Test--Week 7

5 process groups

Knowledge Areas	Project Management Process Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring and Controlling Process Group	Closing Process Group
4. Project Integration Management	4.1 Develop Project Charter	4.2 Develop Project Management Plan	4.3 Direct and Manage Project Work	4.4 Monitor and Control Project Work 4.5 Perform Integrated Change Control	4.6 Close Project or Phase
5. Project Scope Management		5.1 Plan Scope Management 5.2 Collect Requirements 5.3 Define Scope 5.4 Create WBS		5.5 Validate Scope 5.6 Control Scope	
6. Project Time Management		6.1 Plan Schedule Management 6.2 Define Activities 6.3 Sequence Activities 6.4 Estimate Activity Resources 6.5 Estimate Activity Durations 6.6 Develop Schedule		6.7 Control Schedule	
7. Project Cost Management		7.1 Plan Cost Management 7.2 Estimate Costs 7.3 Determine Budget		7.4 Control Costs	
8. Project Quality Management		8.1 Plan Quality Management	8.2 Perform Quality Assurance	8.3 Control Quality	
9. Project Human Resource Management		9.1 Plan Human Resource Management	9.2 Acquire Project Team 9.3 Develop Project Team 9.4 Manage Project Team		
10. Project Communications Management		10.1 Plan Communications Management	10.2 Manage Communications	10.3 Control Communications	
11. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Qualitative Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Responses		11.6 Control Risks	
12. Project Procurement Management		12.1 Plan Procurement Management	12.2 Conduct Procurements	12.3 Control Procurements	12.4 Close Procurements
13. Project Stakeholder Management	13.1 Identify Stakeholders	13.2 Plan Stakeholder Management	13.3 Manage Stakeholder Engagement	13.4 Control Stakeholder Engagement	

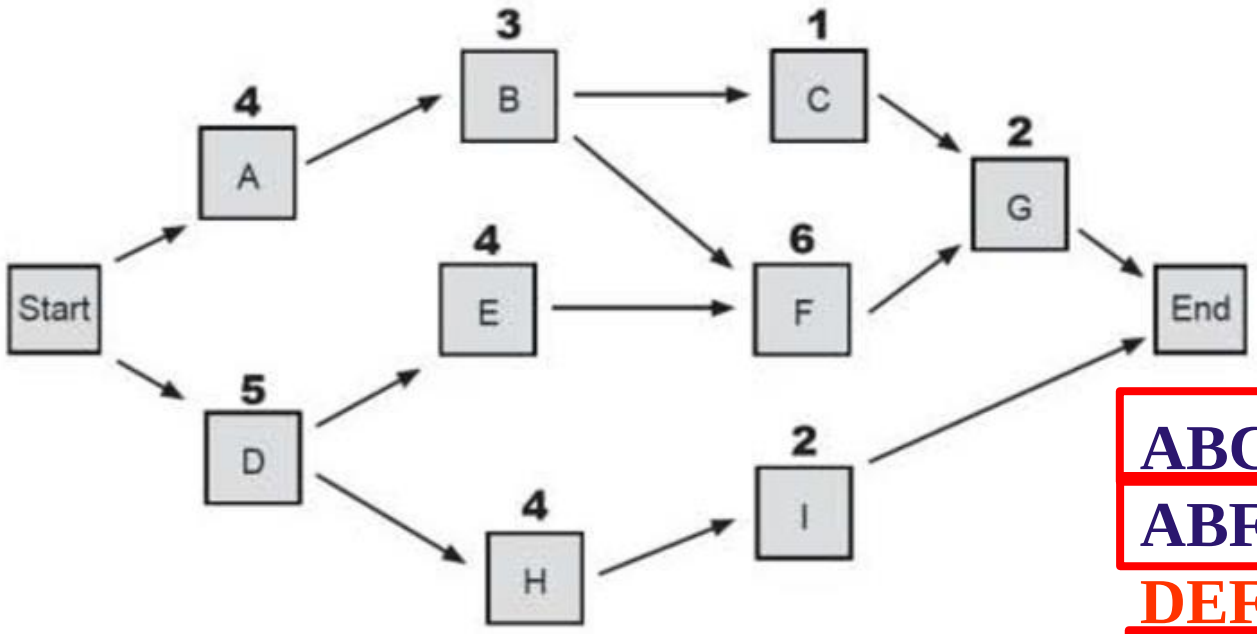
10 knowledge areas

Get it done on time!

3. Time Management

1. Plan Schedule Management
2. Define Activities
3. Sequence Activities
4. ~~Estimate Activity Resources~~
5. Estimate Activity Durations
6. Develop Schedule
7. Control Schedule

Test--Week 7



ABCG 4312=10

ABFG 4362=15

DEFG 5462=17

DHI 542=11

How many paths 4

Critical path Start->D->E->F->G

Write down the Float for each activity:

A 2 B 2 C 7 D 0 E 0

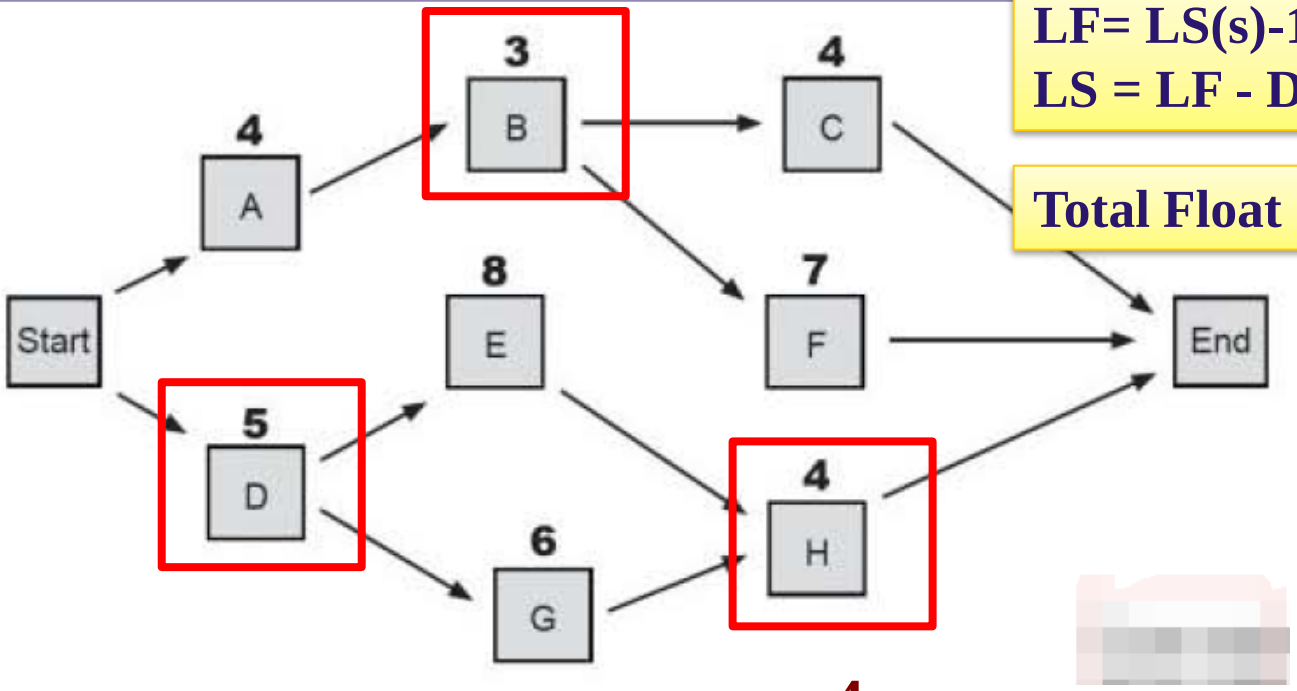
F 0 G 0 H 6 I 6

Test

ES= EF(p)+1
EF = ES + Duration -1

LF= LS(s)-1
LS = LF - Duration +1

Total Float = LF – EF = LS - ES



How many paths ____4____

Critical path ____Start->D->E->H->End____

Write down the Float for each activity:

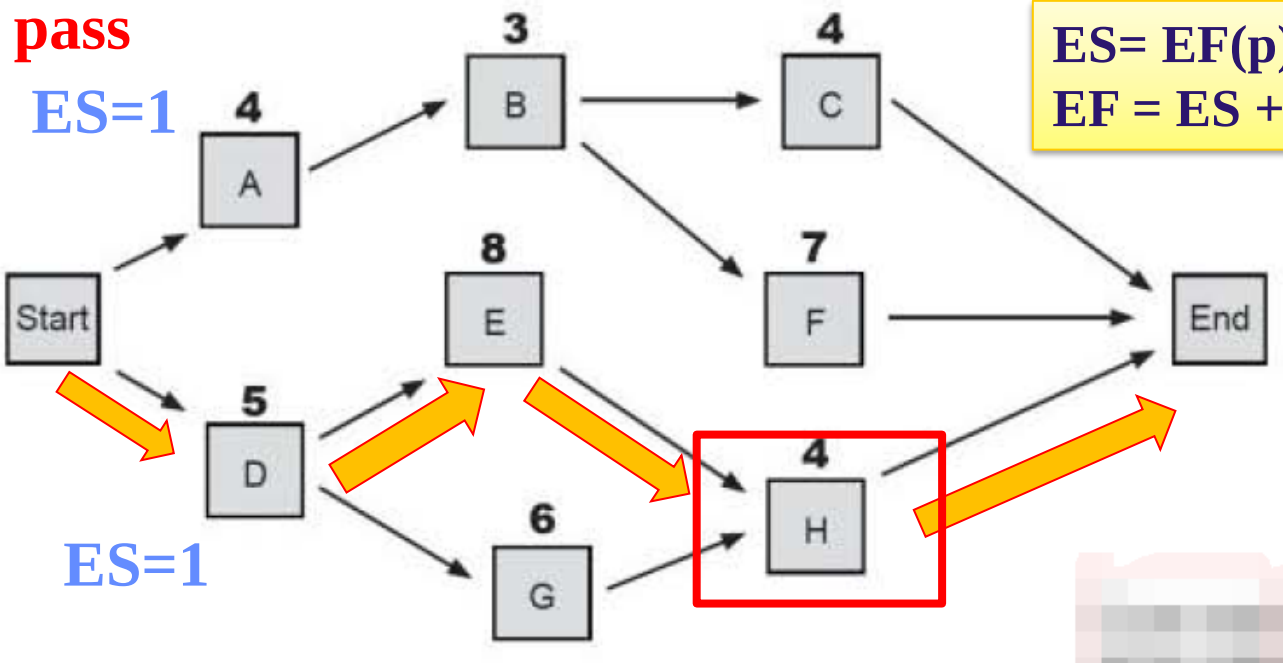
A__3__ B__3__ C__6__ D__0__

E__0__ F__3__ G__2__ H__0__

Calculate the ES, EF, LS, LF of each activity

Test

Forward pass



ES= EF(p)+1
EF = ES + Duration -1

Critical path **Start->D->E->H->End**

ABC 434=11
ABF 437=14
DEH 584=17
DGH 564=15

D: ES=1, EF= 1+5-1=5

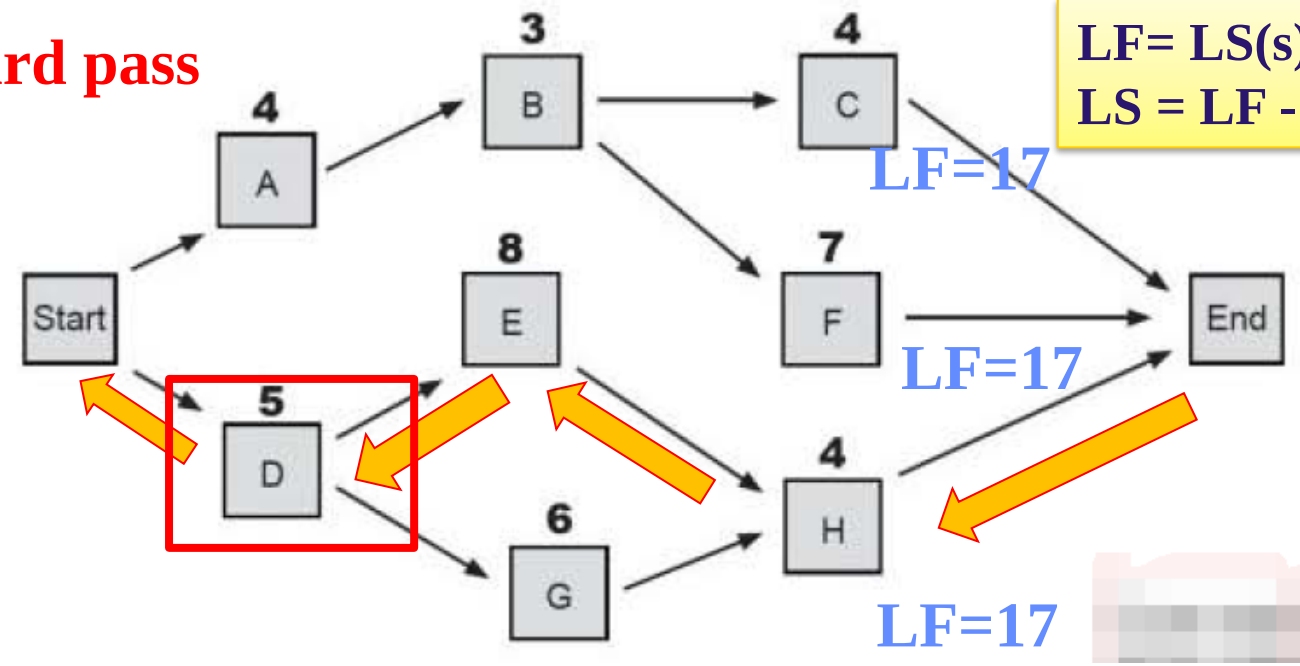
E: ES=5+1=6, EF= 6+8-1=13

G: ES=5+1=6, EF= 6+6-1=11

H: ES=13+1=14, EF= 14+4-1=17

Test

Backward pass



LF= LS(s)-1
LS = LF - Duration +1

Critical path Start->D->E->H->End

ABC 434=11
ABF 437=14
DEH 584=17
DGH 564=15

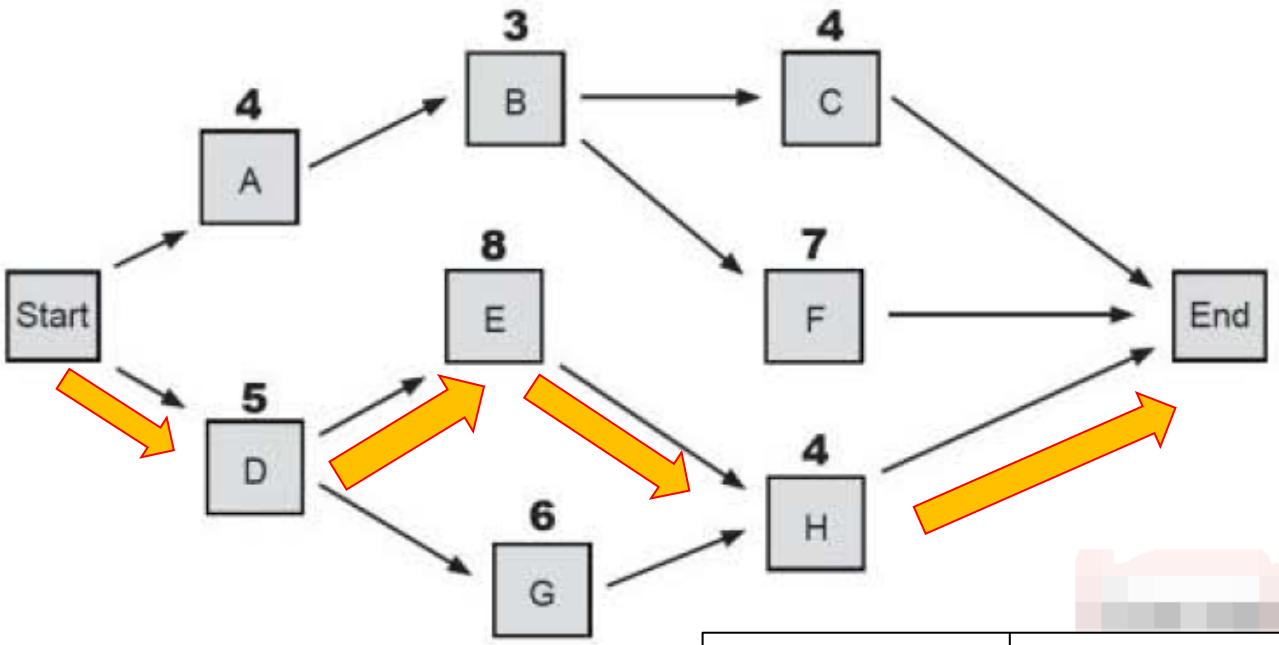
H: LF=17, LS= 17-4+1=14

E: LF=14-1=13, LS= 13-8+1=6

G: LF=14-1=13, LS= 13-6+1=8

D: LF=6-1=5, LS= 5-5+1=1

Test



Early Start (ES)	Duration	Early Finish (EF)
Activity Name		
Late Start (LS)	Total Float	Late Finish (LF)

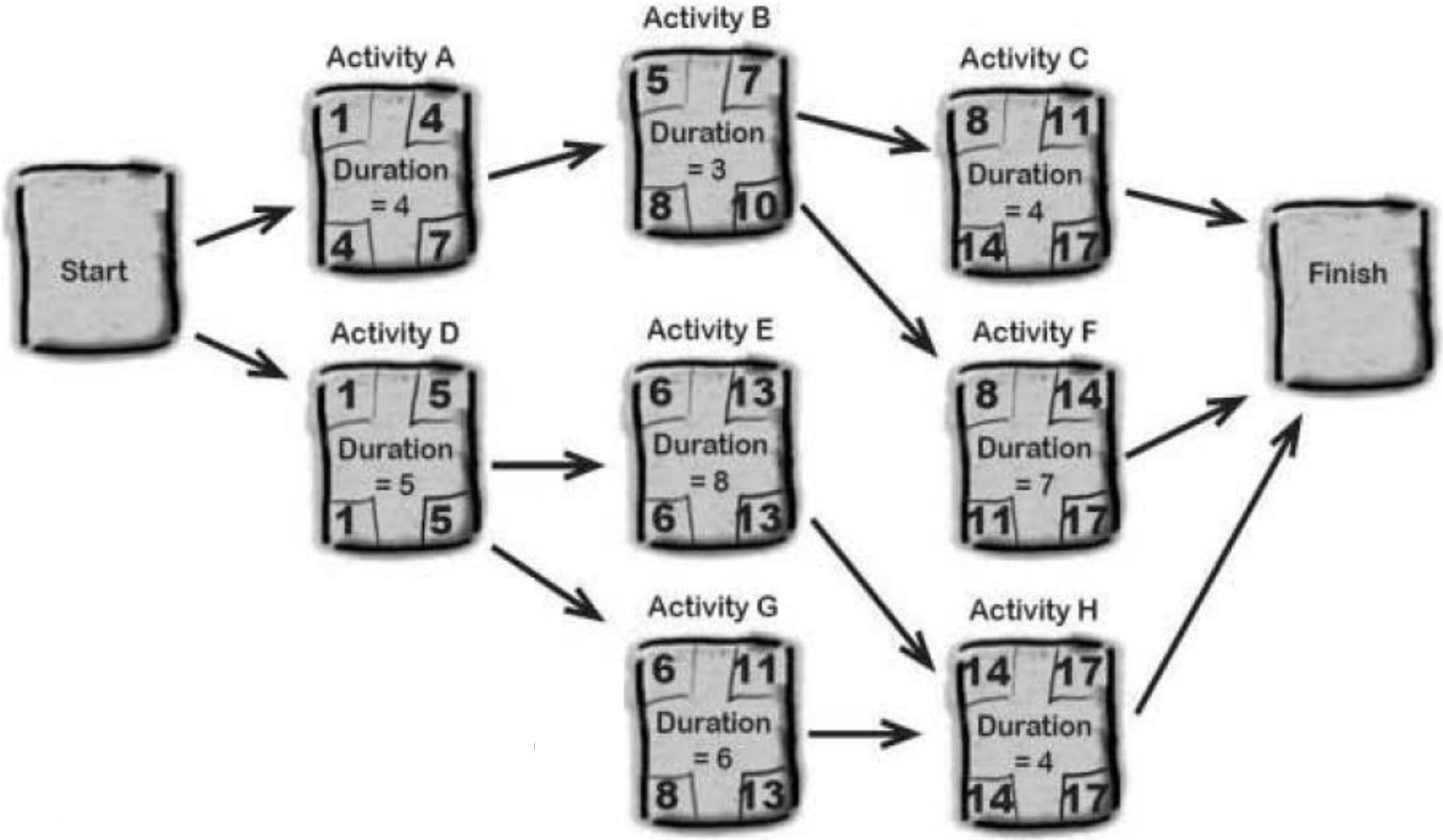
ABC 434=11

ABF 437=14

DEH 584=17

DGH 564=15

Test


Start
Activity A
1 4
Duration = 4
4 7
Activity B
5 7
Duration = 3
8 10
Activity C
8 11
Duration = 4
14 17
Finish
Activity D
1 5
Duration = 5
1 5
Activity E
6 13
Duration = 8
6 13
Activity F
8 14
Duration = 7
11 17
Activity G
6 11
Duration = 6
8 13
Activity H
14 17
Duration = 4
14 17

Assignment

- **Assignment 1**
  - **Project charter**
    - Template
    - Sample (for reference only)
- **Assignment 2**
  - **Project management plan**
    - Template
    - Sample (for reference only, not the standard answer)
- **You can delete or add some parts based on the template.**
- **The ability to apply what you have learned;**
- **Self-study, uniqueness**

Software Project Management

Chapter 5: Cost Management

Structure of this course

	5 process groups				
10 knowledge areas	**Initiating**	**Planning**	**Executing**	**Monitoring & Controlling**	**Closing**
1. Integration management					
2. Scope					
3. Time					
4. Cost					
5. Quality					
6. Human resource					
7. Communications					
8. Risk					
9. Procurement					
10. Stakeholder					

Cost Management Overview

What is Cost Management?

Watching the bottom line!

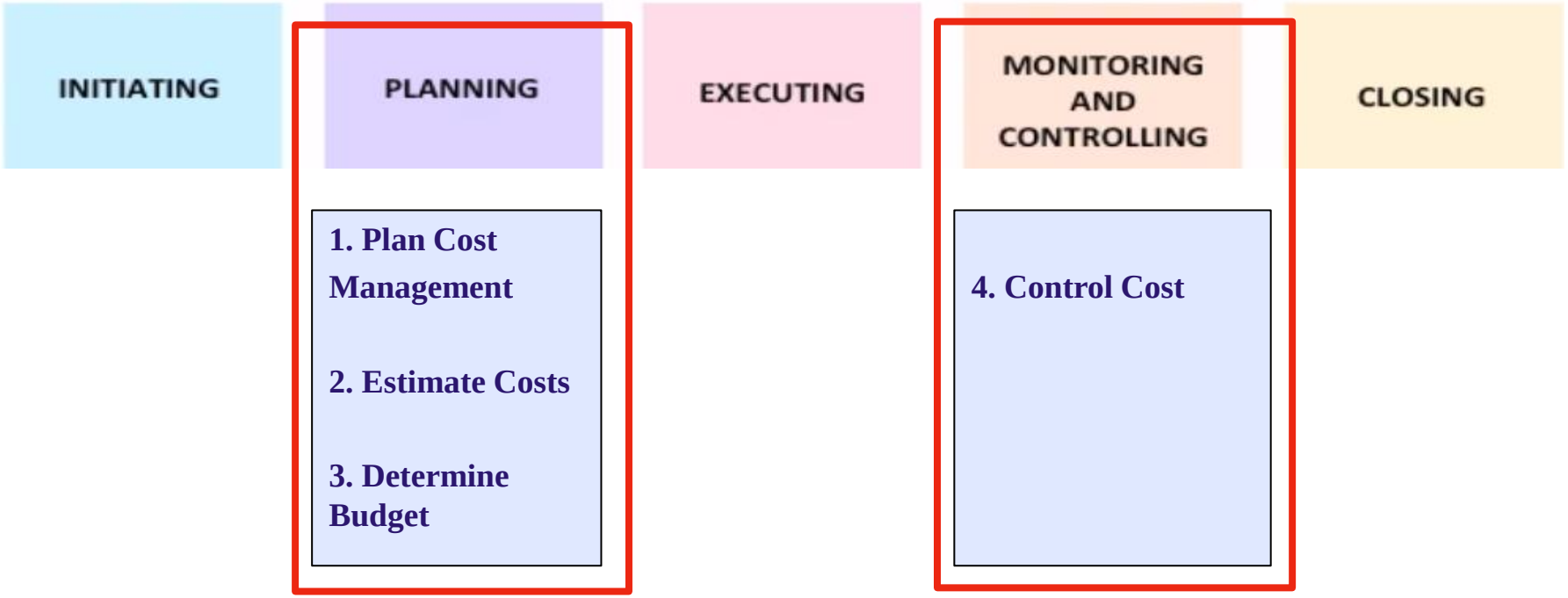
Project Cost Management includes the processes involved in planning, estimating, budgeting, financing, funding, managing, and controlling costs so that the project can be completed within the approved budget.

Cost is a resource expended or used to achieve a specific objective, or something given up in exchange.

Cost is often measured in terms of money.

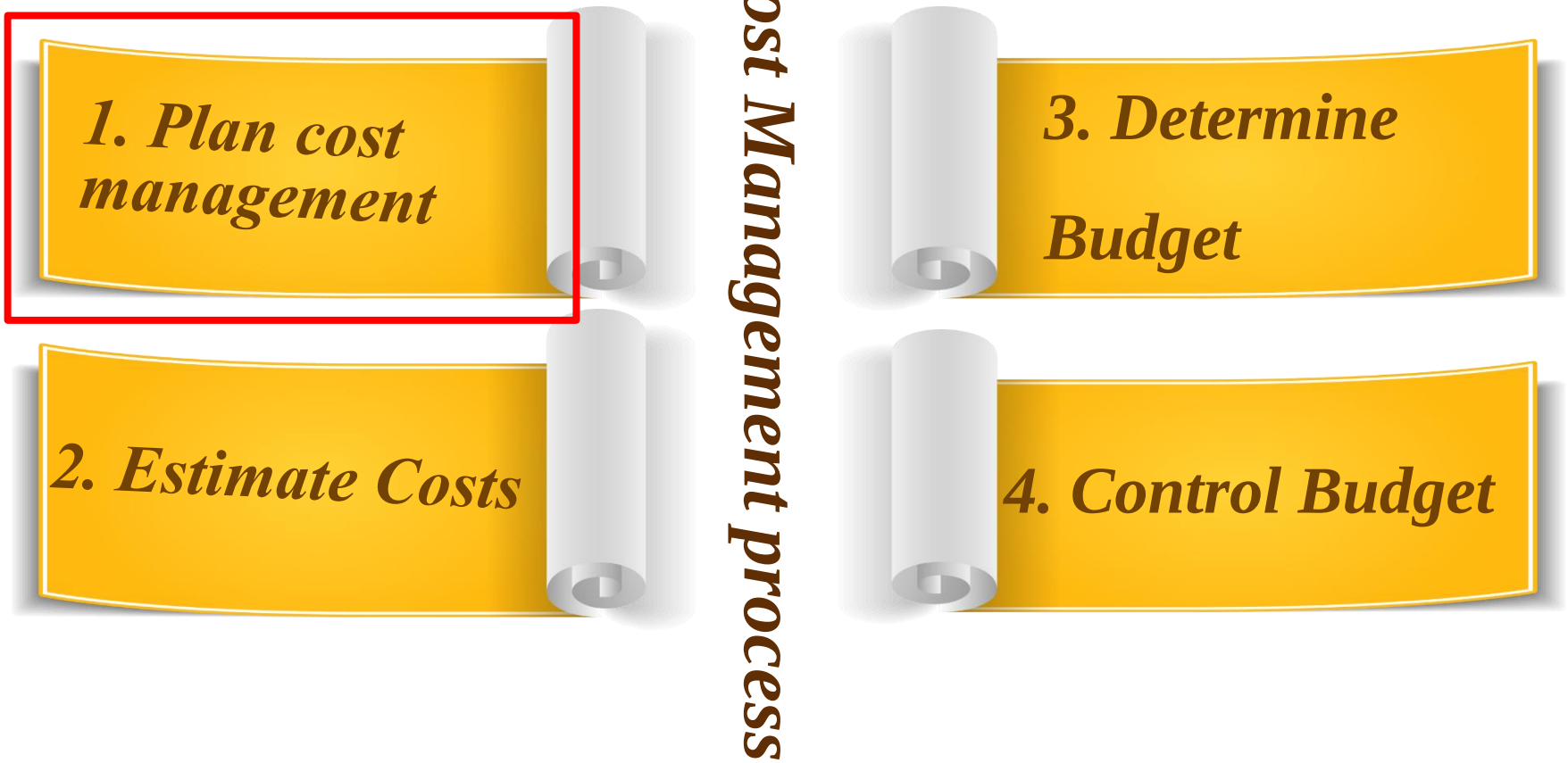
Cost Management Overview

5 Process Groups



4 Cost Management processes

Cost Management Overview



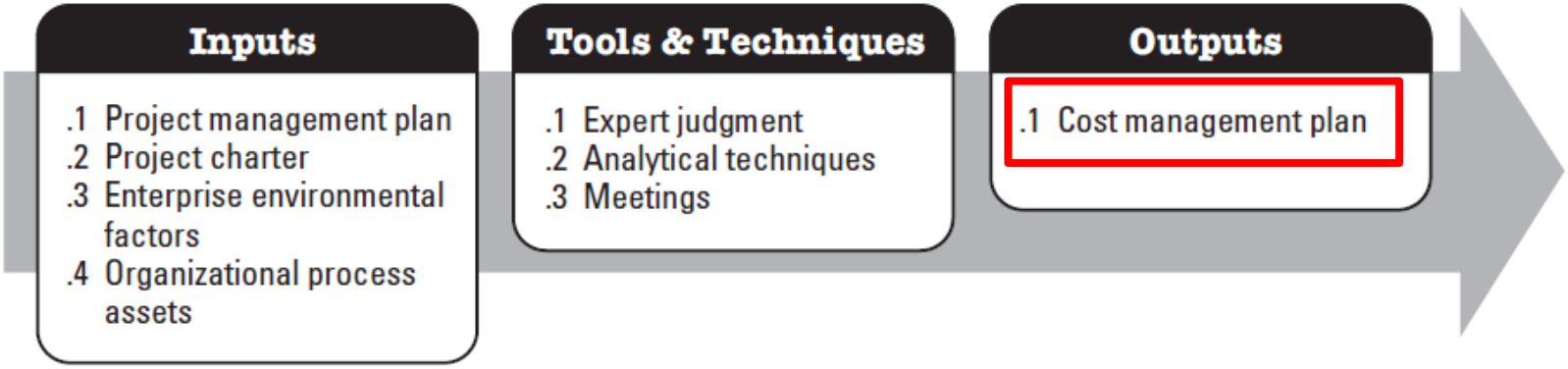
Section 5.1: Plan Cost Management

Plan Cost Management

Plan Cost Management is the process that establishes the policies, procedures, and documentation for planning, managing, expending, and controlling project costs.

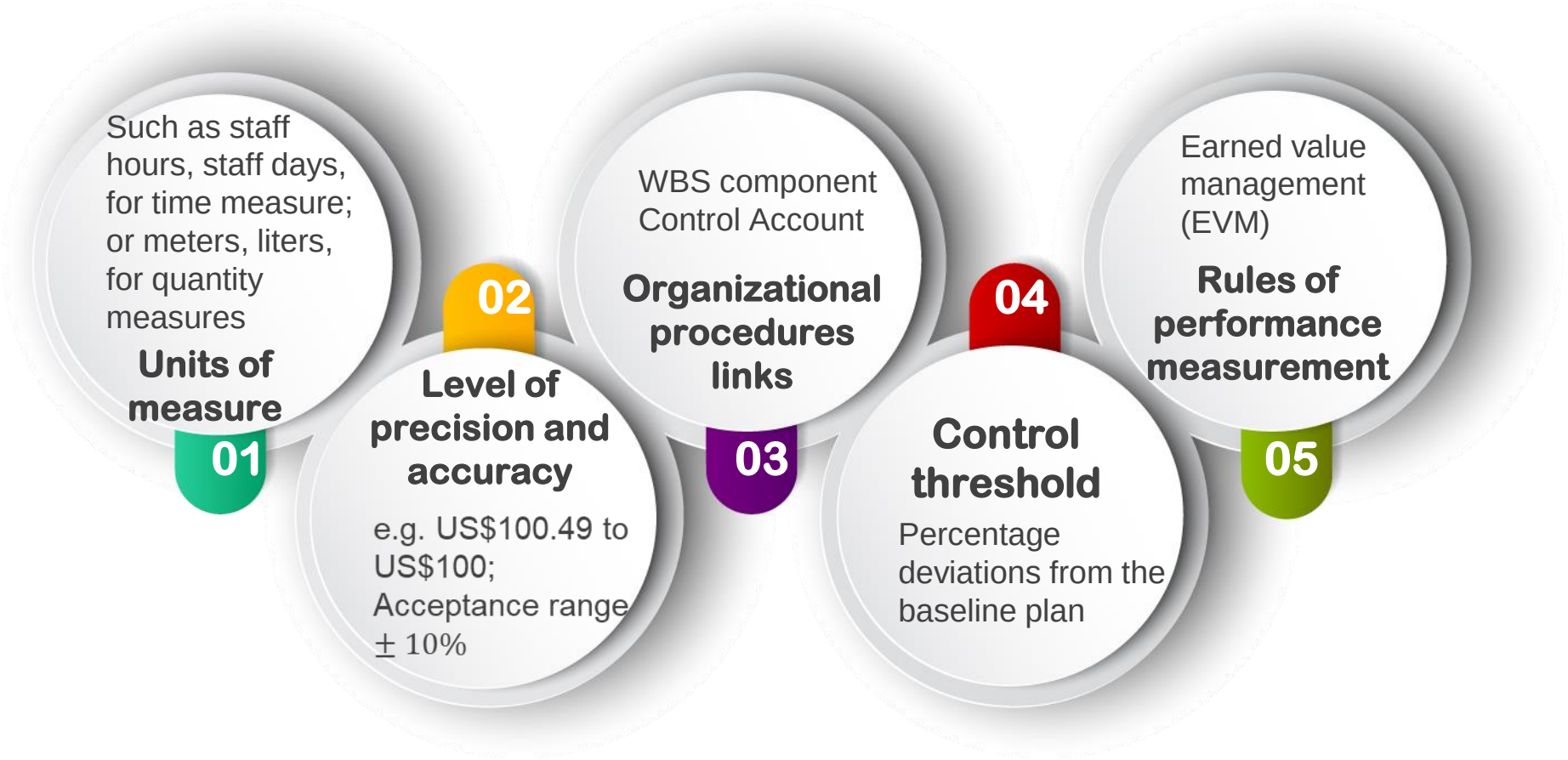
The key benefit of this process is that it provides guidance and direction on how the project costs will be managed throughout the project.

Section 5.1: Plan Cost Management



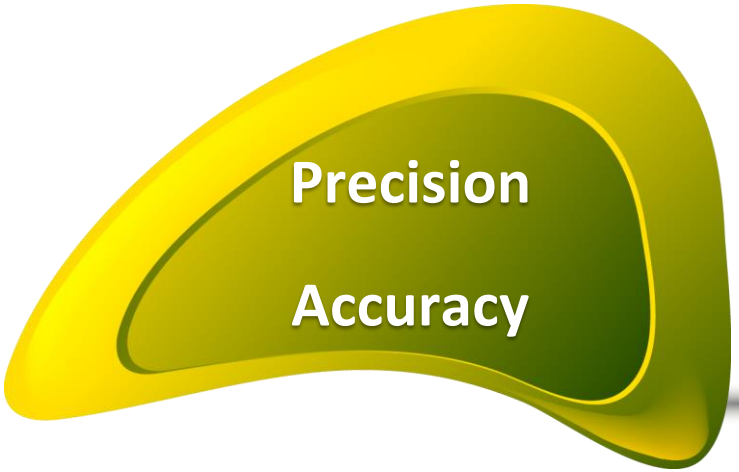
The cost management plan is a component of the project management plan and describes how the project costs will be planned, structured, and controlled.

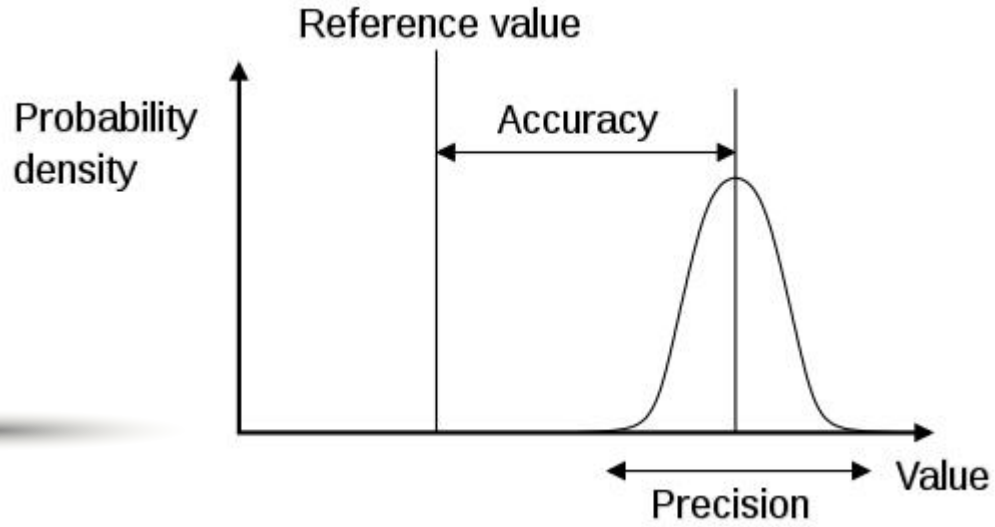
Section 5.1: Plan Cost Management



Cost management plan

Section 5.1: Plan Cost Management





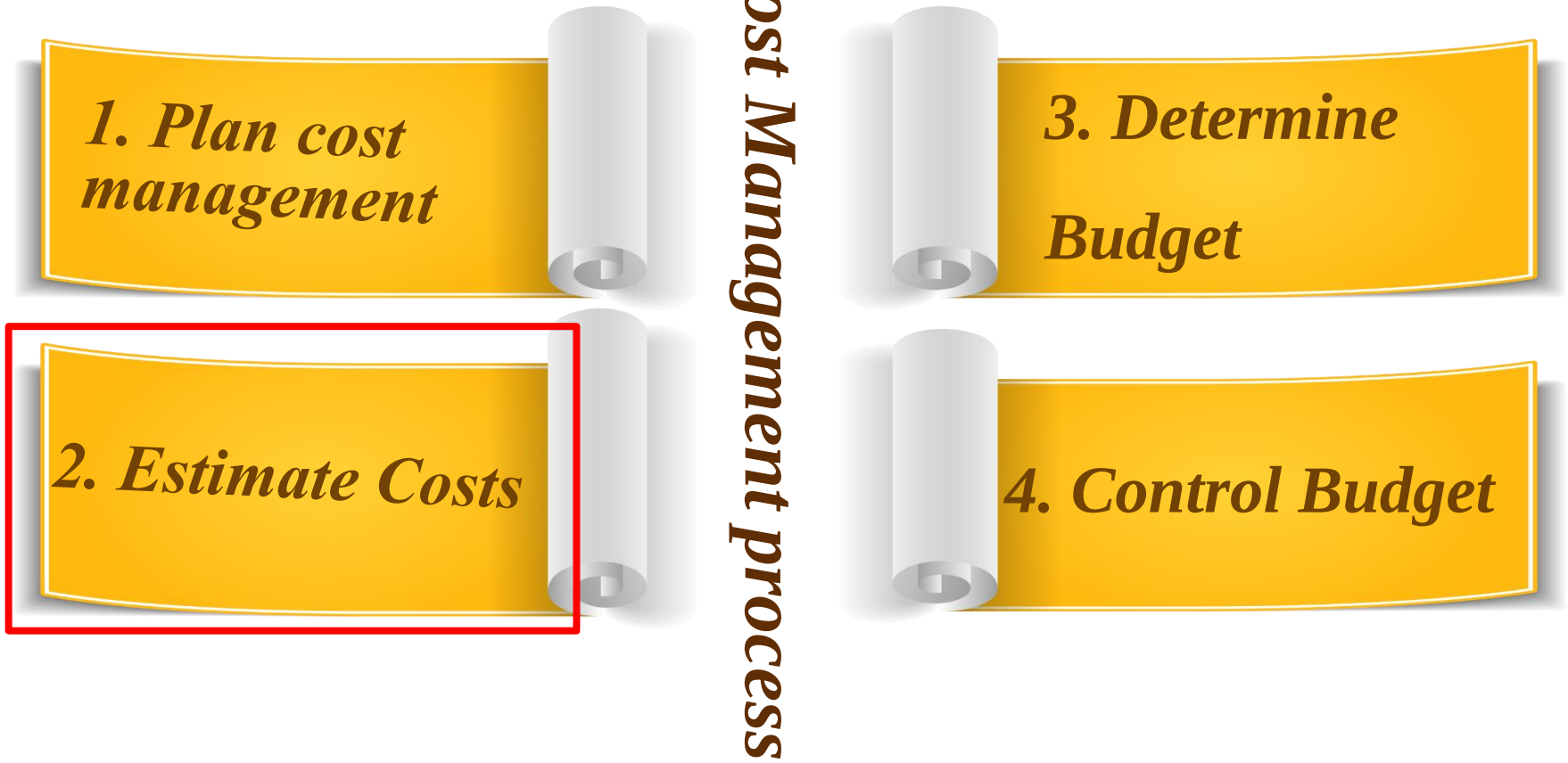
High Accuracy
High Precision

Low Accuracy
High Precision

High Accuracy
Low Precision

Low Accuracy
Low Precision

Cost Management Overview



Section 5.2 Estimate Cost

Estimate Costs

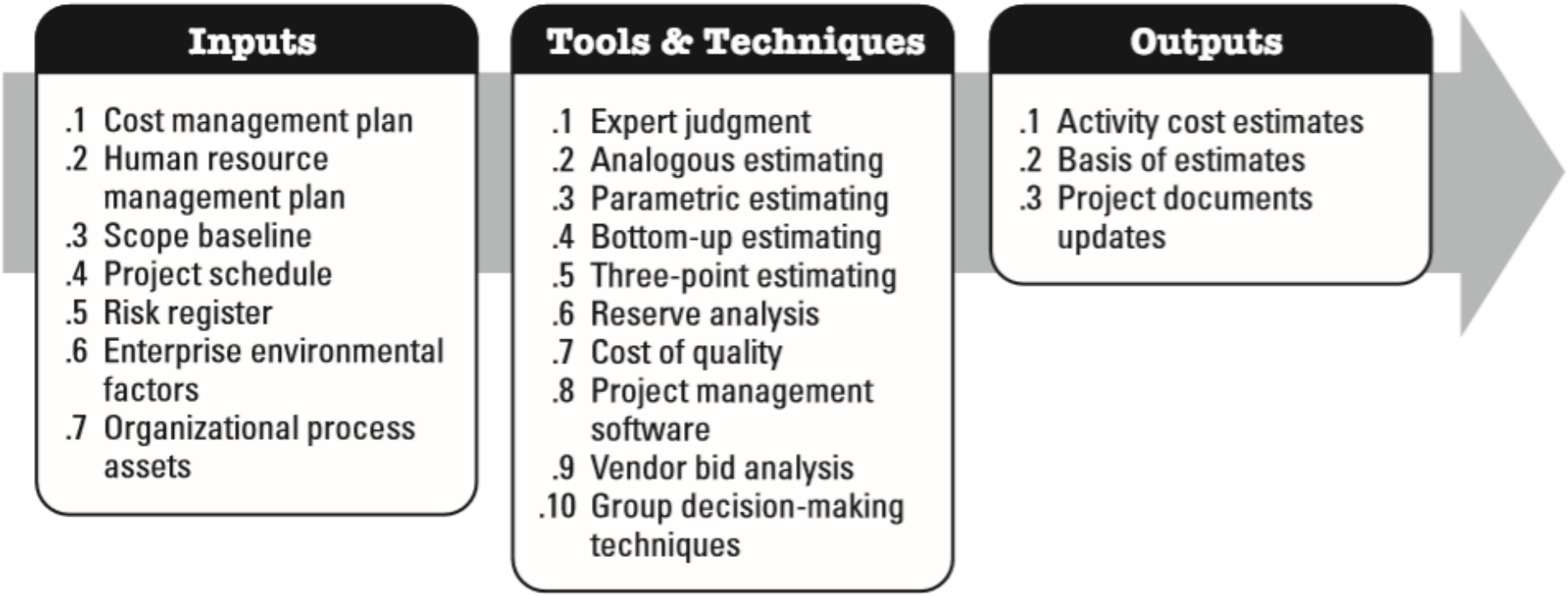
The process of **developing** an approximation of the **monetary** resources needed to complete project activities.

The key benefit of this process is that it **determines the amount of cost required** to complete project work.

Section 5.2 Estimate Costs

- Cost estimates are a prediction that is based on the information known at a given point in time.
- Cost estimates are generally expressed in units of some currency (i.e., dollars, euros, yen, etc.), although in some instances other units of measure, such as staff hours or staff days, are used to facilitate comparisons by eliminating the effects of currency fluctuations.
- Cost estimates should be reviewed and refined during the course of the project to reflect additional detail as it becomes available and assumptions are tested.
- The accuracy will increases as the project progresses through the project life cycle.

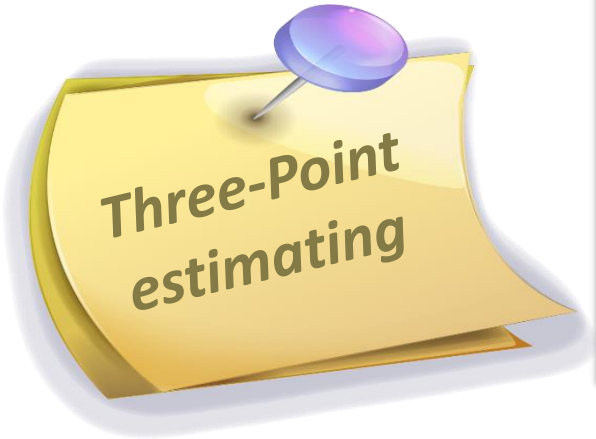
Section 5.2 Estimate Costs



Section 5.2 Estimate Costs

1. Expert judgment
2. Analogous estimating
3. Parametric estimating
4. Three-point estimating
5. Group decision-making techniques
6. Reserve analysis
7. Bottom-up estimating

Section 5.2 Estimate Costs



Most likely (cM)

Optimistic (cO)

Pessimistic (cP)

the expected Costs, cE

1) Triangular Distribution

$$cE=(cO+cM+cP)/3$$

2) Beta Distribution

$$cE=(cO+4cM+cP)/6$$

Section 4.4 Estimate Activity Durations

Three-point Estimating

Depending on the assumed distribution of values within the range of the three estimates, the expected duration, tE, can be calculated using the formula

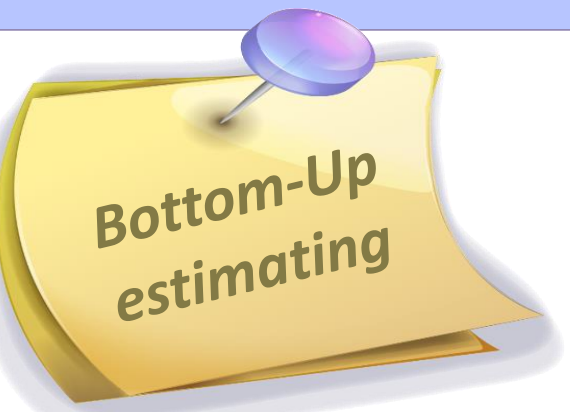
1) Triangular Distribution

$$tE=(tO+tM+tP)/3$$

2) Beta Distribution (from the traditional PERT technique)

$$tE=(tO+4tM+tP)/6$$

Section 5.2 Estimate Costs

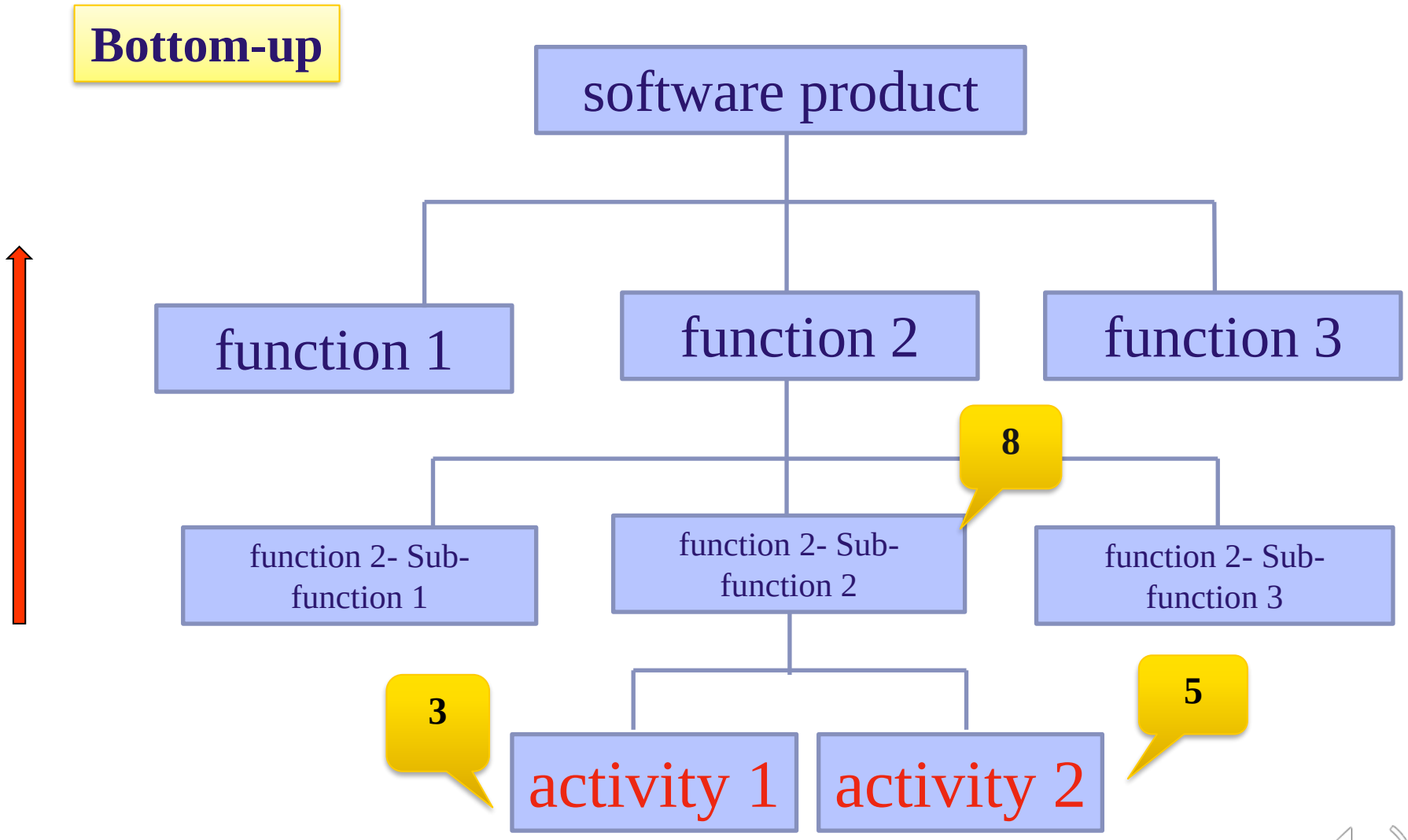


Bottom-up estimating is a method of estimating a component of work.

- **The cost of individual work packages or activities is estimated to the greatest level of specified detail.**
- **The detailed cost is then summarized or "rolled up" to higher levels for subsequent reporting and tracking purposes.**
- **The cost and accuracy of bottom-up cost estimating are typically influenced by the size and complexity of the individual activity or work package.**

Section 5.2 Estimate Costs

Bottom-up



Section 5.2 Estimate Costs

	# Units/Hrs.	Cost/Unit/Hr.	Subtotals	WBS Level 1 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**	

Section 5.2 Estimate Costs

1. Activity Cost Estimates

- Activity cost estimates are quantitative assessments of the probable costs required to complete project work.

form

- Cost estimates can be presented in summary form or in detail.

content

- Costs are estimated for all resources that are applied to the activity cost estimate: direct labor, materials, equipment, services, facilities, information technology,

2. Basis of Estimates

- Supporting documentation: how the cost estimate was derived.

Section 5.2 Estimate Costs—software project

1. Software project cost estimating
    1. Lines Of Code (LOC)
    2. Function point (FP)
    3. Expert estimation method
    4. A practical software cost estimation process

Section 5.2 Estimate Costs—software project

- **Software project scale measurement unit：**
  - **LOC(Lines of Code)：Measurement of source code program length.**
  - **FP(Function Point)：System function number of measurements.**
- **Software project workload refers to the software engineering task that must be completed in order to provide the function of the software.**
  - **Its measure unit is: Man-months、Man-days 、 Man-years (The amount of work done by a person in a unit of time)**
- **The workload is closely related to the scale, and is also related to the project and product characteristics (such as complexity).**

Software Project Cost

- **Software Project Cost: Completion of the cost of the corresponding software project effort, that is, to be developed software projects needed funds.**
- **The cost of labor consumption is the main cost of software products.**
- **Costs are generally calculated by the monetary unit, such as the RMB, US dollar, etc..**

Software Project Cost

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- **The cost of labor consumption is the main cost of software products.**
- **Costs are generally calculated by the monetary unit, such as the RMB, US dollar, etc..**

Software Project Cost

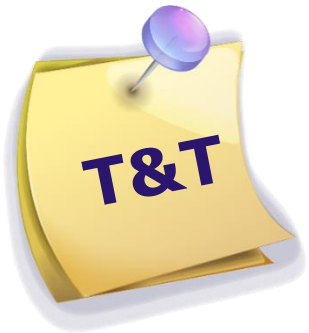
- The relationship between workload and cost
  - The workload is the main consideration of the cost, the project workload estimation and cost estimation are often carried out at the same time.
  - If the cost of the unit is determined, the project cost can be calculated directly according to the project work.

For example: if a software project workload is 20 person-months, and the company's human cost parameter is 20,000 yuan / person-months, the cost of the project is $ 400,000.

Section 5.2 Estimate Costs—software project

1. Software project cost estimating
    1. Lines Of Code (LOC)
    2. Function point (FP)
    3. Expert estimation method
    4. A practical software cost estimation process

Software Project Cost Estimating



- **1. Lines of code （LOC）**
  - Define the size of the project from the perspective of the amount of software programs.
  - Functional decomposition requires sufficient detail.
  - There are certain empirical data (analog and empirical methods).
  - Related to the specific programming language.

Example: LOC=10000 lines

productivity=100 lines/person days

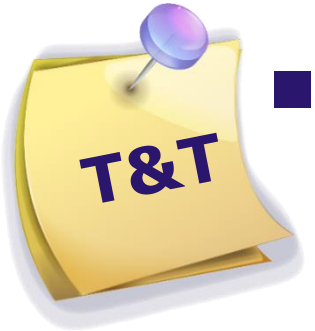
workload= 100 person days

Software Project Cost Estimating

Lines of code （LOC）

- **Advantage：**
  - **Intuitive and accurate (in the case of code), the easy-to-calculate (statistical tools can be used lines of code).**
- **Disadvantage：**
  - **There is no accepted measure of lines of code in standard definition.**
  - **The number of lines of code dependent on the programming language and personal programming style.**
  - **Early in the project, demand instability, immature design, realization is difficult to accurately estimate the amount of code under uncertain circumstances.**

Software Project Cost Estimating



- 2. Function Point （FP）
  - It is not related to the language and technology used by the system to measure the size of the system.
  - Count the external and internal functions of the system. (Unadjusted Function Point Count)
  - According to the technical complexity factor, they are adjusted to produce the product scale measurement results.

- FP =UFC*TCF
  - UFC(Unadjusted Function Point Count)
  - TFC(Technical Complexity Factor)

Software Project Cost Estimating

UFC's calculation method

- First, calculating feature count items, Count the following five types of elements:
  - External input: an application oriented data item entered by the user.
  - External Output: Output data items to the user.
  - External query: interactive input for system response.
  - External interface file: interface data files with other systems.
  - Internal file: internal fixation for system use.

Software Project Cost Estimating

UFC's calculation method

- **Then for each function and summing the weighted count items，gained UFC。**

Feature Count items	Complexity Weight		
	simple	medium	complex
External input	3	4	6
External Output	4	5	7
External inquiry	3	4	6
External interface file	5	7	10
Internal documents	7	10	15

Software Project Cost Estimating

Example

Feature Count items	**Counts**	Complexity Weight
External input	0	
External Output	1 complex	7
External inquiry	1 medium	4
External interface file	3 medium	7
Internal documents	0	

UFC=1*7+1*4+3*7=32

Software Project Cost Estimating

TCF's calculation method

Technical complexity factors			
F1	Reliable backup and recovery	F2	data communication
F3	Distributed function	F4	performance
F5	Large use of configuration	F6	Online data entry
F7	Simplicity of operation	F8	Online upgrade
F9	Complex interface	F10	Complex data processing
F11	Reusability	F12	Installation simplicity
F13	Multiple Sites	F14	Easy to modify

Software Project Cost Estimating

TCF's calculation method

Each technical complexity of factors affecting the range:

Value	Impact on the system
0	Does not exist or has no effect
1	No significant impact
2	Considerable influence
3	Average effect
4	Significant effect
5	Powerful influence

TCF=0.65+0.01(sum(Fi))： Fi:0-5,TCF:0.65~1.35

Software Project Cost Estimating

Technical complexity factors					
F1	Reliable backup and recovery	1	F2	data communication	5
F3	Distributed function	0	F4	performance	3
F5	Large use of configuration	1	F6	On-line data entry	0
F7	Simplicity of operation	1	F8	Online upgrade	0
F9	Complex interface	1	F10	Complex data processing	4
F11	Reusability	0	F12	Installation simplicity	3
F13	Multiple Sites	0	F14	Easy to modify	3

sum(Fi)=22

FP =UFC*TCF

TCF=0.65+0.01(sum(Fi))=0.65+0.01*22=0.87

Software Project Cost Estimating

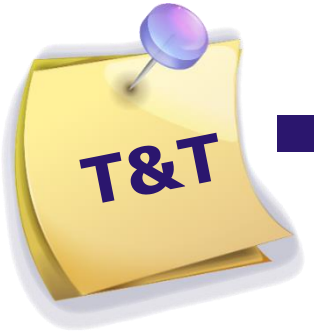
Function point and code line conversion

Language	**LOC/FP**
Assembly	320
C	150
COBOL	105
FORTRAN	105
PASCAL	91
ADA	71
PL/1	65
PROLOG/LISP	64
SMALLTALK	21
SPREADSHEET	6

Software Project Cost Estimating

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

Software Project Cost Estimating



- 3. Expert estimation method
  - By a number of application areas and development environment has extensive experience of experts to estimate the cost.
  - In order to avoid a single expert bias, as far as possible by a number of experts to estimate, to obtain multiple estimates, and finally come to a comprehensive estimate.

Expert estimation method -Delphi

Software Project Cost Estimating

Expert estimation method -Delphi

- The organizers send each expert a software system specifications and a record of the estimated value of the form, then they estimate.
- After a detailed study of the software specifications, the software proposed 3 work (or cost) of the estimated value:
  - Minimum a_i
  - The most likely value m_i
  - Maximum b_i
- Calculating the average estimate of each expert. $E_i=(a_i+4m_i+b_i)/6$ and total average $E=(E1+E2+\ldots+En)/n$ (n represents n experts)。

Software Project Cost Estimating

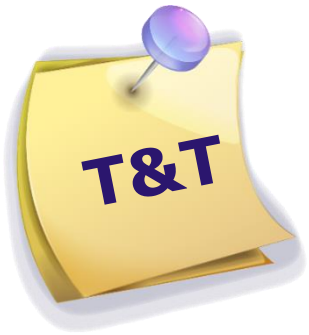
Expert estimation method -Delphi

- Organize experts to fill out the form, compare the estimates, and find out the reason.
- If the estimated differences between the various experts outside the specified range (for example: 15%), need to repeat the process, and ultimately obtained a majority consensus of expert software effort (or cost) estimates.

Software Project Cost Estimating

- **Example**
  - **Expert 1：1，8，9 ⟶ （1+9+4*8）/6=7（ten thousands）**
  - **Expert 2：4，6，8 ⟶ （4+8+4*6）/6=6（ten thousands）**
  - **Estimate=（6+7）/2=6.5**

Software Project Cost Estimating



- **4. A practical software cost estimation process:**
  1. **Task decomposition(activity): T1, T2,…,Ti,…,Tn**
  2. **Estimate the cost of each task Ci**
  3. **Direct cost of the project =C_1+C_2+…+C_i+…+Cn**
  4. **Indirect cost estimation**
  5. **Total project cost = direct cost + indirect cost**

Software Project Cost Estimating

Step 2. Estimate the cost of each task

- First estimate the workload of the task E_i (Generally in the man-month as the unit)
- Then estimate the cost of the task $C_i = E_i *$ Human cost parameters

For example: if a software project workload is 3 person-months, and the company's human cost parameter is 20,000 yuan / person-months, the cost of the project is $ 60,000.

Software Project Cost Estimating

Step 3. Direct cost estimation

- The structure of direct cost: development cost, management cost, quality cost
- A simple estimation method of management and quality cost:
  - Development workload: Effort(Dev)
  - Management and quality work :Effort(Mgn)=a*Effort(Dev)

    a is scaling factor， According to the specific circumstances of the enterprise， such as:20%--25%。

- Direct cost = Effort(Dev) + a*Effort(Dev)

Software Project Cost Estimating

Step 4. Indirect cost estimation

- **Calculated based on firm-specific cost model.**
- **Simplified Estimation:**
  - **Indirect costs = Direct costs *Indirect cost factor**
  - **The indirect cost coefficient is determined according to the specific circumstances of the enterprise， such as:0.3。**

Software Project Cost Estimating

Step 5. Total project cost estimate

- **Total estimated cost**

  = direct cost + indirect cost

  = direct cost + direct cost *Indirect cost coefficient

  = direct cost (1+ Indirect cost coefficient)

  = workload * human cost parameters （1+ Indirect cost coefficient）
- **Cost coefficient**

  = human cost parameters *（1+ Indirect cost coefficient）
- **Total estimated cost = workload * cost coefficient**

For example: The workload of a project is 40 months, Cost coefficient of 20 thousand yuan/man-month, the total estimated cost of the project is 40*20=800 thousand.