

## SOFTWARE ENGINEERING - UNIT II -18BIT41C

**UNIT II:** Software Cost Estimation: Software Cost Factors – Software Cost Estimation Techniques – Staffing-Level Estimation – Estimating Software Maintenance Costs.

# SOFTWARE COST FACTORS

## 1. Programmer Ability

Experiment sackman and colleagues. The goal was to determine the relative influence of batch and time-shared access on programmers productivity.

Ex: 12 programmers given 2 programmes each

11 years experience

productivity variation 16:1

Individual differences in ability can be significant.

## 2. Product complexity

3 categories of software product

- ✓ Application programs
- ✓ Utility programs
- ✓ System programs

Brooks states that utility programs are 3 times as difficult to write as application programs and that systems programs are 3 times as difficult to write utility programs

1(App)-3(utility)-9(System)

## Boehm three levels

PM=programmer months

KDSI= number of thousands of delivered instructions

### Application

$$PM=2.4*(KDSI)**1.05 \longrightarrow \text{Program cost}$$

### Utility

$$PM=2.4*(KDSI)**1.05 \longrightarrow \text{Programmer effort}$$

$$PM=3.0*(KDSI)**1.12$$

### System

$$PM=3.6*(KDSI)**1.20$$

## 3. Product size:

A large software product is obviously more expensive to develop the small one. Boehm's equations indicate that the rate of increase in required effort grows with the number of source instructions at an exponential rate slightly greater than one.

#### 4. Available time:

Total project effort is sensitive to the calendar time available for project completion. Most of them agree that software projects require more total effort if development time is compressed or expanded from the optimal time.

#### 5. Required level of reliability

Software reliability can be defined as the probability that a program will perform a required function under stated conditions for a stated period of time. It can be expressed in terms of accuracy, robustness, completeness, consistency of the source code.

#### Boehm describes five categories

Category	Effect of failure
Very low	Slight inconvenience
Low	Losses easily recovered
Nominal	Moderately difficult to recover losses
High	High financial loss
Very high	Risk to human life

## 6. Level of technology

Software development project is reflected by the programming language, the abstract machine, the programming practices and software tools used. The number of source instructions written per day is largely dependent of the language used, written in HLL, expand into several machine level statements.

### SOFTWARE COST ESTIMATION TECHNIQUES

- ✓ Software cost estimates are based on past performance.
- ✓ Historical data are used to identify cost factors and determine the relative importance and various factors with in the environment of that organization.
- ✓ Cost estimates can be either top-down or bottom-up.
- ✓ Top-down estimation first focuses on system-level costs(such as personal required to develop the system)
- ✓ Bottom-up cost estimation first estimates the cost of develop each module or subsystem.

## 1. Expert judgement

- The most widely used cost estimation technique is expert judgement, which is an inherently top-down estimation technique .
- Expert judgement relies on the experience background and business sense of one or more key people in the organization.

### Advantages

- ✓ Experience can also be a liability.
- ✓ The expert may be confident that the project is similar to a previous one, but may have overlooked some factors that make the new project significantly different.

## 2. Delphi cost estimation

Developed by **Rand corporation in 1948** to gain expert consensus without introducing the adverse side effects.

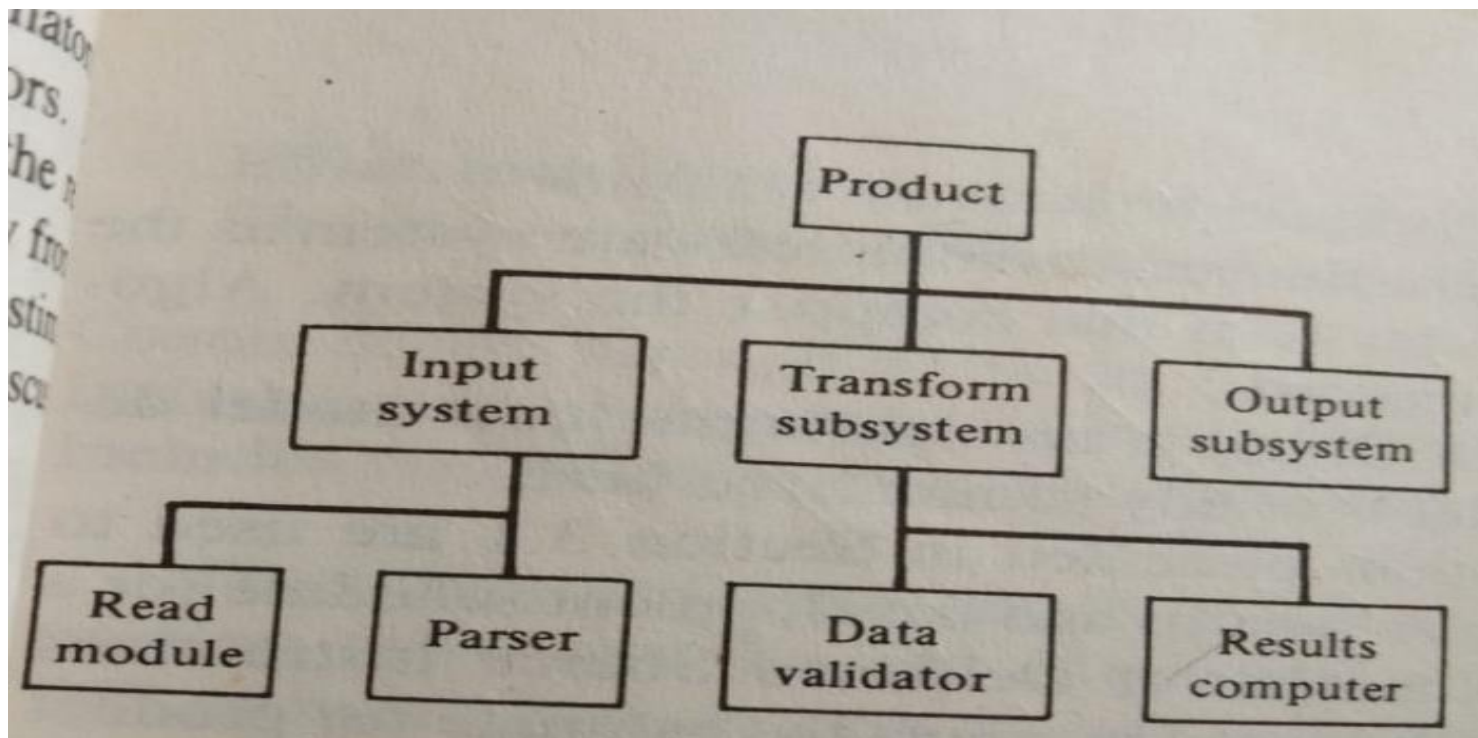
**Delphi technique** can be adapted to software cost estimation in the following manner.

- Coordinator provides each estimator with the system definition document with the system definition document and a form for recording a cost estimate.

- They complete their estimates. They may ask questions of the coordinator but they do not discuss their estimates with one another.
- The coordinator prepared distributes a summary of the estimators, responses and includes any unusual rationales, noted by the estimators.
- Estimators complete another estimate, using the results from the previous estimate.
- The process is iterated for as many rounds as required . No group discussion is allowed during the entire process.

### 3. Work breakdown structure

- ✓ The work break down chart can indicate either product hierarchy or process hierarchy.
- ✓ Product hierarchy identifies the product components and indicates the manner in which the components and interconnected.
- ✓ Process hierarchy identifies the work activities and relationship among activities.



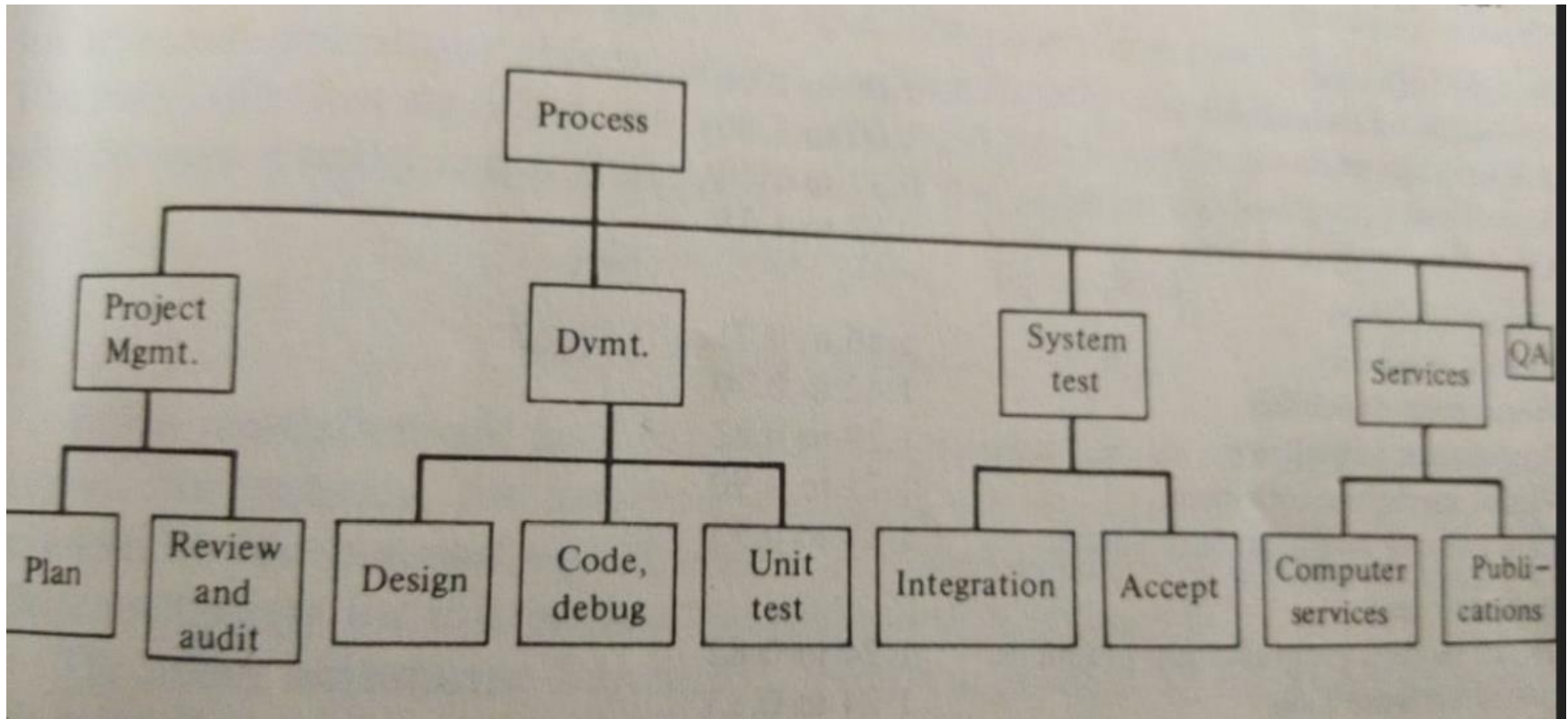
### Product hierarchy

- ✓ Some planners use both product and process hierarchy.

### Advantages

- Work break down structure technique are identifying and accounting for various process and product factors, and is making explicit exactly which costs are included in the estimate.





## Process of work breakdown structure

## 4. Algorithmic cost models

- Bottom-up estimators
- Constructive cost model(COCOMO) is an algorithmic cost model described by bohem
- COCOMO effort multipliers
  - a. Product attributes
  - b. computer attributes
  - c. personal attributes
  - d. project attributes

**Ex:**normal organic mode equations apply in the following types of situations.

Small to medium size projects(2k to 32k) familiar applications area.

Stable, well-understood virtual machine in house development effort.