

CZ3002 - Advanced Software Engineering

Software Project Management - Project Estimation (Function Points)

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Lesson Objectives

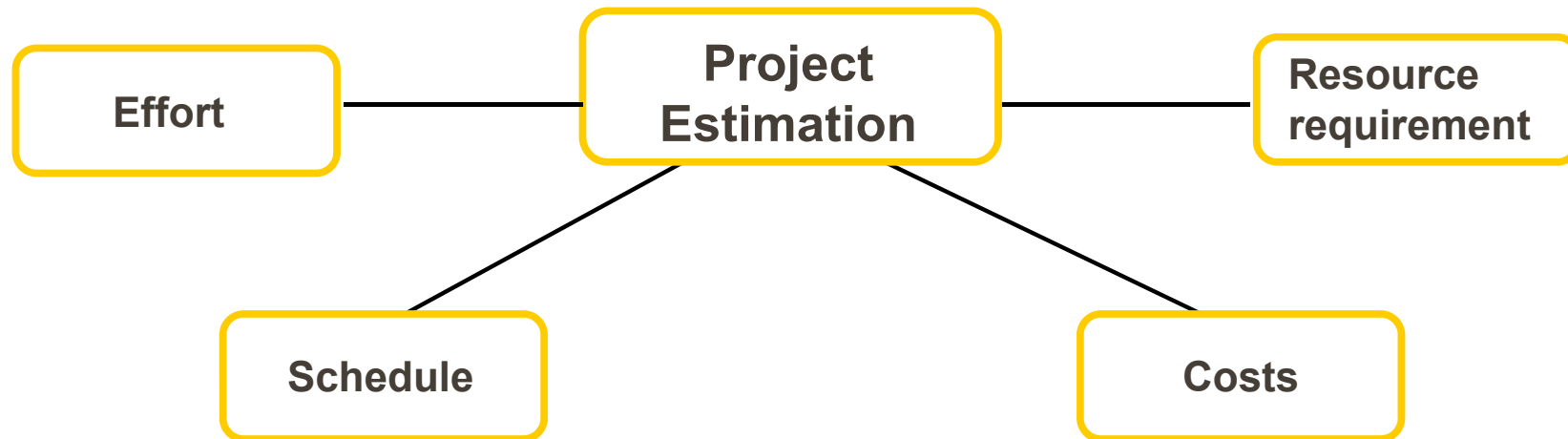
At the end of the lesson, you should be able to:

- ▶ Establish the six steps in creating a project estimate
- ▶ Compare between Lines of Code and Function Points
- ▶ Calculate effort, duration and team size using Function Points



Project Estimation

- An analysis of a proposed (or active) project to produce a forecast of its effort, schedule, costs, and resource requirements.

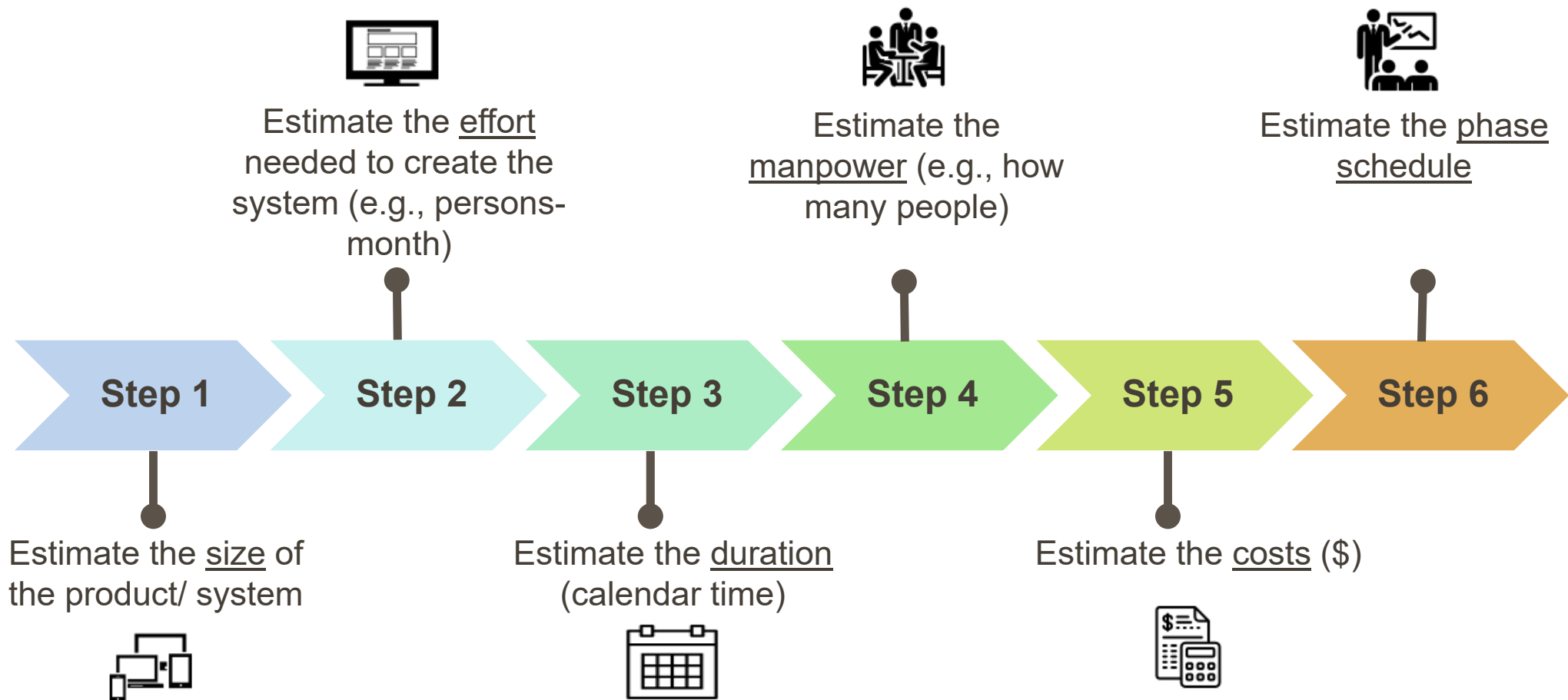


Problems of Estimation

- ▶ Software estimation is difficult
- ▶ Many estimates are hurried, and based on assumptions
- ▶ Managers, developers are, in general, overly optimistic

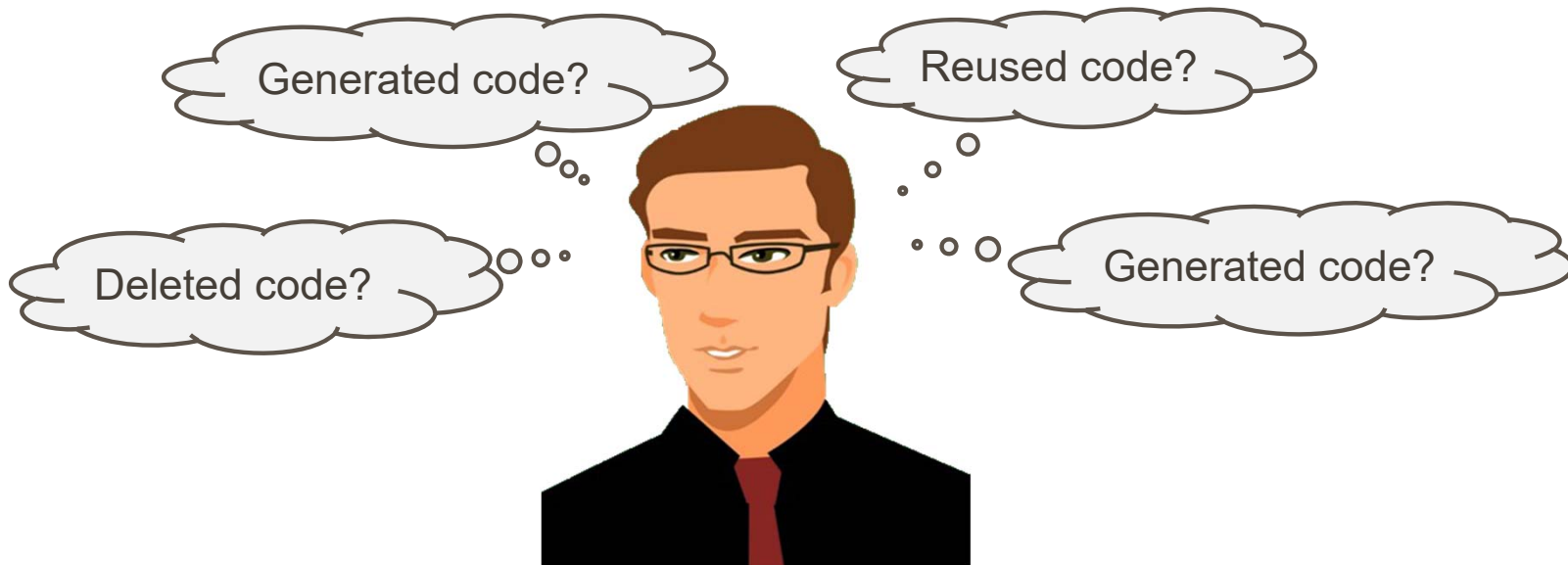


Steps in Creating a Project Estimate



Step 1 - Estimating the Size by Line of Code

- ▶ What definition?
 - ❖ Count physical or logical lines?
 - ❖ Count blank lines or comment lines?
 - ❖ Executable lines only, or include data definitions?
 - ❖ LOC, SLOC, KLOC, KSLOC, DSI (Delivered Source Instructions)



Size by Function Points (FPs)

- ▶ By Analogy
- ▶ Function Point
 - ❖ A unit of measurement to express the amount of business functionality an information system provides to a user.
 - ❖ FPs are proposed first by Allan Albrecht (IBM) in 1979
 - ❖ Popular used by software organisations
 - ❖ FPs are easier to determine from a requirements spec. than LOC are

Size by Function Points (FPs)

► 5 Primary Elements

- ❖ Inputs: application-oriented data (such as file names and menu selections)
- ❖ Outputs: transaction data output to user (printed reports)
- ❖ Inquiries: interactive inputs requiring a response (not update file)
- ❖ Logical files: logical master files in the system
- ❖ Interfaces: machine-readable interfaces to other systems

FP Example: The Unadjusted FP Total

Characteristic	Low Complexity	Medium Complexity	High Complexity
# Inputs	6 x 3 = 18	? x 4	? x 6
# Outputs	7 x 4 = 28	? x 5	? x 7
Inquiries	1 x 3 = 3	? x 4	? x 6
Logical files	5 x 7 = 35	? x 10	? x 15
Interfaces	9 x 5 = 45	? x 7	? x 10
Unadjusted FP Total = L+M+H= 307	129	71	107

in red, number of characteristics

FP Practice: Find the Five Elements

- ▶ A system being developed has the following requirements:
 - ❖ A login page/ new user registration page
 - ❖ A data retrieval page
 - ❖ Print a monthly report
 - ❖ Enquiry user history data from another archiving subsystem
 - ❖ A data update/ delete page

FP Practice: Find the Five Elements

- ▶ A system being developed has the following characteristics:
 - ❖ Number of inputs
 - 1 (registration, simple)
 - 2 (update/ delete, average)
 - ❖ Number of outputs
 - 1 (monthly report, complex)
 - ❖ Number of inquiries
 - 2 (data retrieval, enquiry, simple)
 - 1 (login, average)

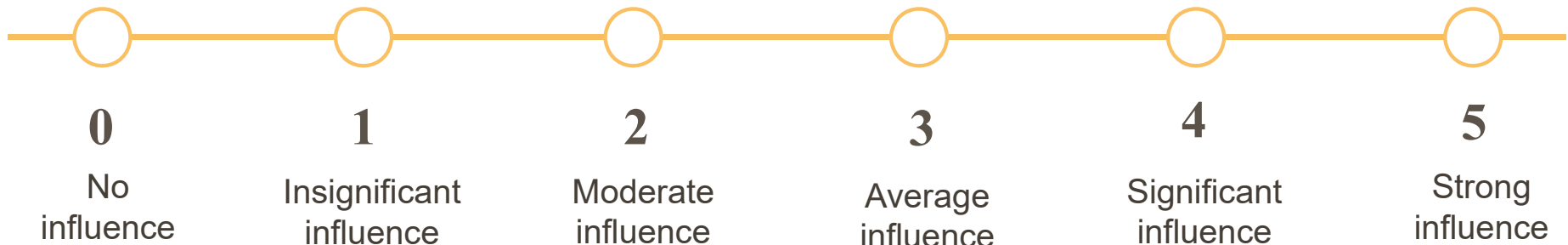
FP Practice: Find the Five Elements

- ❖ Number of files
 - 3 (registration, update/ delete, average)
- ❖ Number of external interfaces
 - 1 (enquiry, simple)

Adjusted FP Total

- ▶ Influences factors - that affect the complexity of the code (14 identified factors) include:
 - ❖ Data communications, distributed processing, performance issues, designing for re-use,

- ▶ Scoring:



Total score = sum of influences factors

Influence multiplier = (Total score) \times 0.01 + 0.65

Total Adjusted Function Points = (Unadjusted Total) \times (Influence multiplier)

Adjusted FP Total

	Influence Factors	Score (0-5)
1.	Data Communications	3
2.	Distributed Functions	3
3.	Performance	4
4.	Heavily Used	3
5.	Transaction Rate	2
6.	On-line Data Entry	4
7.	Transaction Rate	4
8.	End-user Efficiency	3
9.	On-line Update	5
10.	Complex Processing	4
11.	Reusability	4
12.	Installation Ease	3
13.	Operational Ease	3
14.	Multiple Sites	3
15.	Facilitate Change	2
Total score (add up the columns)		50

FP Example: The Adjusted FP Total

Unadjusted FP Total	= 307
Influence multiplier	= 1.15
Adjusted FP Total	= 353

- ▶ Total score = sum of influences factors = 50
- ▶ Influence multiplier = (Total score) \times 0.01 + 0.65 = $50 \times 0.01 + 0.65 = 1.15$
- ▶ Total Adjusted Function Points = (Unadjusted Total) \times (Influence multiplier)
= 307×1.15
= 353

Converting FP to LOC

- ▶ Capers Jones' firm, SPR, has done studies and produced tables of average number of source lines per FP (mainly for calculating FPs for existing systems), called "backfiring".

System Type	LOC Per FP
C	128
COBOL	105
Java	53
C++	29
SQL	13

Step 2: From Size to Effort


- ▶ Using “conventional productivity”:
 - ❖ “Simple effort” = (size) / (production rate)

$$\begin{aligned} 30,000 \text{ SLOC} / (640 \text{ SLOC per PM}) &= 46.8 \text{ PM} \\ 234 \text{ FP} / (5 \text{ FP per PM}) &= 46.8 \text{ PM} \end{aligned}$$

- ▶ Production rates can be obtained from:
 - ❖ Industry benchmarks
 - E.g., (US 97) 31 LOC / PD; (CND 97) 62 LOC / PD
 - ❖ Your own historical data


The Fact

Below is the conversation between two computer science students, James and Adam.



Can we say that the 200,000-LOC project just require twice the effort as compared to the 100,000-LOC project?

James



No, that's incorrect. It should be **more than** twice the effort.

Adam

Step 3: From Effort to Duration

► **An Achievable Duration = $3.0 \times (\text{Effort})^{\frac{1}{3}}$**

❖ $3.0 \times 46.8^{(.33)} = 10.7 \text{ months}$

Step 4: From Duration to Team Size (Roughly)

▶ A Probable Team Size = Effort / Duration

- ❖ 46.8 PM / 10.7 months = 4.4 people
(i.e., the amount of effort is equally divided amongst a number of people)

FP Practice Sheet:

Factors	Weights		
	<i>Simple</i>	<i>Average</i>	<i>Complex</i>
Number of user inputs	3	4	6
Number of user outputs	4	5	7
Number of user inquiries	3	4	6
Number of files	7	10	15
Number of external interfaces	5	7	10
Unadjusted FP total			
Adjusted FP total			
Effort			
Duration			
Team size			

FP Practice: Find the Team Size

- A system being developed has the following characteristics:

Number of user inputs	10 (simple)
Number of user outputs	7 (simple)
Number of user inquiries	3 (average)
Number of files	6 (average)
Number of external interfaces	1 (complex)
Influence Multiplier	0.68
C++ LOC to FP	29 per FP
Production rate	640 LOC per PM

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Unadjusted FP total			
Adjusted FP total			
Effort			
Duration			
Team size			

Number of user inputs	10 (simple)
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Number of files	6 (average)
Number of external interfaces	1 (complex)
Influence Multiplier	0.68
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FP Practice Sheet:

Factors	Weights		
	<i>Simple</i>	<i>Average</i>	<i>Complex</i>
Number of user inputs	$3 \times 10 = 30$	4	6
Number of user outputs	$4 \times 7 = 28$	5	7
Number of user inquiries	3	$4 \times 3 = 12$	6
Number of files	7	$10 \times 6 = 60$	15
Number of external interfaces	5	7	$10 \times 1 = 10$
Unadjusted FP total	$58 + 72 + 10 = 140$		
Adjusted FP total	95.2		
Effort	4.31 PM		
Duration	4.86 months		
Team size	0.887		