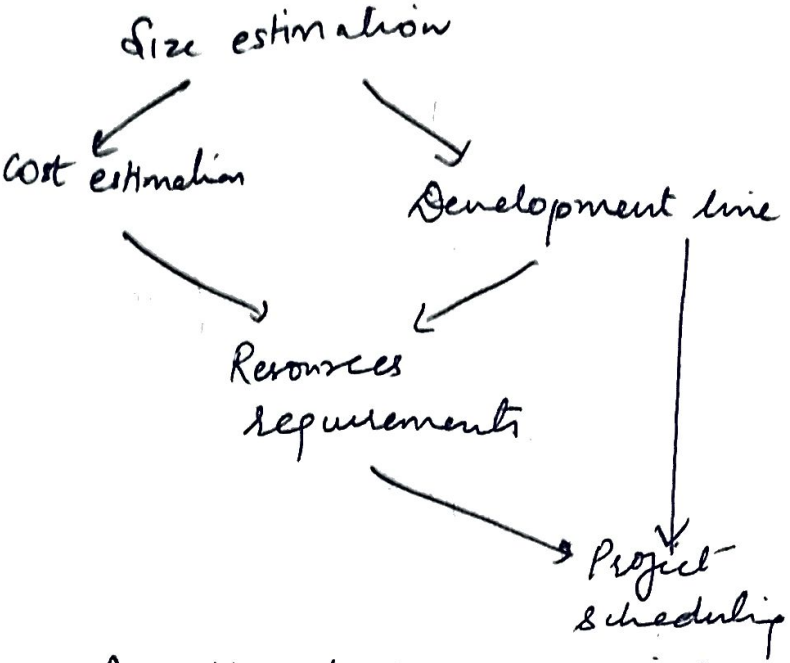
Ch-4

Software Project Planning

Planning starts before technical work starts.

First activity to estimate the size of the project



Activities during SW project planning

Size estimation

A very critical & a difficult area of the project planning.

LOC (Lines of Code)

Metric to estimate the size

It is simply a count of number of lines in code

for eg:

```
int a, b, c;                    — line 1
for (i = 1; i<10; i++)          — line 2
{                               — line 3
    c = a+b;                    — line 4
}                               — line 5
return;                         — line 6
```

This code contains **6 LOC**

LOC Lines of code that is not a comment, or blank lines regardless of the no of statements or fragments on the lines

It includes lines as program headers, declarations and executable & non-executable statements.

Function Count

Talking in terms of functions available

A technique called FPA (function Point Analysis)

FPA measures functionality from the users point of view that is what users requests & receives in return

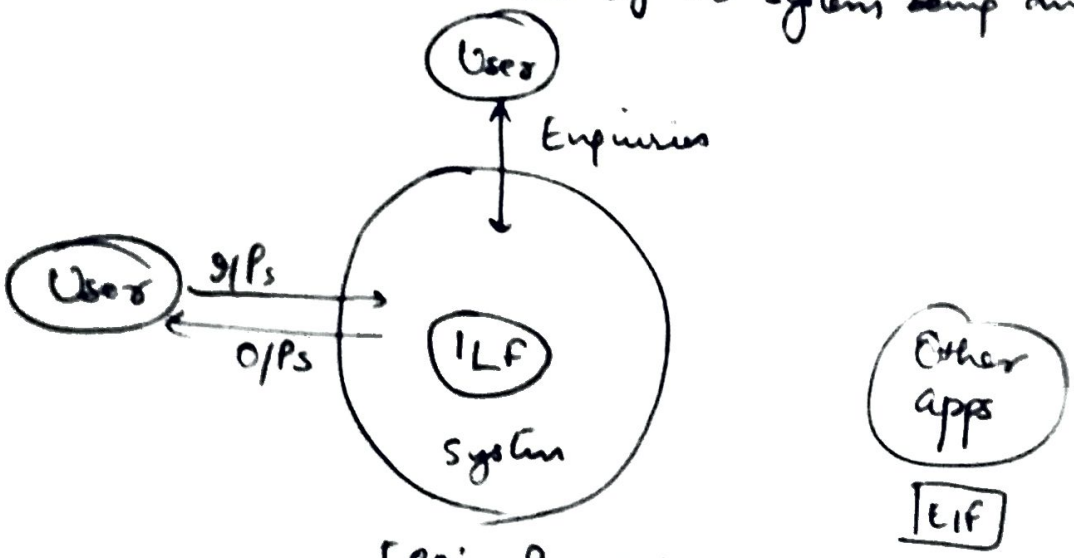
Differences b/w LOC & FPA

LOC	FPA
→ deals with lines of code	deals with functionality being delivered
→ Size measurement is dependent on technology used	Size measurement is independent of the technology used

for eg: different no of lines of code when same program executed in python

FPA → Here, system divided into functional units

1. Inputs - info entering the system
2. Outputs - info leaving the system
3. Enquiries - requests for access to any info
4. ILF (Internal logical files) - info held within the system
5. EIF (External Interface files) - info held by other systems that is used by the system being analysed



FPA's functional units

Above 5 divided into 2 categories

Data function types
1. ILF
2. EIF

Transactional function types
1. I/P
2. O/P
3. Enquiry

UFP Unadjusted function Point

$$UFP = \sum_{i=1}^{5} \sum_{j=1}^{3} z_{ij} w_{ij}$$

FU	Weigh	
	low	Avera
EI	3	4
EO	4	5
EQ	3	4
ILF	7	10
EIF	5	7

Table 1

w_{ij} - entry of i^{th} row & j^{th} column

z_{ij} = count of no of functional units of type i corresponding to complexity column j

i = 1 - 5 —
1. EI (External I/Ps)
2. EO (External O/Ps)
3. EQ (External Inquiries)
4. ILF (Internal Logical files)
5. EIF (External Interface files)

j = 1 - 3 —
1. Low
2. Average
3. High

CAF = complexity adjustment factor.

$$CAF = [0.65 + 0.01 \times \sum f_i]$$

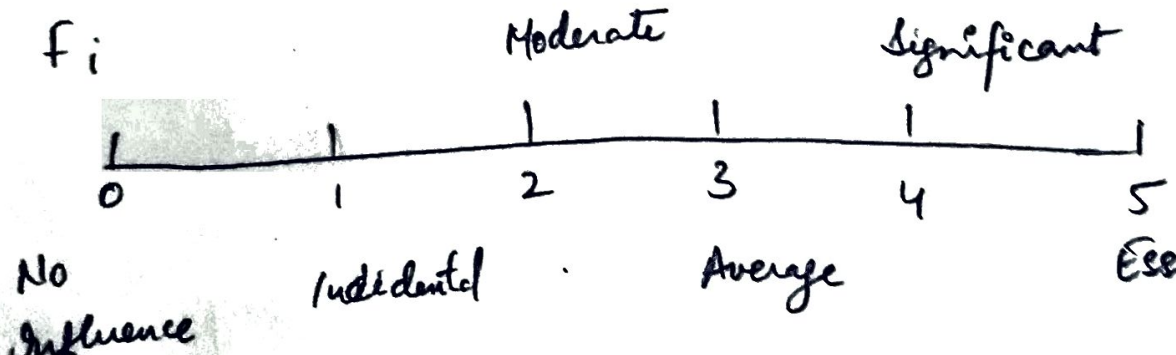


Table 2

formula for calculating function point

$$FP = UFP * CAF$$

$$UFP = \sum_{i=1}^{c} \sum_{j=1}^{3} Z_{ij} w_{ij}$$

$$CAF = 0.65 + 0.01 * \sum f_i$$

f_i = degree of influence (1 to 14)

(Refer Table 1
Weighting factor w_{ij} = Average

CAF = Average (value = 1)
(Refer Table 2)

Q

EI = 50

EO = 40

EQ = 35

ILF = 06

EIF = 04

$UFP = 50 \times 4 + 40 \times 5 + 35 \times 4 + 6 \times 10 + 4 \times 7$

$= 628$

$CAF = 0.65 + 0.01 \times [14 \times 3]$

$= 1.07$

$FP = UFP \times CAF$

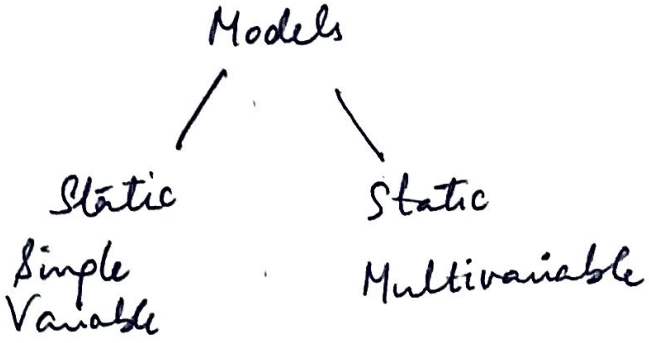
$= 672$

Practice Ex 4.2, Ex 4.3

Cost Estimation

for a new s/w project, cost to develop and development time it will take will be necessary to calculate.

Models



Static simple variable

When a unique variable (size) is taken as the key element for calculating all other variables (cost, time) in the systems.

$$C = aL^b$$

C : cost

L : lines of code

a, b : constants

$$E = 1.4L^{0.93}$$

$$DOC = 30.4L^{0.90}$$

$$D = 4.6L^{0.26}$$

E : effort

Doc: documentation

D : duration

Static Multivariable Models

Actually models depend on several variables like methods used, user participation, memory constraints, etc

WALSTON AND FELIX MODEL

It provides a relationship b/w lines of code (L) & effort (E)

$E = 5.2 L^{0.91}$ → E effort (person-months)

$D = 4.1 L^{0.36}$ → D: duration (months)

Productivity Index

$$I = \sum_{i=1}^{29} W_i X_i$$

W_i = weight factor for i^{th} variable

$X_i = \{-1, 0, +1\}$

COCOMO

[CO : Constructive
CO : cost
MO : Model]

Aims at estimating the cost of the project

Three models are there in this model.

Organic
Semi-detached
Embedded

Read differences b/w three (Refer Pg 153 Table 4.4)

Basic COCOMO equations:

$$E = a_b (KLOC)^{b_b}$$

$$D = c_b (E)^{d_b}$$

E: effort in person-months

D: development time in months

	a	b	c	d
Organic	2.4	1.05	2.5	0.38
Semidetached	3.0	1.12	2.5	0.35
Embedded	3.6	1.20	2.5	0.32

Average staff size = $\frac{E}{D}$ persons

If project size known,

$$P = \frac{KLOC}{E} = KLOC/PM$$

~~Group~~

Q KLOC = 400 KLOC [Refer Pg 154 table]

Effort = ?

Development time?

for three modes - ? Organic - ?
Semidetached - ?
Embedded - ?

Organic

$$E = a(KLOC)^b$$

$$= 2.4 (400)^{1.05} = 1295.31 PM$$

~~D = c (KLOC~~

$$D = c(E)^d$$

$$= 2.5 (1295.31)^{0.38} = 38.07 \text{ M}$$

$$\text{Average staff size} = \frac{E}{D} = \frac{1295.31 \text{ PM}}{38.07 \text{ M}}$$

$$= \_\_\_\_ \text{ persons}$$

$$\text{Productivity} = \frac{KLOC}{E} = \frac{1100}{1295.31} = \_\_\_\_ \text{ KLOC/PM}$$

Intermediate Model

COCOMO basic model → only estimated rough & quick development time, etc

This model → added 15 predictors called cost drivers to take of of SW development environment.

Cost driven - used to adjust the nominal cost of a project, to increase the accuracy of the project

1. Product attributes
2. Computer attributes
3. Personnel attributes
4. Project attributes

Intermediate COCOMO equations

$$E = a(KLOC)^b \times EAF$$

$$D = c(E)^d$$

	a	b	c	d
Organic	3.2	1.05	2.5	0.38
Semidetached	3.0	1.12	2.5	0.35
Embedded	2.8	1.20	2.5	0.32

Detailed COCOMO

It processes all the project characteristics to construct a s/w estimate. This model introduces two more capabilities:

1. Phase-sensitive effort multipliers:

Some phases like design, test more affected than others by factors defined by cost drivers.

It helps in determining the manpower allocation for each phase of the project.

2. Three-level product hierarchy

Three product levels defined:

Module, Subsystem & System levels.

Rating of cost drivers is done at the level at which it is more prone to ~~rate~~ variation.

S/W development carried in four successive phases:

Plans/Requirements : Reqmts analyzed, product plan set up & specification documented

Product design : Determination of architecture & specification of product

Programming : Detailed design
Code / unit Test

Integration / Test : Putting tested parts together & then testing the final product.

Adv of COCOMO

1) Highly calibrated model based on previous experience
2) Easy to use & documented properly.

Read COCOMO-II Early Design Model

Disadv

1) Ignores safety & security issues.
2) Ignores H/W and customer related issues.
3) No involvement & response of customer is taken.

PUTNAM RESOURCE ALLOCATION MODEL

Introduced Rayleigh curve.
Representation for S/W subsystem development
Representing manpower (Persons/time) as function of time.
expressed in (PY/YR) → person-year / year

$$m(t) = \frac{dy}{dt} = 2kate^{-at^2} \quad -(1)$$

$\frac{dy}{dt}$ = manpower utilization rate per unit time

t : elapsed time

a : parameter effecting the shape of the curve

K : area under the curve $[0, \infty]$

Integrating above

$$y = K\left[1 - e^{-at^2}\right] \quad -(2)$$

$$y(0) = 0$$

$$y(\infty) = K$$

which means

Cumulative manpower → null at the start of the project

Cumulative manpower → grows monotonically towards the total effort K.

Differentiating (1)

$$\frac{d^2y}{dt^2} = 2Kae^{-at^2}\left[1 - 2at^2\right] = 0$$

$$td^2 = \frac{1}{2a}$$

td = denotes the time where max effort rate occurs

$$E = K\left(1 - e^{-0.5}\right) = 0.3935K$$

$$\& \; a = \frac{1}{2td^2}$$

$$m(t) = \frac{K}{td^2} t_e^{\frac{-t^2}{2td^2}}$$

$$\therefore m_o = \frac{K}{t_d \sqrt{e}}$$

K = total project cost

t_d = delivery time

m_o = numbers of persons employed at the peak

Software Risk Management

Important area in S/W industry. to reduce happening of unexpected things.

Mainly deals with a concern befor it becomes a crisis.

Therefore, a key part of the planning process and highlights the specific risk areas.

Risk

Problem that could cause some loss or threaten the success of the project, but which has not happened yet.

Types of Risks.

1. Dependencies : Risks arise due to dependencies of one project on outside agencies.

2. Requirement issues: Of product requirements are not clear in the beginning stage, requirement are frequently changing, not prioritized properly.

3. Management issues
It includes: inadequate planning & risk identification, unclear project ownership & decision making, poor communication staff conflicts, etc

4. Lack of knowledge
It includes: inadequate training, poor understanding of tools, techniques & methods, inadequate application domain experience

5. Other categories
Unavailability of adequate testing facilities, unachievable performance requirements, etc.

Risk Management Activities

Risk Management
- Risk assessment
  - Risk Identification
  - Risk Analysis
  - Risk prioritization
- Risk control
  - Risk Management Planning
  - Risk Monitoring
  - Risk Resolution

also Read Ch-6.1, 6.2, 6.3, 6.4