Project Estimation

Project Planning ➜ Project Estimation

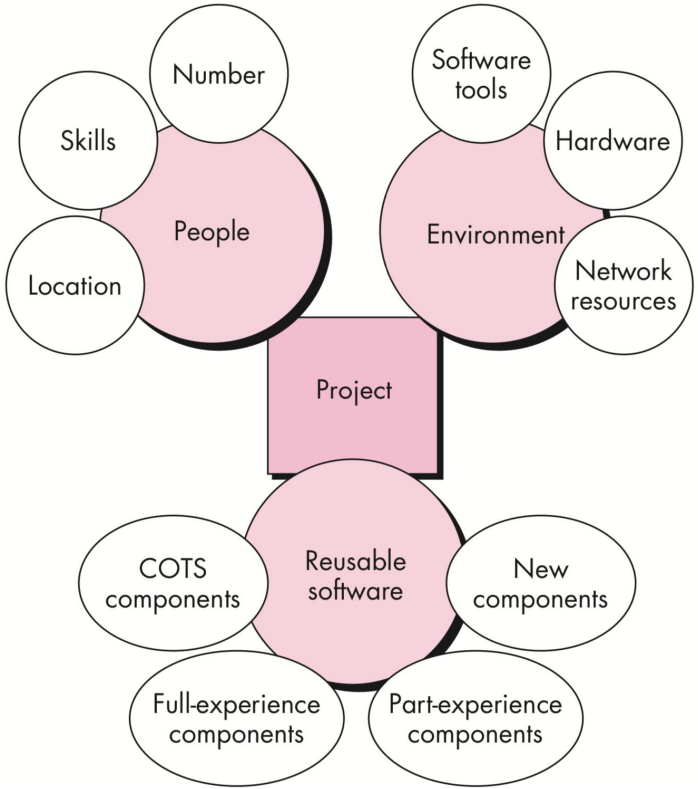
- Project management starts with Project Planning
- Project Planning involves
  - Estimation
  - Scheduling
  - Risk Analysis
  - Quality Management Planning
  - Change Management Planning

Estimation

Estimation of

- Resources
- Cost
- Time

Estimation of Resources



Estimation of Cost and Time (Effort)

- **Decomposition Technique**

Decomposes a project into major functions and related software engineering activities. This information is used to estimate the cost and effort.

- **Empirical Estimation Models**

These models are based on experience (historical data) which takes the form

$$d = f(v_i)$$

where v_i are independent parameters and d is one of the estimated values (eg. effort, cost, project duration)

Decomposition: LOC Based Estimation

E-commerce website

Function	Estimated LOC
User Interface	5000
Database Management	3000
Payment functionalities	2000
Estimated Lines of Code	10000

Based on historical information average productivity of the organization is 620 LOC/pm

Labour rate is $8000. i.e $13 per line

Total estimated project cost is $1,30,000 and effort is 17 person-months

Decomposition: Function Point (FP) based Estimation

Function Point Metrics

Number of user (external) inputs
Number of user (external) outputs
Number of user (external) inquiries
Number of files
Number of external interfaces

Information Domain Value	Count		Weighting factor Simple	Average	Complex		
External Inputs (EIs)		×	3	4	6	=	
External Outputs (EOs)		×	4	5	7	=	
External Inquiries (EQs)		×	3	4	6	=	
Internal Logical Files (ILFs)		×	7	10	15	=	
External Interface Files (EIFs)		×	5	7	10	=	
Count total	→						

Decomposition: Function Point (FP) based Estimation

Function Point Metrics

$$FP = count\#total \times [0.65 + 0.01 \times \sum F_i]$$

F_i (i= 1 to 14) are value adjustment factors (VAF)

Based on the average productivity (FP/pm) of the organization, cost and effort are estimated.

This estimation focusses on information values rather than software functions

Decomposition: Process based Estimation

The whole process is divided into set of small tasks and effort required to accomplish each task is estimated

Activity →	CC	Planning	Risk analysis	Engineering		Construction release		CE	Totals
Task →				Analysis	Design	Code	Test		
Function									
↓									
UICF				0.50	2.50	0.40	5.00	n/a	8.40
2DGA				0.75	4.00	0.60	2.00	n/a	7.35
3DGA				0.50	4.00	1.00	3.00	n/a	8.50
CGDF				0.50	3.00	1.00	1.50	n/a	6.00
DBM				0.50	3.00	0.75	1.50	n/a	5.75
PCF				0.25	2.00	0.50	1.50	n/a	4.25
DAM				0.50	2.00	0.50	2.00	n/a	5.00
Totals	0.25	0.25	0.25	3.50	20.50	4.50	16.50		46.00
% effort	1%	1%	1%	8%	45%	10%	36%		

CC = customer communication CE = customer evaluation

values in person-months

Empirical Estimation Models

- Empirically derived formulas
- Predict effort as a function of LOC or FP

Structure of such model

$$E = A + B \times (ev)^C$$

E : Effort in person-months
ev : estimation variable (LOC or FP)
A, B, C : empirically derived constants

- An empirical model must be calibrated to reflect local conditions
- Should be tried with completed projects.

Some Empirical Models

LOC oriented models

$E = 5.2 \times (\text{KLOC})^{0.91}$	Walston-Felix model
$E = 5.5 + 0.73 \times (\text{KLOC})^{1.16}$	Bailey-Basili model
$E = 3.2 \times (\text{KLOC})^{1.05}$	Boehm simple model
$E = 5.288 \times (\text{KLOC})^{1.047}$	Doty model for KLOC > 9

FP oriented models

$E = -91.4 + 0.355\ \text{FP}$	Albrecht and Gaffney model
$E = -37 + 0.96\ \text{FP}$	Kemerer model
$E = -12.88 + 0.405\ \text{FP}$	Small project regression model

Estimation models must calibrated for local needs

COCOMO Model

- COnstructive COst MOdel
- Proposed by Barry Boehm in 1981
- It helps to predict the effort and schedule (time required)
- Different COCOMO models are proposed to do cost estimation at different levels

COCOMO Model: Project Categories

Organic: Good experience, small team, less complexity

Semi-detached: Experienced + freshers, team size larger than organic

Embedded: Experienced team, large team, high complexity

COCOMO Model: Formulation

$$Effort = a \times (KLOC)^b$$

$$Duration = C \times (Effort)^d$$

$$Persons = Effort/Duration$$

Software Projects	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

Basic COCOMO Example

LOC = 30,000

Project type = Simple

KLOC= 30

Effort = $2.4 * (30)^{1.05}$ = 85 PM

Duration = $2.5 * (85)^{0.38}$ = 13.5 months

Avg. staffing: 85/13.5 = 6.3 persons

Other COCOMO Models

Basic COCOMO model assumes effort is a function only of LOC

Intermediate Model

Uses various other factors known as cost drivers. 15 cost drivers.

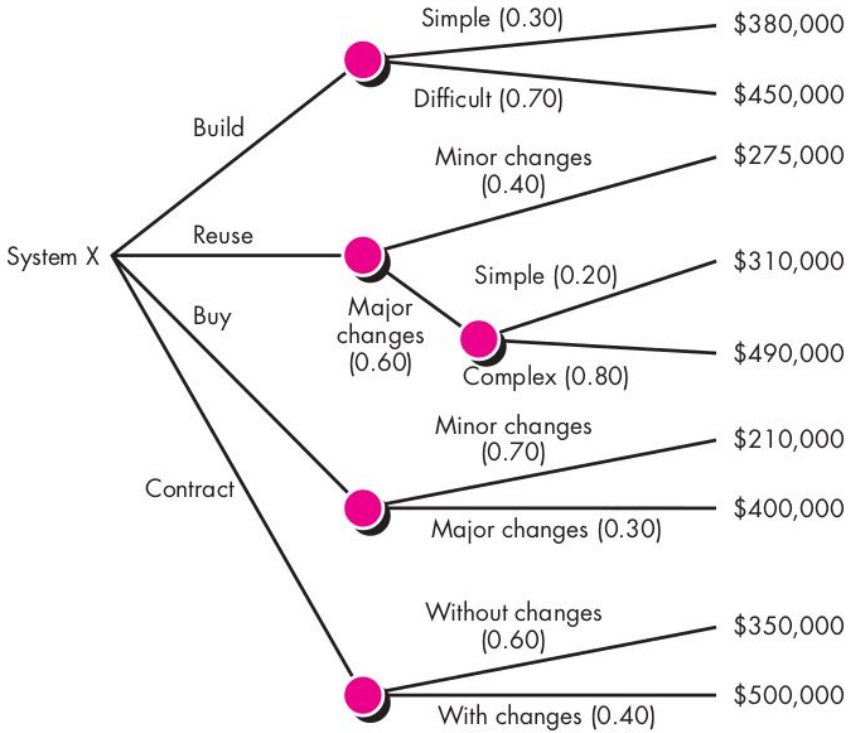
Eg. Size of the application database, complexity of the product, Programming language experience

Detailed Model

Includes all characteristics of Intermediate model, with assessment of impact of cost drivers in each step of software engineering process

Make/Buy Decision

Decision Tree Analysis



$$ExpectedCost = \sum (pathprobability)_i \times (estimatedpathcost)_i$$