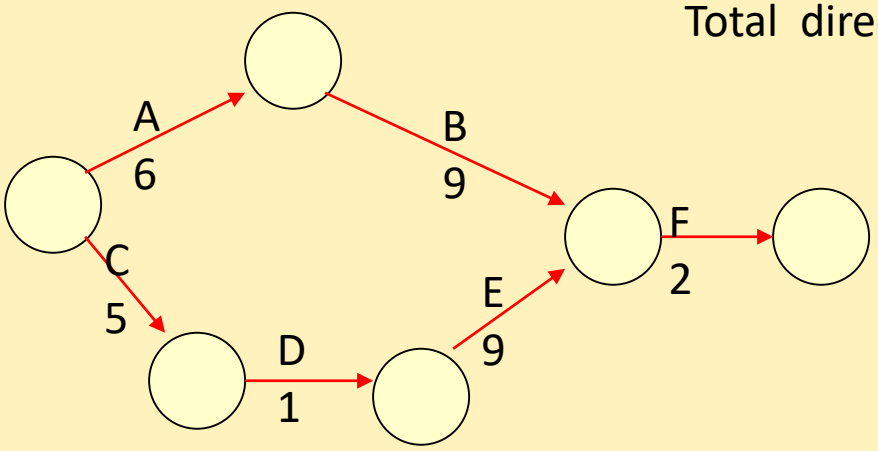
A-B-F = 6 + 10 + 2 = 18 hari, cost slope terkecil di aktivitas **B**

C-D-E-F = 5 + 2 + 9 + 2 = 18 hari cost slope terkecil di aktivitas **D** (masih bisa di crash karena maximum crash bisa sampai 1 hari

act	time	crash time	normal cost	crash cost/day	cost slope
A	6	6	200	0	0
B	10	8	300	500	100
C	5	4	100	300	200
D	4	1	550	700	50
E	9	7	400	600	100
F	2	1	650	800	150

Aktivitas B dipersingkat sehari dari 10 hari menjadi 9 hari

Aktivitas D dipersingkat 3 hari dari 4 hari mejadi sehari, sehingga D tidak bisa dicrash lagi



Total direct cost **= 200 +300 +100 +550 +400 + 650** = 2200 + **100 +50 +50 + 50 =2450**

A-B-F = 6 + 9 + 2 = 17 hari

C-D-E-F = 5 + 1 + 9 + 2 = 17 hari

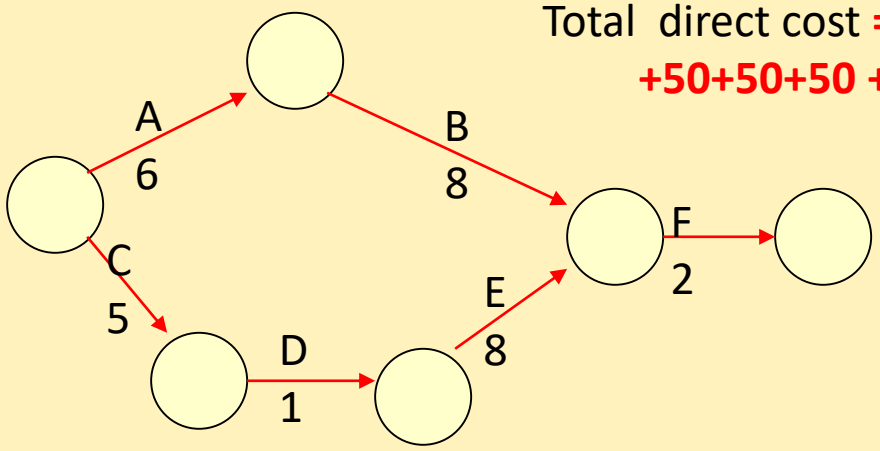
menjadi ada 2 lintasan kritis

A-B-F = 17 hari, cost slope terkecil di aktivitas **B**
C-D-E-F = 17 hari cost slope terkecil di aktivitas E

act	time	crash time	normal cost	crash cost/day	cost slope
A	6	6	200	0	0
B	10	8	300	500	100
C	5	4	100	300	200
D	4	1	550	700	50
E	9	7	400	600	100
F	2	1	650	800	150

Aktivitas B dipersingkat 2 hari dari 10 hari menjadi 8 hari
Aktivitas E dipersingkat sehari dari 9 hari mejadi 8 hari,

Total direct cost **= 200 +300 +100 +550 +400 + 650** = 2200 +
+50+50+50 +100+ 100 + 100=2650

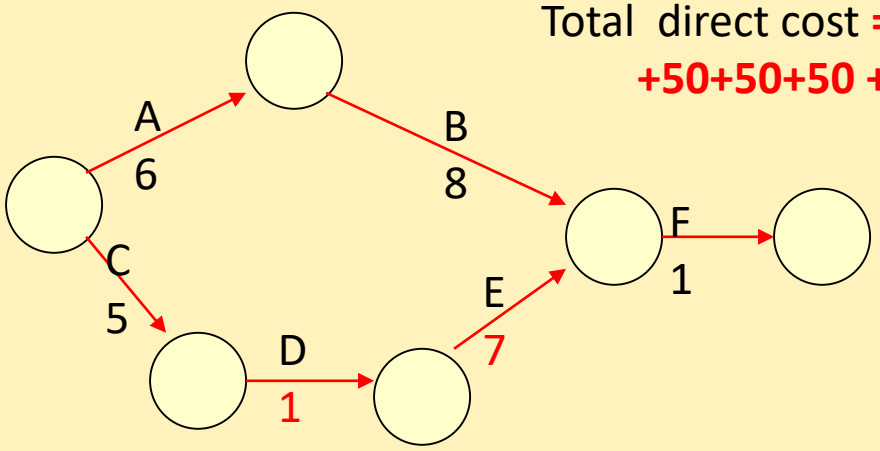


A-B-F = 6 + 8 + 2 = 16 hari
C-D-E-F = 5 + 1 + 8 + 2 = 16 hari
menjadi ada 2 lintasan kritis

A-B-F = 16 hari, cost slope terkecil di aktivitas **F, B sudah maximum**
C-D-E-F = 16 hari cost slope terkecil di aktivitas **E**

act	time	crash time	normal cost	crash cost/day	cost slope
A	6	6	200	0	0
B	10	8	300	500	100
C	5	4	100	300	200
D	4	1	550	700	50
E	9	7	400	600	100
F	2	1	650	800	150

Aktivitas F dipersingkat sehari dari 2 hari menjadi 1 hari
Aktivitas E dipersingkat dua hari dari 9 hari mejadi 7 hari,



Total direct cost **= 200 +300 +100 +550 +400 + 650** = 2200 +
+50+50+50 +100+ 100 + 100+ 100+150=2900

A-B-F = 6 + 8 + 1 = 15 hari
C-D-E-F = 5 + 1 + 7 + 1 = 14 hari
proyek bisa dipersingkat hingga 15 hari

Total cost = total direct cost + total indirect cost

= 2900+(15 hari x100) = 40400

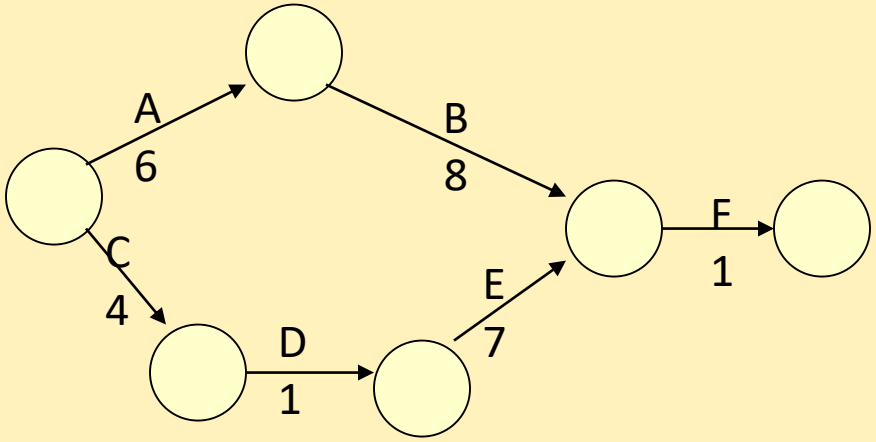
durasi	20	19	18	17	16	15
direct cost	2200	2250	2300	2450	2650	2900
indirect	2000	1900	1800	1700	1600	1500
total cost	**4200**	**4150**	**4100**	**4150**	**4250**	**4400**

Durasi normal 20 hari, jika dipersingkat sehari maka total costnya 4250

Jika dipersingkat 2 hari maka total costnya menjadi 4100

Jika ingin mengetahui durasi tercepat maka semua aktivitas di buat crash

act	crash time	normal cost	crash cost/day	cost slope
A	6	200	0	0
B	8	300	500	100
C	4	100	300	200
D	1	550	700	50
E	7	400	600	100
F	1	650	800	150



Direct cost =
500+300+700+600+800 = 2900

A-B-F = 6 + 8 + 1 = 15 hari
C-D-E-F = 4 + 1 + 7 + 1 = 13 hari
lintasan kritis A-B-F

slope termahal non kritis di C
C dinormalkan menjadi 5 hari

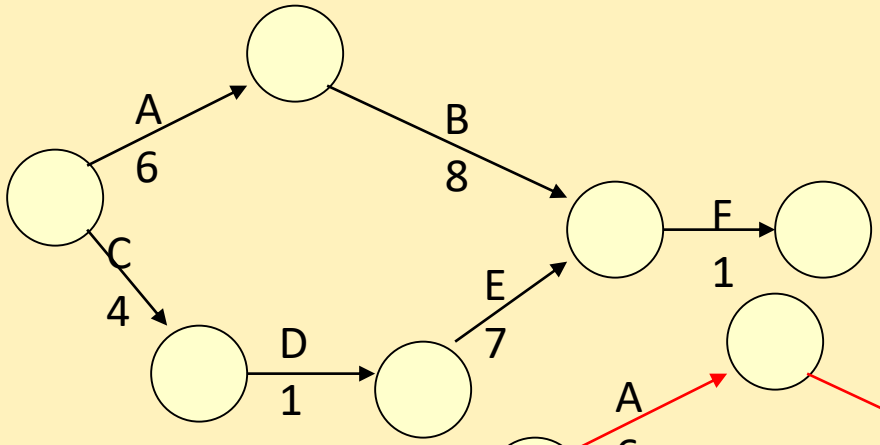
Jika ingin mengetahui durasi tercepat maka semua aktivitas di buat crash

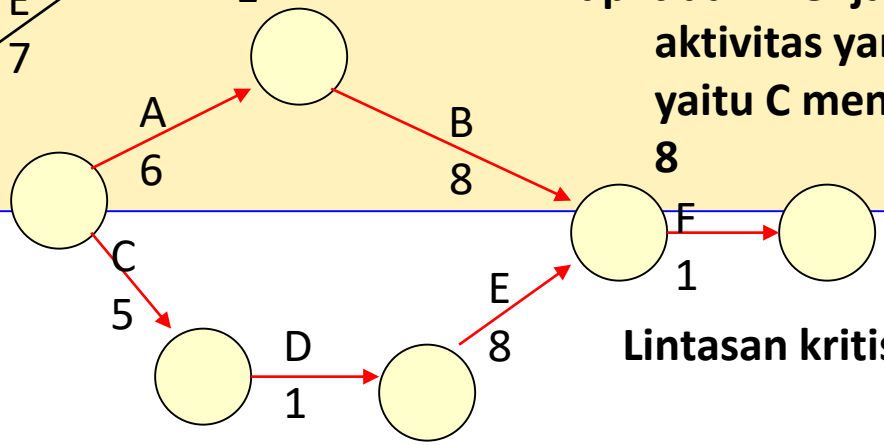
act	crash time	normal cost	crash cost/day	cost slope
A	6	200	0	0
B	8	300	500	100
C	4	100	300	200
D	1	550	700	50
E	7	400	600	100
F	1	650	800	150

Direct cost =
500+300+700+600+800 = 2900

A-B-F = 6 + 8 + 1 = 15 hari
C-D-E-F = 4 + 1 + 7 + 1 = 13 hari
lintasan kritis A-B-F

slope termahal non kritis di C
C dinormalkan menjadi 5 hari
Tapi tidak menjadi kritis maka yang aktivitas yang diubah bertambah yaitu C menjadi 5 dan E menjadi 8

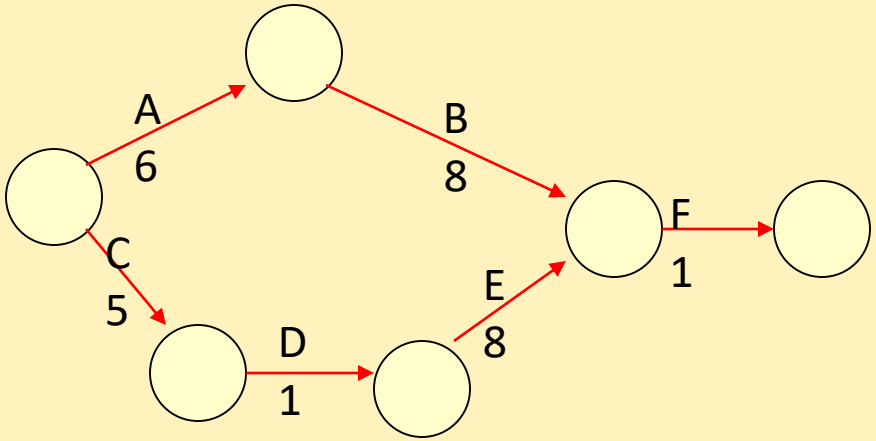




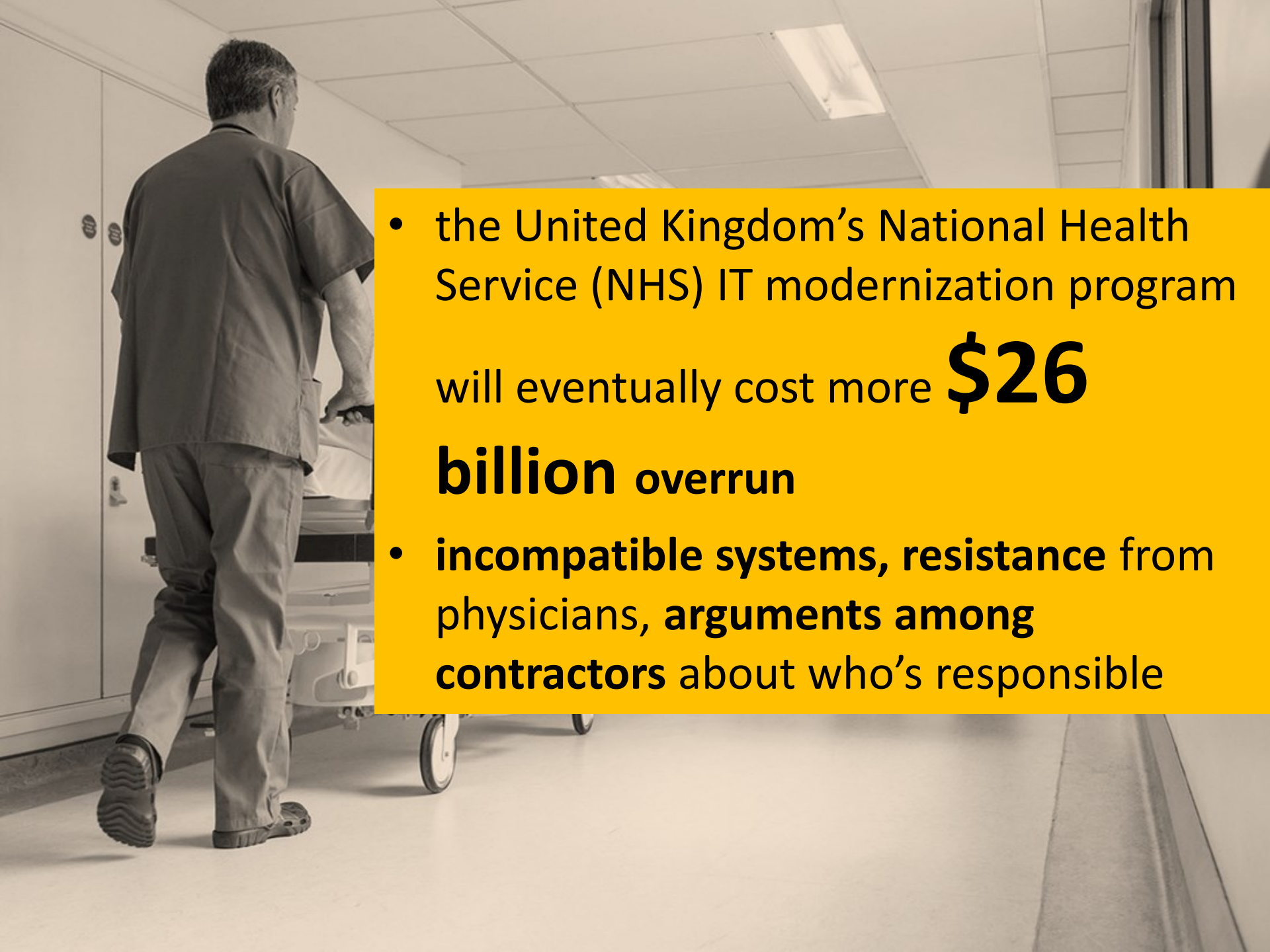
Lintasan kritis menjadi 2

Jika ingin mengetahui durasi tercepat maka semua aktivitas di buat crash

act	crash time	normal cost	crash cost/day	cost slope
A	6	200	0	0
B	8	300	500	100
C	4	100	300	200
D	1	550	700	50
E	7	400	600	100
F	1	650	800	150



Sehingga Direct cost = 500+300+700+600+800 = 2900-200 - 100 = 2600 +1500 = 4100



- the United Kingdom's National Health Service (NHS) IT modernization program will eventually cost more **$26 billion overrun**
- **incompatible systems, resistance** from physicians, **arguments among contractors** about who's responsible

- **The Obama** campaign used **16 different online social platforms**,
- **80 percent of all contributions** originated from social networks,