Test Effort Estimation

Time and Cost involved in Testing Process

Software Effort Estimation

$$\text{Effort} = a \times (\text{KLOC})^{b} \text{ , unit=person-months}$$

$$\text{Development Time} = c \times (\text{Effort})^{d} \text{ , unit=months}$$

$$\text{Average Staff Size} = (\text{Effort}) / (\text{Development Time}), \text{ unit=persons}$$

$$\text{Productivity} = (\text{KLOC}) / (\text{Effort}) \text{ , unit} = \text{kloc/person-month}$$

Mode	a	b	c	d
organic	2.4	1.05	2.5	0.38
semi-detached	3.0	1.12	2.5	0.35
Embedded	3.6	1.20	2.5	0.32

Given below are two statements:

Statement I : Software testing must be recognized as a significant effort, and its planning must begin at the earliest possible time.
Statement II: The cost of software testing is an important contribution in determining overall software development costs.

If every requirement can be checked by a cost-effective process, then SRS called Verifiable

tracing each defect to its underlying cause, isolating the vital few causes, and moving to correct them

Suppose that a Basic project was estimated to be 400 KLOC (kilo lines of code). Calculate effort and time for each of the three modes of development. All the constants value provided in the following table:

1. for organic mode,
   - effort = $2.4 \times (400)^{1.05} \approx 1295$ person-month.
   - dev. time = $2.5 \times (1295)^{0.38} \approx 38$ months.
2. for semi-detach mode,
   - effort = $3 \times (400)^{1.12} \approx 2462$ person-month.
   - dev. time = $2.5 \times (2462)^{0.35} \approx 38$ months.
3. for Embedded mode,
   - effort = $3.6 \times (400)^{1.20} \approx 4772$ person-month.
   - dev. time = $2.5 \times (4772)^{0.32} \approx 38$ months.

1. What is the **Functional Point?**

To measure the standard worth of the software, as a unit of software worth, Function Point was developed.

Allan Albrecht of IBM in 1977.

FP measures functionality from the User's point of view like what the user receives from the software and what the user requests from the software. It focuses on what functionality is being delivered.

"A Functional Point" is a unit of measurement to express the amount of business functionality an information system provides to a user. - Wiki

Using historical data, the FP metric can then be used to

1. Estimate the cost or effort required to design, code, and test the software.

2. Predict the number of errors that will be encountered during testing

3. Forecast the number of components and/or the number of projected source lines in the implemented system.

The five functional units to calculate the FP are.

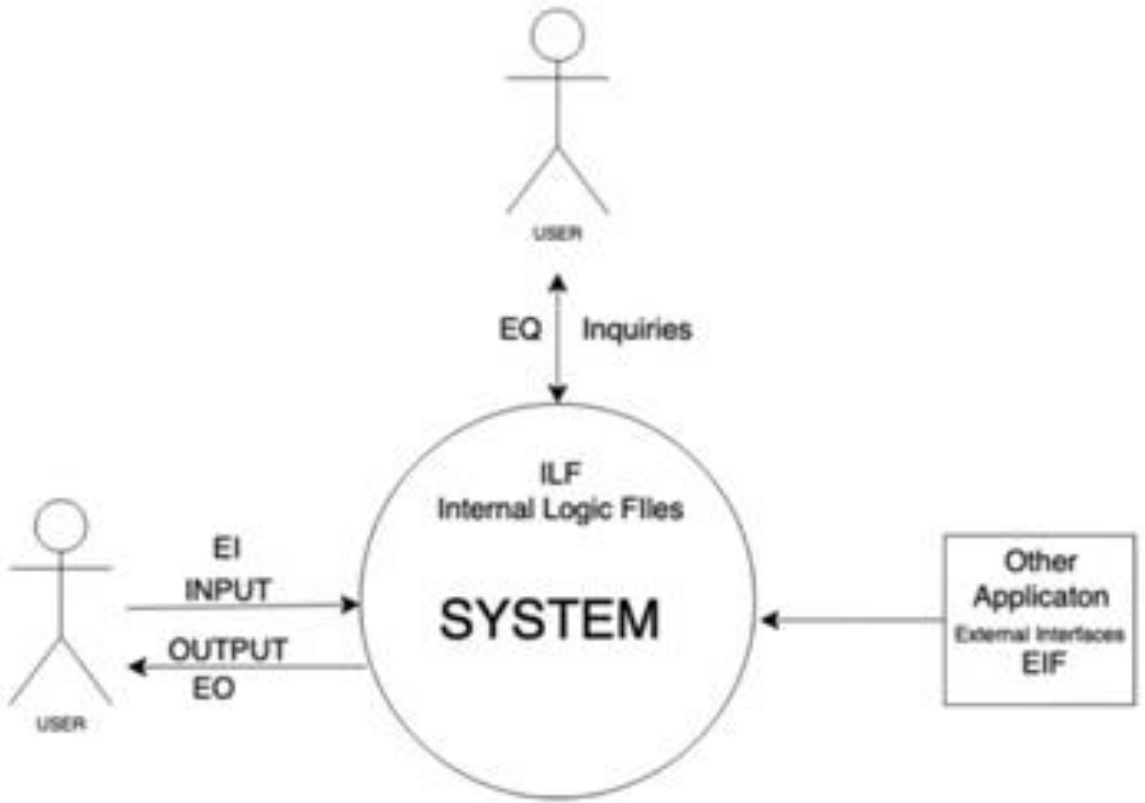
1. Internal Logic Files (ILF) – The control info or logically related data that is present within the system.
2. External Interface Files (EIF) – The control data referenced by the system but present in another system.
3. External Inputs (EI) – Data / control info that comes from outside our system
4. External Outputs (EO) – data that goes out of the system after generation
5. External Enquired (EQ) – Combination of i/o – o/p resulting data retrieval

$$F.P = UFP \ X \ CAF$$

Where,

$UFP = Unadjusted\ Functional\ Point$

$CAF = Complexity\ Adjustment\ Factor$



Functional Unit	Wighting Factors		
	Low	Average	High
External Inputs (EI)	3	4	6
External Outputs (EO)	4	5	7
External Enquired (EQ)	3	4	6
Internal Logic Files (ILF)	7	10	15
External Interface Files (EIF)	5	7	10

Measurement Parameter	Counts		Weighting Factor Low	Average	High		
External Inputs (EI)		X	3	4	6	=	
External Outputs (EO)		X	4	5	7	=	+
External Enquired (EQ)		X	3	4	6	=	+
Internal Logic Files (ILF)		X	7	10	15	=	+
External Interface Files (EIF)		X	5	7	10	=	+

Unadjusted Function Points (UFP) = Total Count =

UFP = Sum of all the Complexities of all the EI's, EO's, EQ's, ILF's, and EIF's

$$CAF = 0.65 + (0.01 \times \Sigma Fi)$$

Where,

Fi = *Value adjustment factors based on responses to the following 14 questions*

Complexity Adjustment Factor

1. Data Communication
2. Distributed Data Processing
3. Performance
4. Heavily Used Configuration
5. Transaction Role
6. Online Data Entry
7. End-User Efficiency
8. Online Update
9. Complex Processing
10. Reusability
11. Installation Ease
12. Operational Ease
13. Multiple Sites
14. Facilitate Change

Complexity Adjustment Factor is calculated using 14 aspects of processing complexity and these 14 questions answered on a scale of 0 – 5

0 - No Influences or No Important

1 - Incidental

2 - Moderate

3 - Average

4 - Significant

5 - Essential

$$\text{Productivity} = \frac{\text{FP}}{\text{Effort}} \qquad \text{Cost per function} = \frac{\text{cost}}{\text{productivity}}$$

Test Estimation?

How long will this testing take?

How much will it cost?

How to estimate?

Work Breakdown Structure (WBS)

- Breaking down the test project into small pieces

Three Point Estimation

- Estimation method is based on statistical data

Functional Point Method

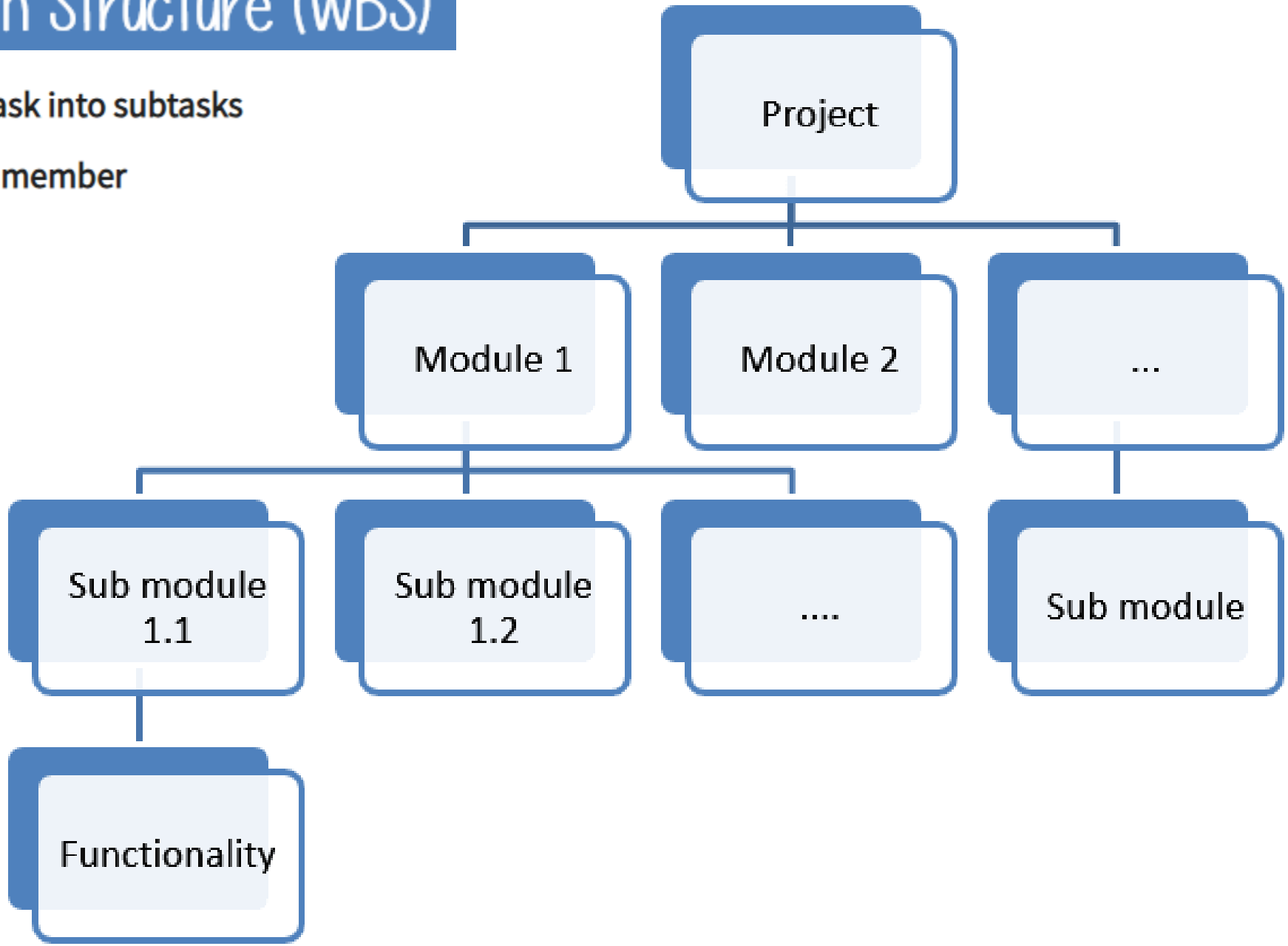
- Measure the size and give weightage to each function point

Work Breakdown Structure (WBS)

Divide the whole project task into subtasks

Allocate each task to team member

Effort Estimation For Tasks



Effort Estimation For Tasks

1. **Functional Point Method**
2. **Three Point Estimation**

Method 1) Function Point Method

In this method, the Test Manager estimates Size, Duration, and Cost for the tasks

Step A) Size "Create the test specification"

Step B) Duration

Step C) Cost

Group	Weightage
Complex	5
Medium	3
Simple	1

The website is divided into **12 function** points, you can determine the **complexity** of each function points as follows

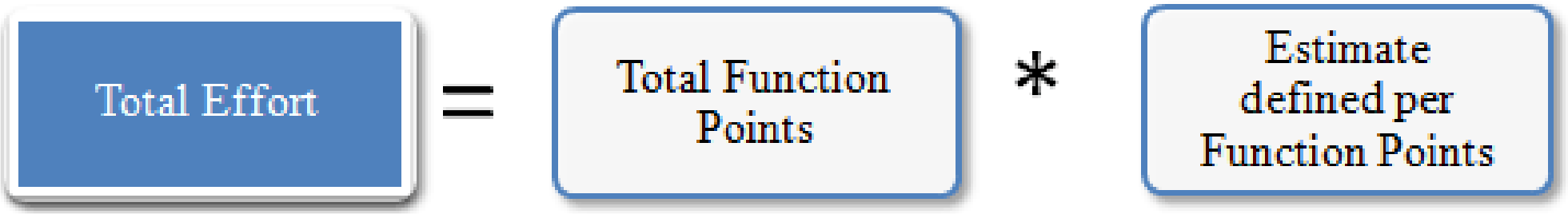
No.	Module Name	Applicable Roles	Description	Weightage
1.	Balance Enquiry	Manager Customer	**Customer:**A customer can have multiple bank accounts. He can view balance of his accounts only **Manager:** A manager can view balance of all the customers who come under his supervision	3
2.	Fund Transfer	Manager Customer	**Customer:**A customer can have transfer funds from his “own” account to any destination account. **Manager:** A manager can transfer funds from any source bank account to destination account	5
			A Mini statement will show last 5 transactions of an account	

3.	Mini Statement	Manager Customer	**Customer:**A customer can see mini-statement of only his “own” accounts **Manager:** A manager can see mini-statement of any account	3
4.	Customized Statement	Manager Customer	A customized statement allows you to filter and display transactions in an account based on date, transaction value **Customer:**A customer can see Customized-statement of only his “own” accounts **Manager:** A manager can see Customized - statement of any account	5
		..	**Customer:**A customer can change password of only his account.	

8.	Edit Account	Manager	**Manager:** A manager can add an edit account details for an existing account	1
9.	Delete Account	Manager	**Manager:** A manager can add a delete an account for a customer.	1
10.	Delete Customer	Manager	A customer can be deleted only if he/she has no active current or saving accounts **Manager:** A manager can delete a customer.	1
11.	Deposit	Manager	**Manager:** A manager can deposit money into any account. Usually done when cash is deposited at a bank branch.	3
12.	Withdrawal	Manager	**Manager:** A manager can withdraw money from any account. Usually done when cash is withdrawn at a bank branch.	3

Estimate duration for the task

Total modules of the website



	Weightage	# of Function Points	Total
Complex	5	3	15
Medium	3	5	15
Simple	1	4	4
Function Total Points			**34**
Estimate define per point			**5**
Total Estimated Effort (Person Hours)			**170**

Suppose, on average your team salary is $5 per hour. The time required for “Create Test Specs” task is 170 hours. Accordingly, the cost for the task is 5*170= $850. Now you can calculate budget for other activities in WBS and arrive at overall budget for the project.

Estimate the cost for the tasks

Method 2) Three Point Estimation

based on **prior experience** or **best-guesses** as follows

- **a** — The best-case estimate
- **m** — The most likely estimate
- **b** — The worst case estimate

$$a = 120 \quad m = 170 \quad b = 200$$

double-triangular distribution

$$E = (a + 4m + b)/6$$

$$E = (120 + 4 * 170 + 200)/6$$

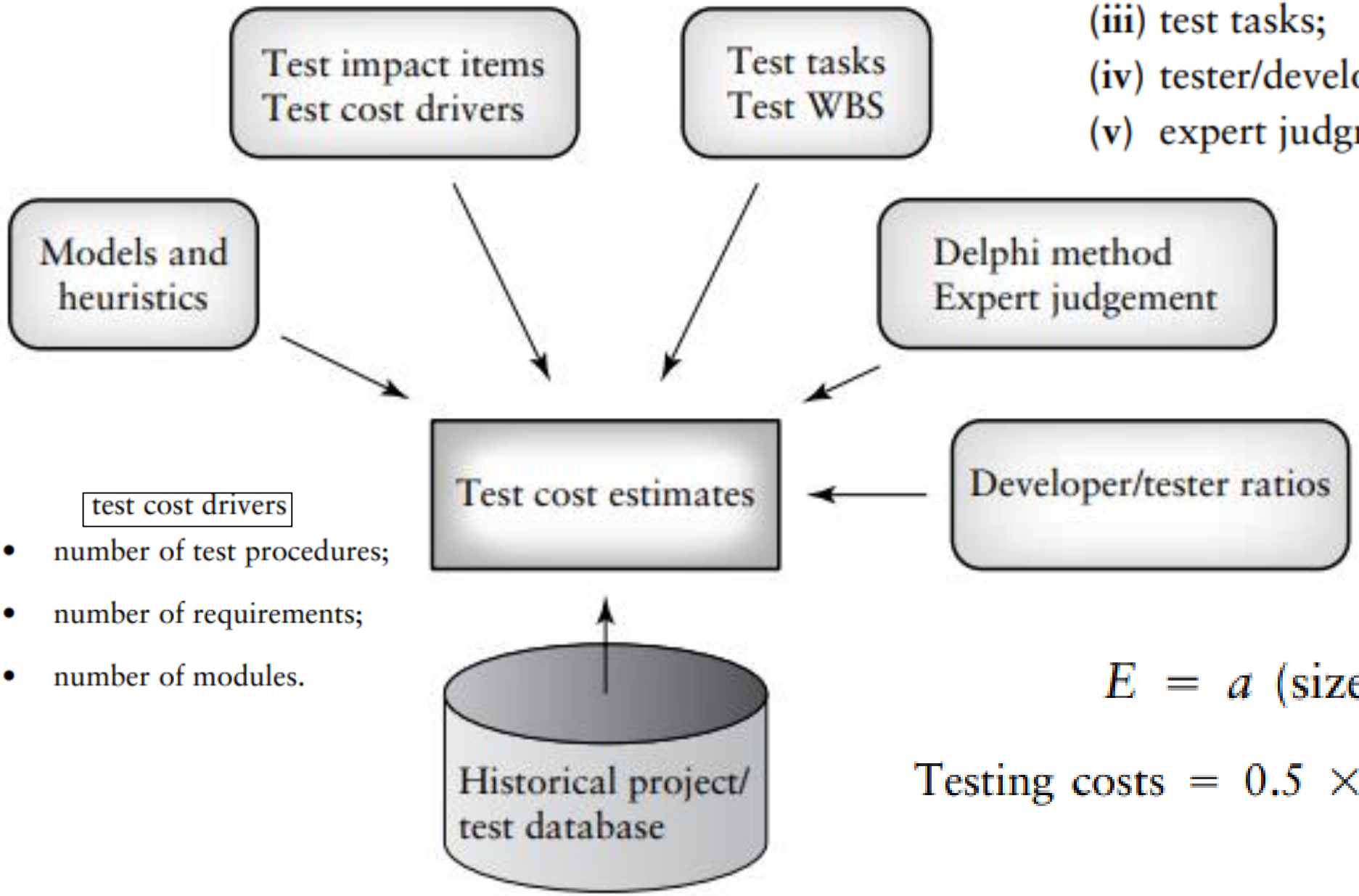
$$E = 166.6\ (man - hours)$$

$$SD = (b - a)/6$$

$$SD = (200 - 120)/6$$

$$SD = 13.33\ (man - hours)$$

(i) the COCOMO model and heuristics;
(ii) use of test cost drivers;
(iii) test tasks;
(iv) tester/developer ratios;
(v) expert judgment (Delphi).



test cost drivers

- number of test procedures;
- number of requirements;
- number of modules.

$$E = a\ (\text{size in KLOC})^b$$

Testing costs = 0.5 × total project costs