

# Noida Institute of Engineering and Technology, Greater Noida

## Software Maintenance and Software Project Management

Unit: V

Software Engineering  
KCS 601

( B Tech 6<sup>th</sup> Sem)



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# Syllabus

Unit	TOPIC
I	Introduction: Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Software Quality Attributes. Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.
II	Software Requirement Specifications (SRS): Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modelling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS. Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model.
III	Software Design: Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures: Halstead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.

# Syllabus

Unit	TOPIC
IV	Software Testing: Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, TopDown and BottomUp Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies: Formal Technical Reviews (Peer Reviews), Walk Through, Code Inspection, Compliance with Design and Coding Standards.
V	Software Maintenance and Software Project management: Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re- Engineering, Reverse Engineering. Software Configuration Management Activities, Change Control Process, Software Version Control, An Overview of CASE Tools. Estimation of Various Parameters such as Cost, Efforts, schedule/Duration, Constructive Cost Models (COCOMO), Resource Allocation Models, Software Risk Analysis and Management.

## Course Objective(Unit-5)

- The ability to engage in life-long maintenance and continuing Software development.
- The ability to work in one or more significant application domains.

# Objective of Topics

TOPIC	Objective
Software Maintenance	To Understand the need of Software Maintenance
Software Project Management	Study of Software Project Management
Cost of Maintenance	To measure the Cost of Maintenance
Software Re- Engineering Reverse Engineering	To understand the Re- Engineering Reverse Engineering
Software Configuration Management	To study the Configuration Management
Estimation of cost and effort Parameters	To Find the cost and effort of the software

At the end of the Course, the student will be able

Course Outcomes (CO)		Bloom's Knowledge Level (KL)
NCS601.1	Explain various software characteristics and analyze different software Development Models.	K1, K2
NCS601.2	Demonstrate the contents of a SRS and apply basic software quality assurance practices to ensure that design, development meet or exceed applicable standards.	K1, K2
NCS601.3	Compare and contrast various methods for software design	K2, K3
NCS601.4	Formulate testing strategy for software systems, employ techniques such as unit testing, Test driven development and functional testing.	K3
NCS601.5	Manage software development process independently as well as in teams and make use of Various software management tools for development, maintenance and analysis.	K3



## CO-PO Correlation Matrices

Correlation levels are taken 1, 2 and 3 as defined below:

**1:** Slight (Low)      **2:** Moderate (Medium)      **3:** Substantial (High)

Software Engineering (Code: KCS-601)									Year of Study: 2020-21			
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>C601.1</b>	2	3	3	3	2	-	-	-	-	-	3	3
<b>C601.2</b>	3	3	3	3	3	-	-	-	-	-	2	3
<b>C601.3</b>	3	2	3	2	2	-	-	-	-	-	3	3
<b>C601.4</b>	2	2	2	2	3	3	-	3	3	-	3	3
<b>C601.5</b>	2	2	3	2	3	3	-	3	-	3	3	3

# CO-PO and PSO Mapping

## Program Specific Outcomes and Course Outcomes Mapping

CO	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	3
CO2	3	3	2	3
CO3	3	3	-	3
CO4	3	3	-	3
CO5	3	3	-	3

\*3= High

\*2= Medium

\*1=Low

# Topic mapping with CO

TOPIC	CO
Software Maintenance	CO5
Software Project Management	CO5
Cost of Maintenance	CO5
Software Re- Engineering Reverse Engineering	CO5
Software Configuration Management	CO5
Estimation of cost and effort Parameters	CO5

## Prerequisite and Recap

- Basic Programming Skills
- Innovative Thinking.
- Enthusiasm to learn Management concepts.

## Software As An Evolutionary Entity (CO5)

- **Software Maintenance** includes **error correction, enhancements of capabilities, deletion of obsolete capabilities & optimization**. As changes cannot be avoided, we should develop mechanism for evaluating, controlling & making modifications. Hence any work done to change the s/w after its operation is considered to be a maintenance work. The term “evolution” has been used with reference to s/w since 1960’s to signify the growth dynamics of s/w.

## Software as an Evolutionary Entity

- Software Maintenance is a very broad activity that includes error corrections, enhancements of capabilities, deletion of obsolete capabilities, and optimization. **As per IEEE**, it is a modification of s/w product after delivery to **correct faults**, to **improve performance** or other attributes or to adapt the product to a modified environment. **As per ISO**, it is a set of activities performed when s/w undergoes modifications to code & associated documentation due to a problem or the need for improvement or adaptation.

## Need For Software Maintenance (CO5)

### Maintenance is needed for:-

- Correct errors.
- Change in user requirement with time.
- Changing hardware/software environment.
- To improve system efficiency
- To optimize the code to run faster
- To modify the components
- To eliminate any unwanted side effects.
- Thus, the maintenance is needed to ensure that the system continues to satisfy user requirements.

# Objective of Software Maintenance

## AIM of Software Maintenance

To correct errors

- To enhance the s/w by changing its functions.
- To update the s/w.
- To adapt the s/w to cope with changes in the environment.



## Categories Of Software Maintenance(co5)

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There are four types of software maintenance:

- ❖ **Corrective maintenance:** This refer to modifications initiated by defects in the software.
- ❖ **Adaptive maintenance:** It includes modifying the software to match changes in the ever changing environment.
- ❖ **Perfective maintenance:** It means improving processing efficiency or performance, or restructuring the software to improve changeability. This may include enhancement of existing system functionality, improvement in computational efficiency etc.

# Categories Of Software Maintenance

- ❖ **Preventive maintenance:** It is the process by which we prevent our system from being obsolete. It involves the concept of reengineering & reverse engineering in which an old system with an old technology is re-engineered using new technology. This maintenance prevents the system from dying out.

## Problems During Maintenance

- The most important problem during maintenance is that before correcting or modifying a program, the programmer must first understand it. Then, the programmer must understand the impact of the intended change.
- Often the program is written by another person or group of persons working over the years in isolation from each other.
- Often the program is changed by person who did not understand it clearly, resulting in a deterioration of the program's original organization. Program listing, even those that are well organized, are not structured to support reading or comprehension.

## Other types of Maintenance

There are long term effects of corrective, adaptive and perfective changes. This leads to increase in the complexity of the software, which reflect deteriorating structure. The work is required to be done to maintain it or to reduce it, if possible. This work may be named as preventive maintenance.

**% Effort**

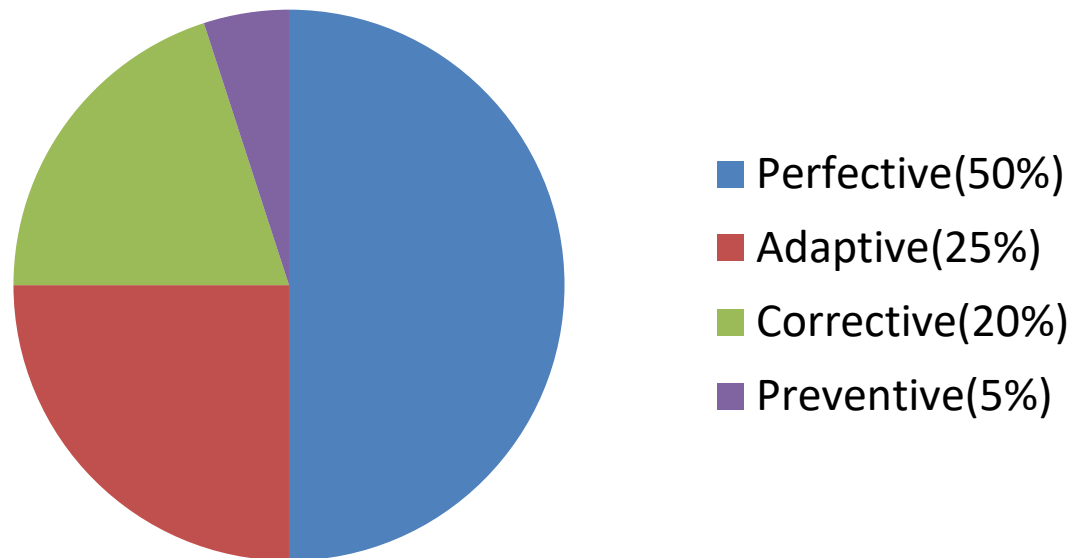


Fig: Distribution of maintenance effort

# Maintenance Process

## Program Understanding

- The first phase consists of analyzing the program in order to understand.

## Generating Particular Maintenance Proposal

- The second phase consists of generating a particular maintenance proposal to accomplish the implementation of the maintenance objective.

## Ripple Effect

- The third phase consists of accounting for all of the ripple effect as a consequence of program modifications.

# Maintenance Process

## Modified Program Testing

- The fourth phase consists of testing the modified program to ensure that the modified program has at least the same reliability level as before.

## Maintainability

- Each of these four phases and their associated software quality attributes are critical to the maintenance process. All of these factors must be combined to form maintainability.

## Cost of maintenance (CO5)

### Estimation of maintenance costs

Phase	Ratio
Analysis	1
Design	10
Implementation	100

### Defect repair ratio

## Belady and Lehman Model

$$M = P + Ke^{(c-d)}$$

where

- M : Total effort expended
- P : Productive effort that involves analysis, design, coding, testing and evaluation.
- K : An empirically determined constant.
- c : Complexity measure due to lack of good design and documentation.
- d : Degree to which maintenance team is familiar with the software.



### Boehm Model

Boehm used a quantity called Annual Change Traffic (ACT).

“The fraction of a software product’s source instructions which undergo change during a year either through addition, deletion or modification”.

$$ATC = \frac{KLOC_{added} + KLOC_{deleted}}{KLOC_{total}}$$

$$AME = ACT \times SDE$$

Where, SDE : Software development effort in person months

ACT : Annual change Traffic

EAF : Effort Adjustment Factor

$$AME = ACT * SDE * EAF$$

### Example –

The development effort for a software project is 500 person months. The empirically determined constant ( $K$ ) is 0.3. The complexity of the code is quite high and is equal to 8. Calculate the total effort expended ( $M$ ) if

- (i) maintenance team has good level of understanding of the project ( $d=0.9$ )
- (ii) maintenance team has poor understanding of the project ( $d=0.1$ )

## Example

### Solution

Development effort (P) = 500 PM

$$K = 0.3$$

$$C = 8$$

(i) maintenance team has good level of understanding of the project ( $d=0.9$ )

$$\begin{aligned} M &= P + Ke^{(c-d)} \\ &= 500 + 0.3e^{(8-0.9)} \\ &= 500 + 363.59 = 863.59 \text{ PM} \end{aligned}$$

(ii) maintenance team has poor understanding of the project ( $d=0.1$ )

$$\begin{aligned} M &= P + Ke^{(c-d)} \\ &= 500 + 0.3e^{(8-0.1)} \\ &= 500 + 809.18 = 1309.18 \text{ PM} \end{aligned}$$

### Example – 9.2

Annual Change Traffic (ACT) for a software system is 15% per year. The development effort is 600 PMs. Compute estimate for Annual Maintenance Effort (AME). If life time of the project is 10 years, what is the total effort of the project ?

## Example

### Solution

The development effort = 600 PM

Annual Change Traffic (ACT) = 15%

Total duration for which effort is to be calculated = 10 years

The maintenance effort is a fraction of development effort and is assumed to be constant.

$$\begin{aligned} \text{AME} &= \text{ACT} \times \text{SDE} \\ &= 0.15 \times 600 = 90 \text{ PM} \end{aligned}$$

$$\text{Maintenance effort for 10 years} = 10 \times 90 = 900 \text{ PM}$$

$$\text{Total effort} = 600 + 900 = 1500 \text{ PM}$$

## Reverse Engineering

Reverse engineering is the process followed in order to find difficult, unknown and hidden information about a software system.

Reverse engineering is the process followed in order to find difficult, unknown and hidden information about a software system.

- ❖ Mapping between concrete and abstract levels
- ❖ Rediscovering high level structures
- ❖ Finding missing links between program syntax and semantics
- ❖ To extract reusable component

## Scope and Tasks

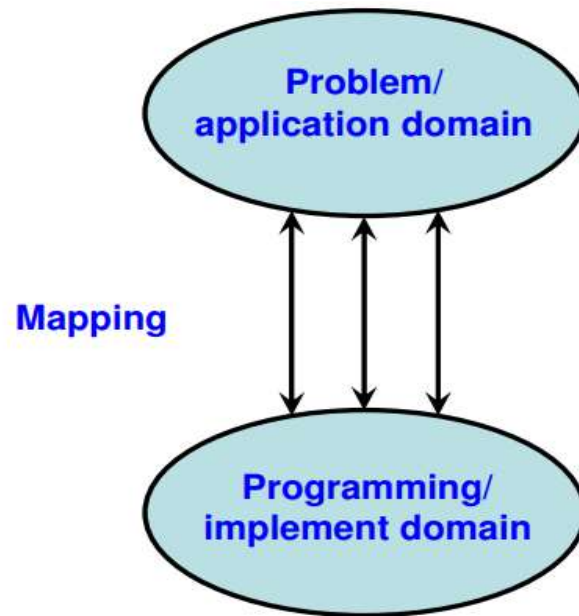
The areas where reverse engineering is applicable include (but not limited to):

1. Program comprehension
2. Re-documentation and/ or document generation
3. Recovery of design approach and design details at any level of abstraction
4. Identifying reusable components
5. Identifying components that need restructuring
6. Recovering business rules, and
7. Understanding high level system description

# Reverse Engineering

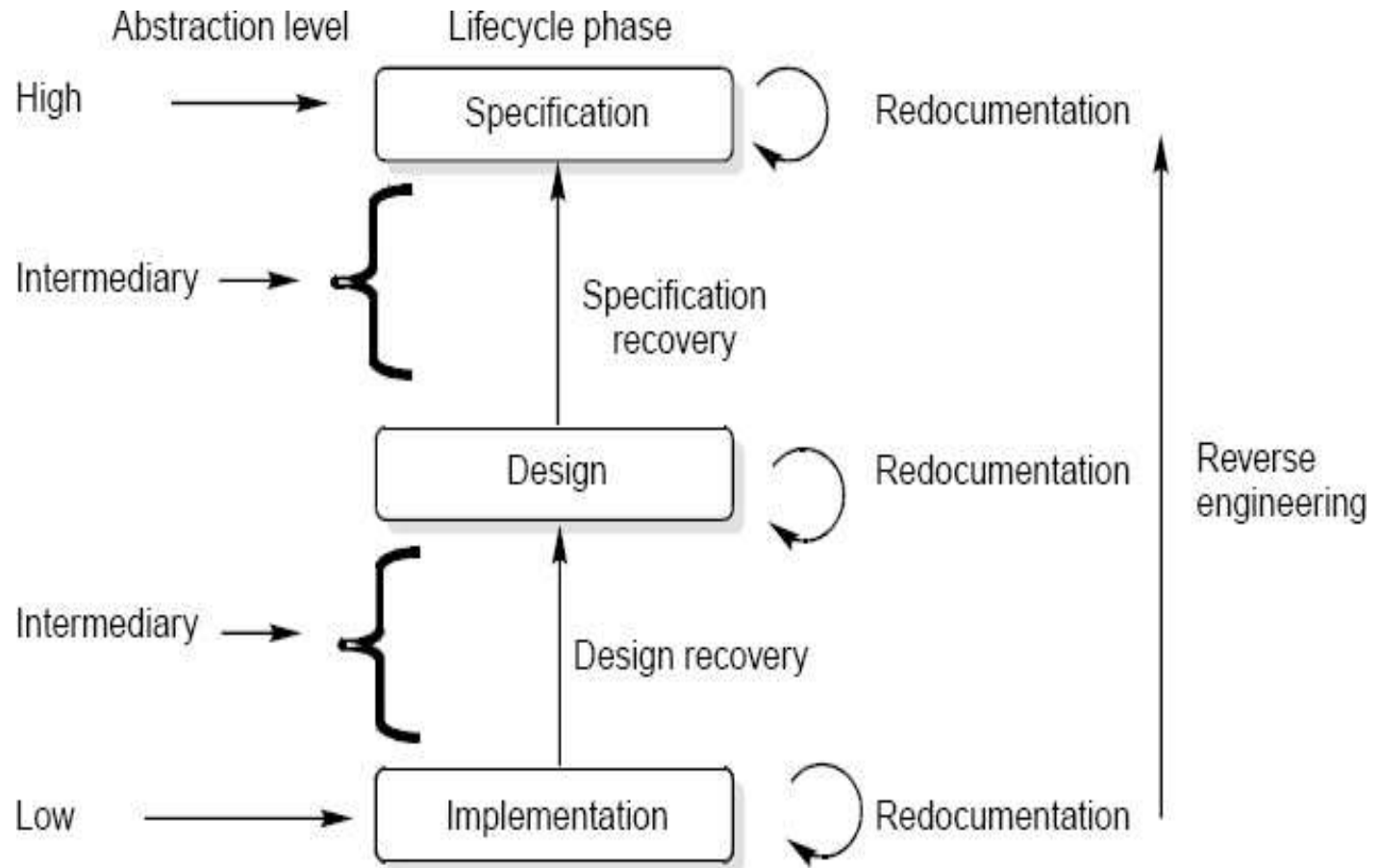
Reverse Engineering encompasses a wide array of tasks related to understanding and modifying software system. This array of tasks can be broken into a number of classes.

- Mapping between application and program domains





# Reverse Engineering



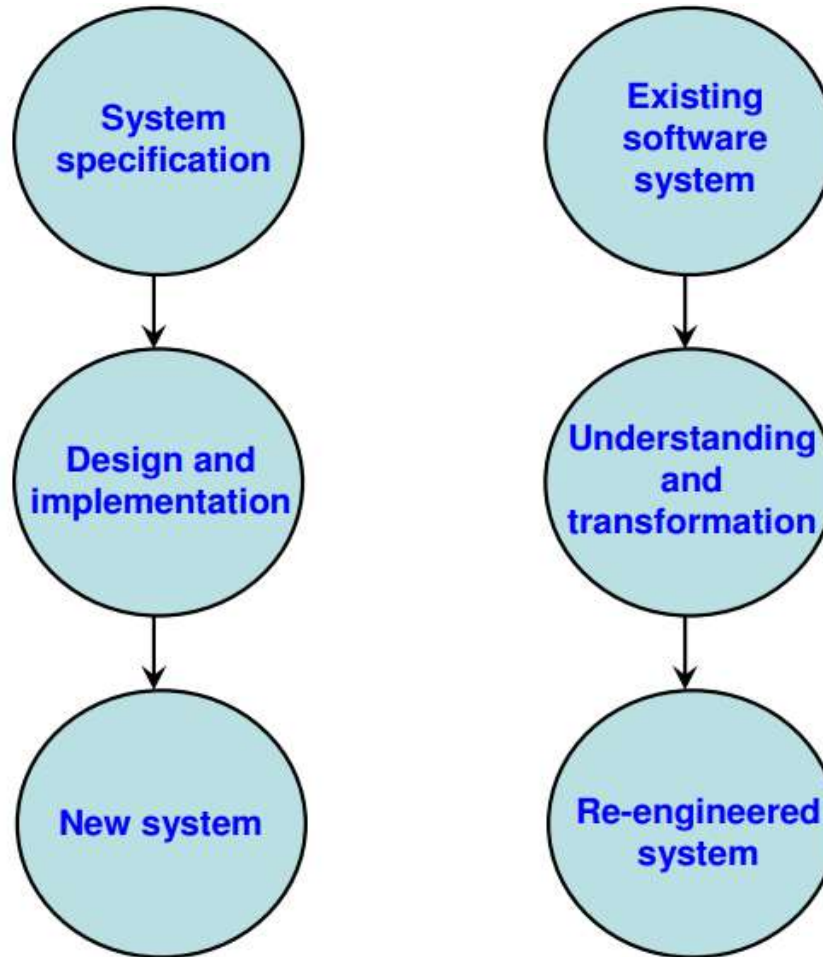
# Reverse Engineering

- In it, the old code is analyzed (abstracted) to extract the module specifications.
  - The module specifications are then analyzed to produce the design.
  - The design is analyzed (abstracted) to produce the original requirements specification.
  - The change requests are then applied to this requirements specification to arrive at the new requirements specification.
  - At the design, module specification, and coding a substantial reuse is made from the reverse engineered products.
- **Advantage**
- it produces a more structured design compared to what the original product had,
  - It produces good documentation, and very often results in increased efficiency.

## RE-Engineering

- Software re-engineering is concerned with taking existing legacy systems and re-implementing them to make them more maintainable.
- The critical distinction between re-engineering and new software development is the starting point for the development as shown in Fig. in next slide

# RE-Engineering



It is the combination of two consecutive process

1. Forward Engineering
2. Reverse Engineering

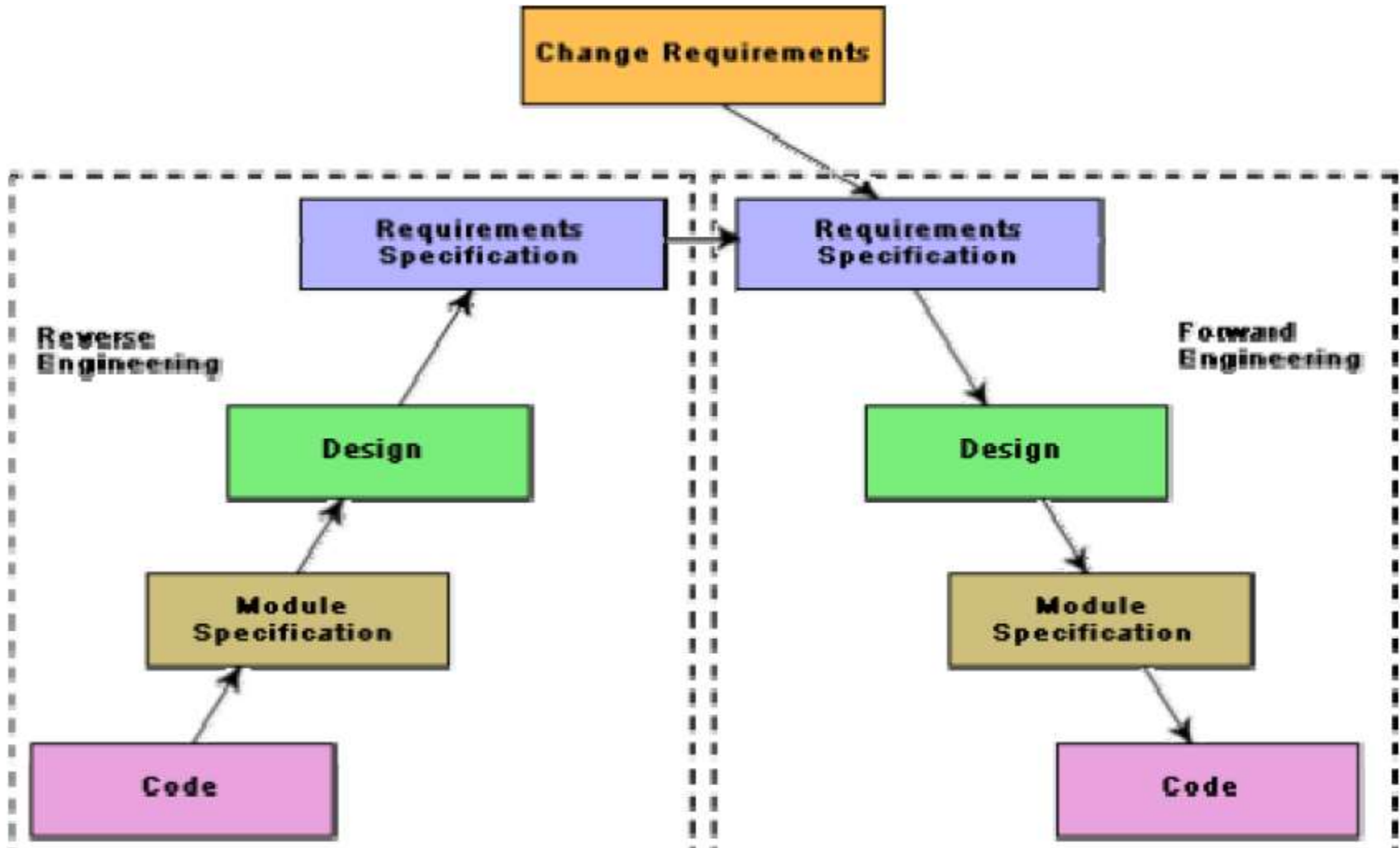
## Objective of -Engineering

- Prepare functional enhancement.
- Improve maintainability.
- Enhance skills of software developers to incorporate newer technologies.
- Improve reliability.
- Apply integration.

### Steps in Re- Engineering

1. Goal setting.
2. Critical analysis of existing scenario such as process, task, design, methods etc.
3. Identifying the problems and solving them by new innovative thinking.

# Re-Engineering



The following suggestions may be useful for the modification of the legacy code:

- ✓ Study code well before attempting changes
- ✓ Concentrate on overall control flow and not coding
- ✓ Heavily comment internal code
- ✓ Create Cross References
- ✓ Build Symbol tables
- ✓ Use own variables, constants and declarations to localize the effect
- ✓ Keep detailed maintenance document
- ✓ Use modern design techniques

# Software Configuration Management (CO5)

## Configuration Management

- SCM is used to controlled the process of software development and software maintenance.
- The configuration management is different in development and maintenance phases of life cycle due to different environments.



# Software Configuration Management Activities

The activities are divided into four broad categories.

- ✓ The identification of the components and changes
- ✓ The control of the way by which the changes are made
- ✓ Auditing the changes
- ✓ Status accounting recording and documenting all the activities that have take place

# Software Configuration Management Activities

The following documents are required for these activities

- Project plan
- Software requirements specification document
- Software design description document
- Source code listing
- Test plans / procedures / test cases
- User manuals

# Software Configuration Management Activities

## Principal Activities of SCM:

1. **Configuration identification:** which parts of a system should keep track of.
- **Configuration control:** ensure change to a system happen smoothly.
- **Necessity of SCM**
  - Inconsistency problem when object is replicated.
  - Problems associated with concurrent accesses.
  - Providing a stable development environment.
  - System accounting and maintaining status.

## Version Control (CO5)

A version control tool is the first stage towards being able to manage multiple versions. Once it is in place, a detailed record of every version of the software must be kept. This comprises the

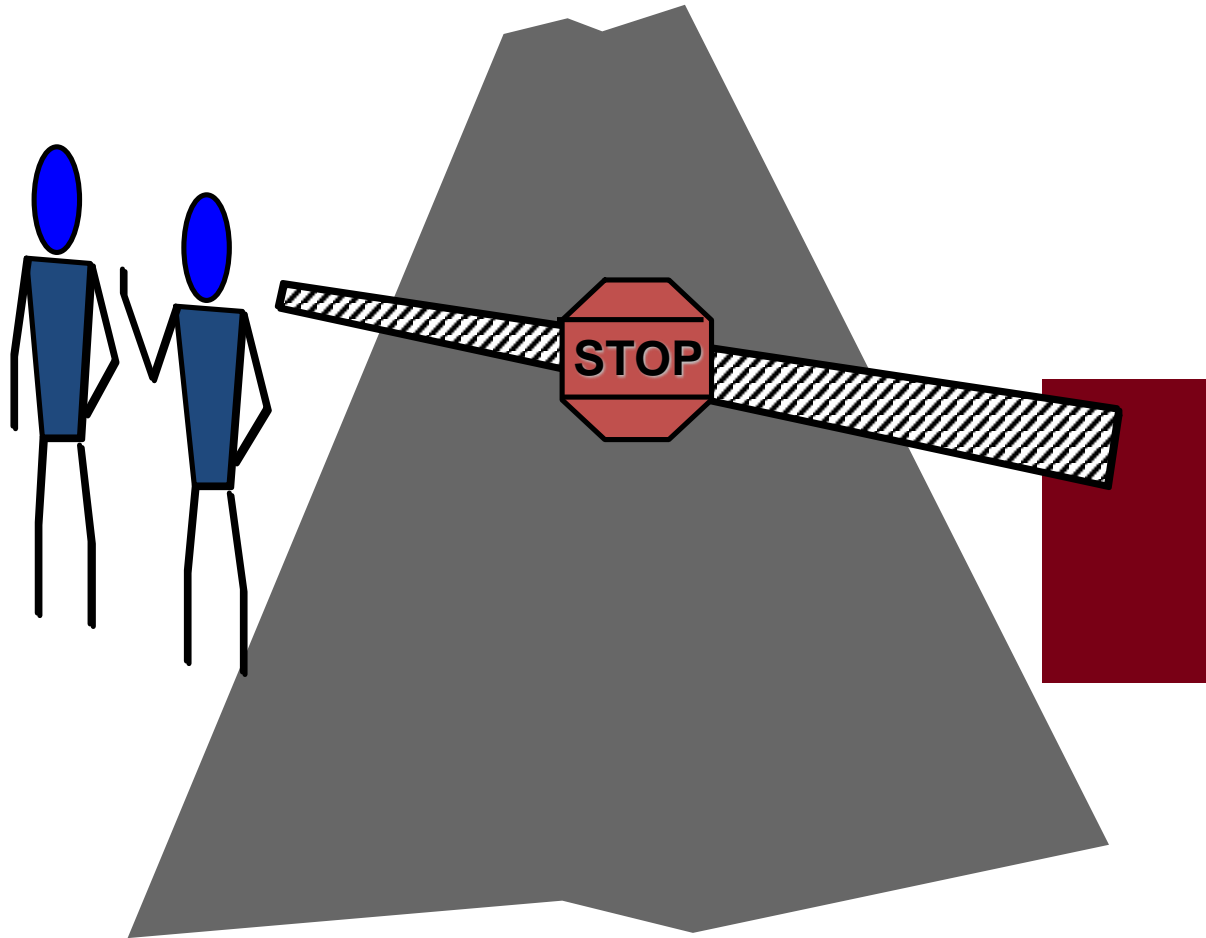
- Name of each source code component, including the variations and revisions
- The versions of the various compilers and linkers used
- The name of the software staff who constructed the component
- The date and the time at which it was constructed

## Change Control Process (CO5)

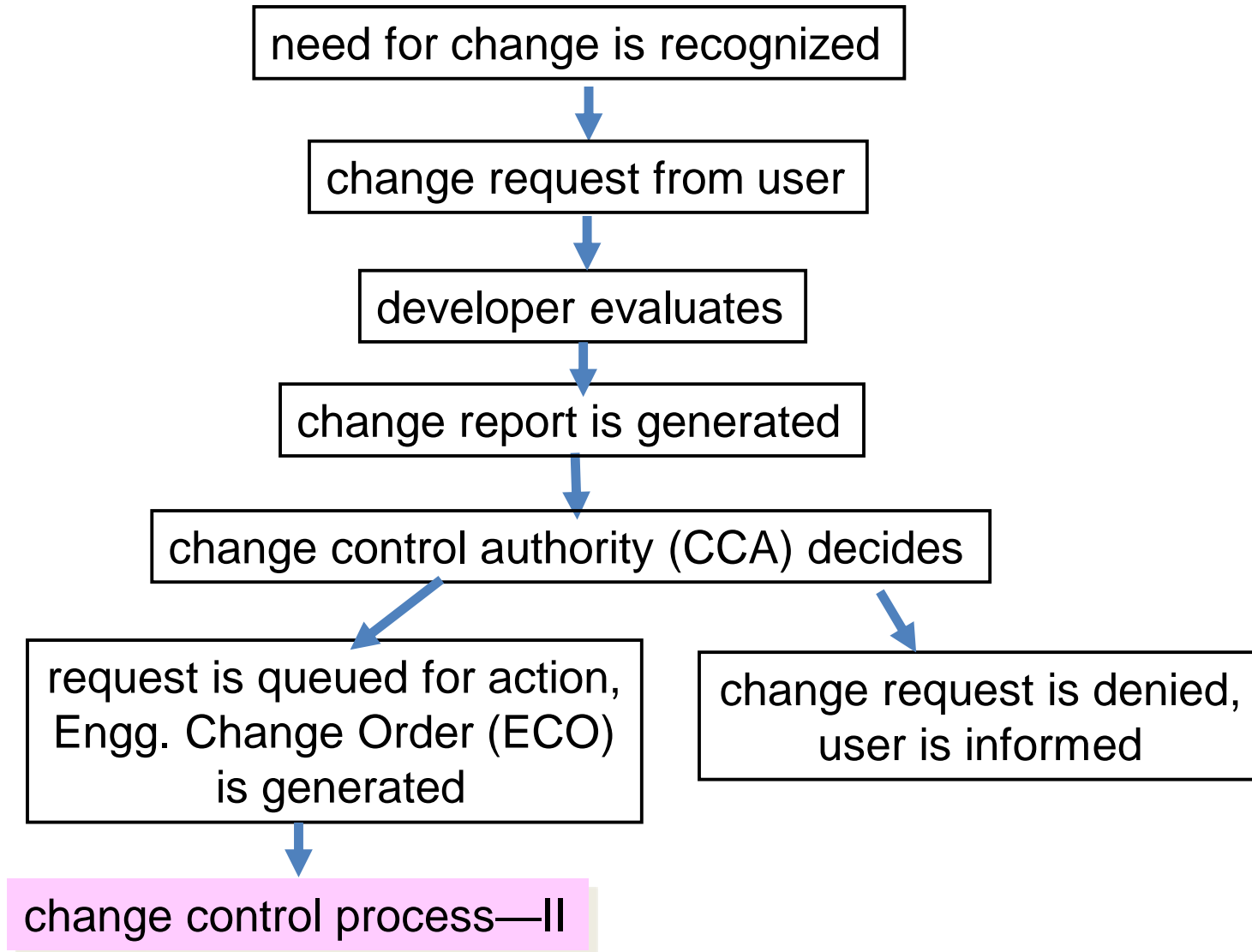
Change control process comes into effect when the software and associated documentation are delivered to configuration management change request form, which should record the recommendations regarding the change.

- Change control process
  - Access control and synchronization control
- Change control
  - Before an SCI becomes a baseline
  - Once an SCI becomes a baseline
- Role of Change Control Authority (CCA) – Take a global view (big picture)
  - How will the change impact h/w?
  - How will the change impact performance?
  - How will the change modify the customer's perception of the product?
  - How will the change affect the product quality and reliability?

# Change control

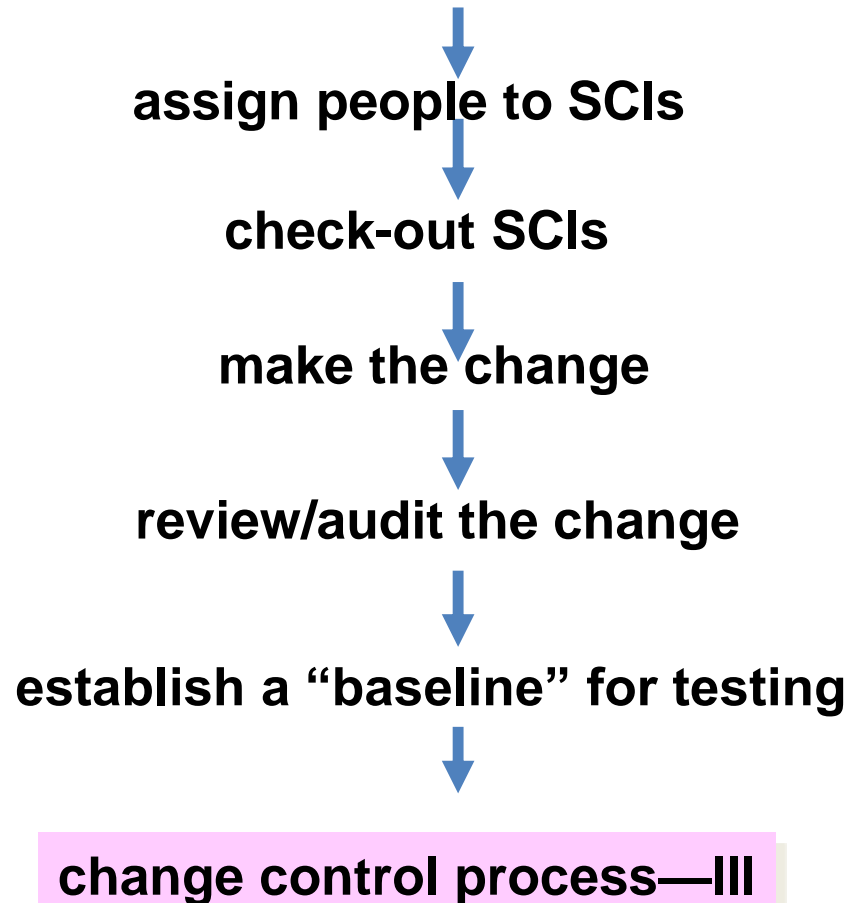


# Change Control Process—I

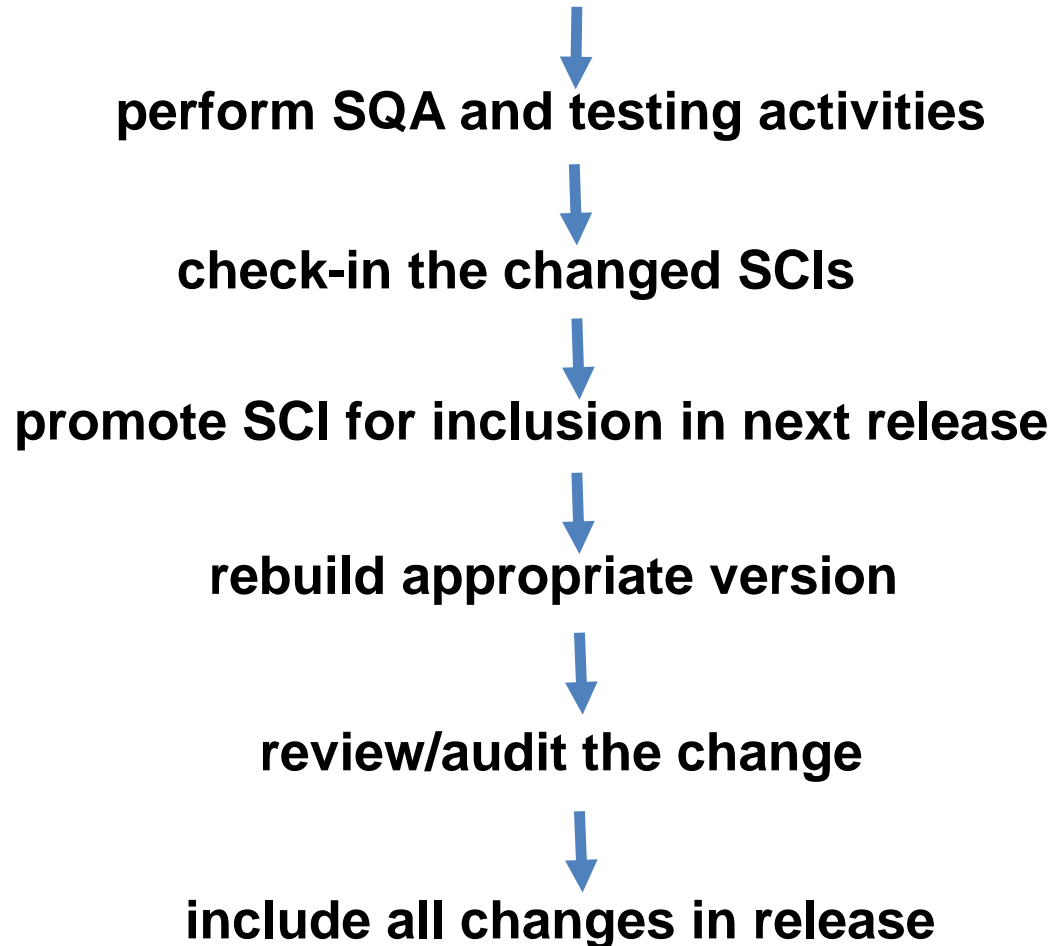




## Change Control Process—II



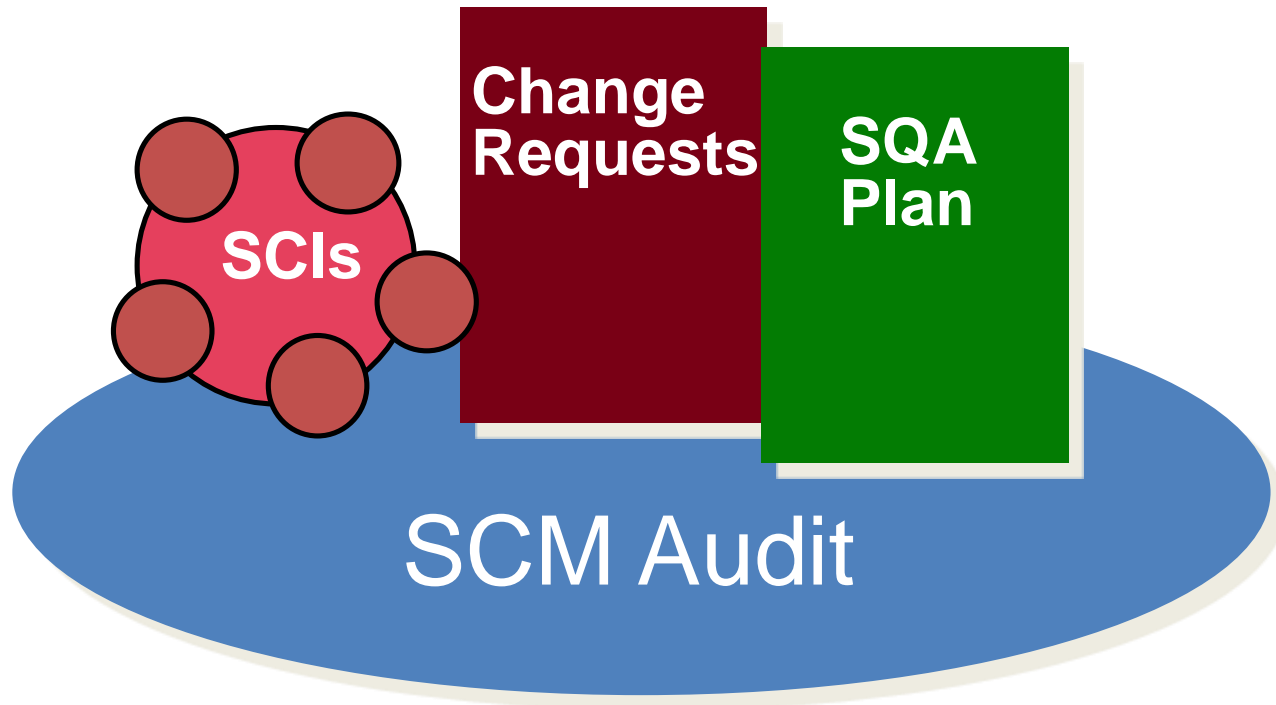
## Change Control Process—III



- How can we ensure that the change has been properly implemented?
  - Formal technical reviews
    - Focuses on the technical correctness of the configuration object that has been modified
  - Software configuration audit
    - Complements FTR by assessing a configuration object for characteristics that are generally not considered during review

# Configuration audit

Auditing

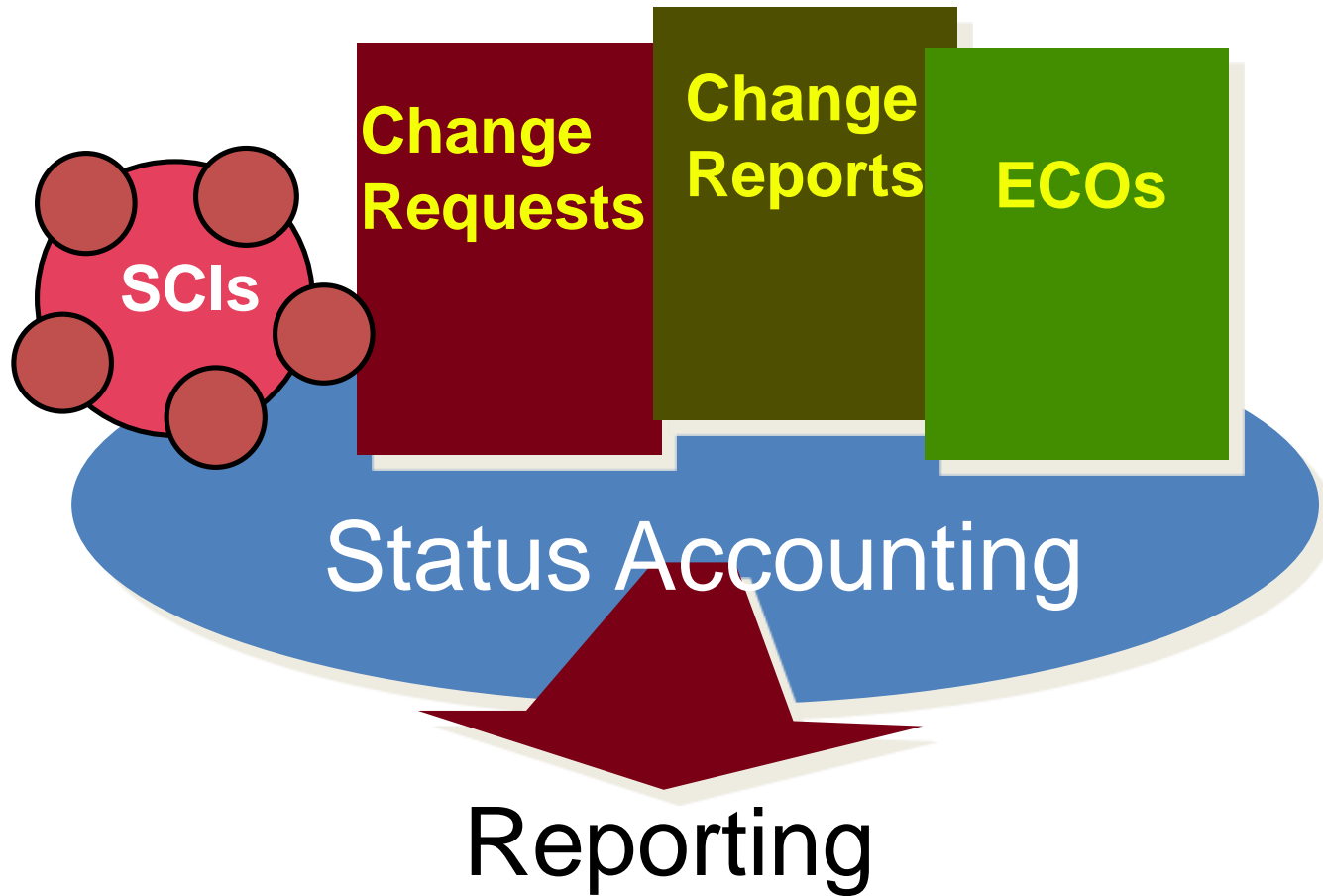


- The audit asks and answers the following questions
  - Has the change specified in the ECO been made? Have any additional modifications been incorporated?
  - Has the change been 'highlighted' in the SCI? Have the change date and change author been specified? Do the attributes of the configuration object reflect the change?
  - Have SCM procedures for noting the change, recording it and reporting it been followed?
  - Have all related SCIs been properly updated?

## Configuration Status Reporting (CSR)

- SCM task that answers these questions
  - What happened?
  - Who did it?
  - When did it happen?
  - What else will be affected?
- When many people are involved, it is likely that ‘the left hand not knowing what the right hand is doing’ syndrome will occur
- CSR helps to eliminate this problem by improving communication among all the people involved

# Status Accounting



**CASE** (Computer Aided Software Engineering)**tool**

a CASE tool used to automate some activity associated with software development.

CASE tools assist

- **Phase activities** such as specification, structured analysis, design, coding, testing, etc.;
- **Non-phase activities** such as project management and configuration management.

**Reasons for using CASE tools**

The primary reasons for using a CASE tool are:

- To increase productivity
- To help produce better quality software at lower cost



## List of CASE Tool

Application.	CASE tool	Purpose of tool
<b>Planning</b>	Excel spreadsheet, ms project, pert network, estimation tools	Functional app.: planning, scheduling, control
<b>Editing</b>	Dig. Editor, text editor, word processor	Speed and efficiency
<b>Testing</b>	Test data generator, file comparator	Speed and efficiency
<b>Prototyping</b>	High level modeling language, UI generator	Confirmation and certification of SRS and SDD

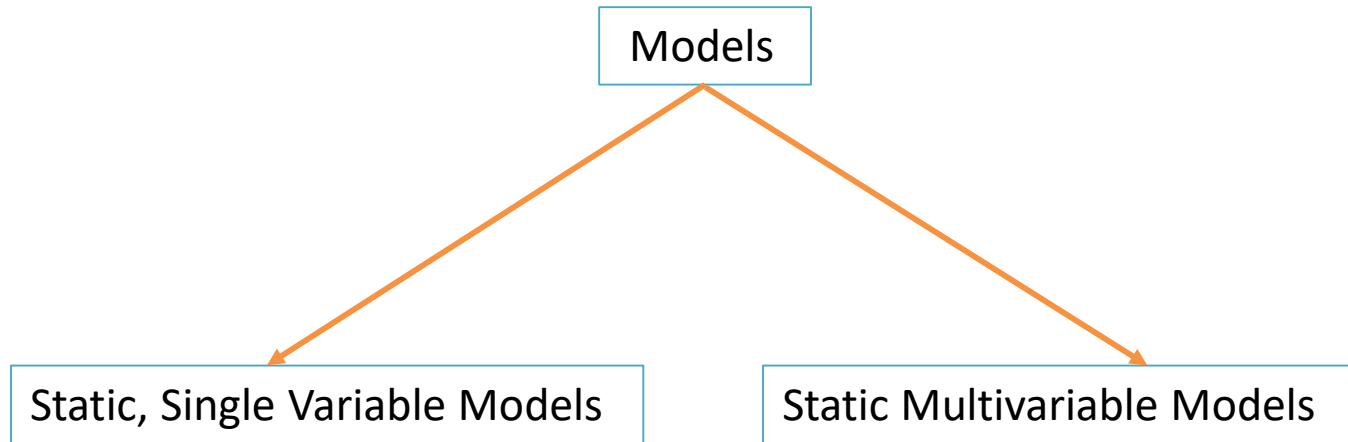
## List of CASE Tool

Application.	CASE tool	Purpose of tool
<b>Documentation</b>	Report generator, PPT presentation	Faster structural documentation
<b>Programming and language processing integration</b>	Program generator, code generator, compiler, interpreter	High quality with error free programming
<b>Re engineering tool</b>	Cross reference system, program re engineering system	Reverse engineering to find structure, design and design information
<b>Program analysis tool</b>	Cross reference system, static and dynamic analyzers	Analyzes risks, functions, features.

## Benefits of CASE Tool

- Improved productivity.
- Better documentation.
- Reduced lifetime maintenance.
- Improved accuracy
- Opportunity to non- programmers

# Cost Estimation (CO5)



## Static, Single Variable Models

**Effort** (E in Person-months), documentation (DOC, in number of pages) and **duration** (D, in months) are calculated from the number of lines of code (L, in thousands of lines) used as a predictor. Methods using this model use an equation to estimate the desired values such as cost, time, effort, etc. They all depend on the same variable used as predictor (say, size)

$$c = aL^b$$

C is the cost, L is the size and a,b are constants

$$Effort(E) = 1.4L^{0.93}$$

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

$$Duration(D) = 4.6L^{0.26}$$

## Static, Multivariable Models

These models are often based on equation (i), they actually depend on several variables representing various aspects of the software development environment, for example method used, user participation, customer oriented changes, memory constraints, etc.

$$E = 5.2 L^{0.91}$$

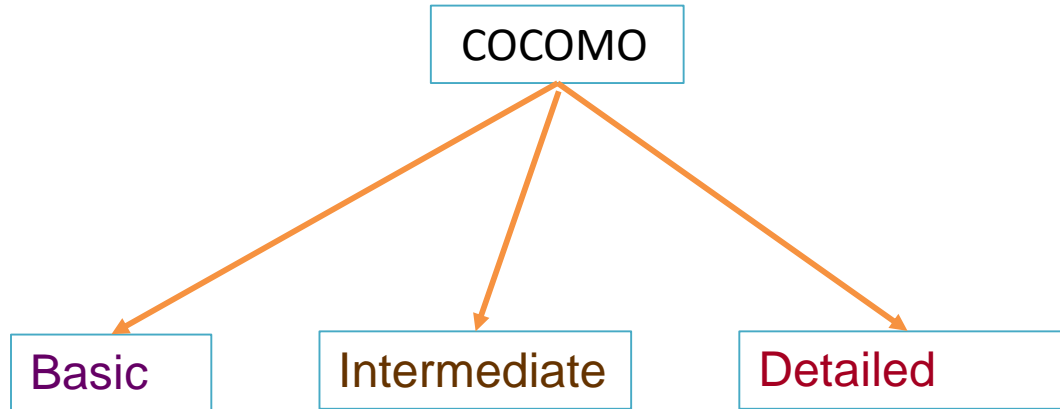
$$D = 4.1 L^{0.36}$$

The productivity index uses 29 variables which are found to be highly correlated to productivity as follows:

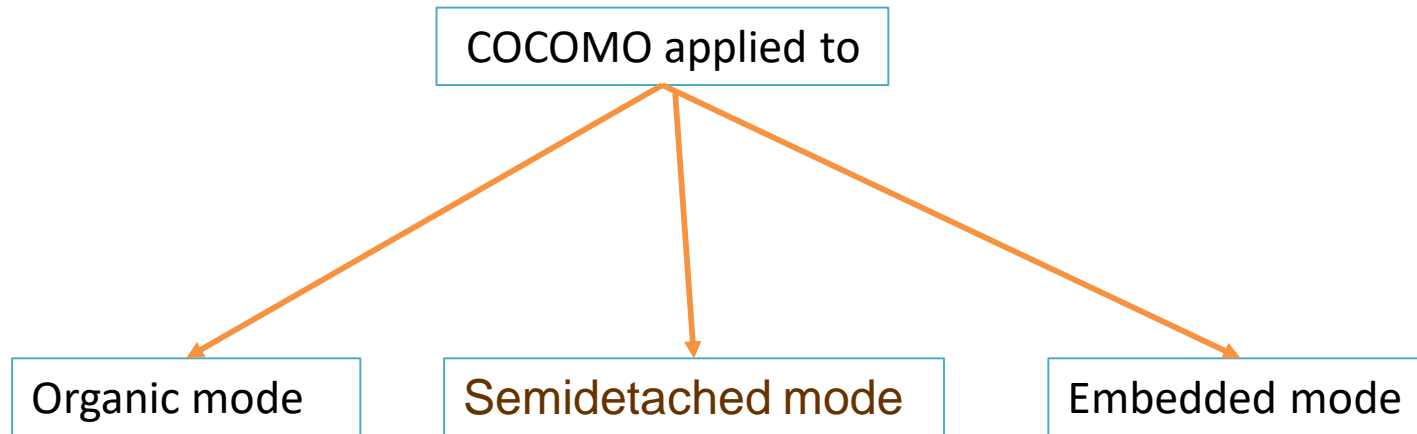
$$I = \sum_{i=1}^{29} W_i X_i$$

# COCOMO (CO5)

## Constructive Cost model



## Constructive Cost model





# Comparison of three COCOMO modes

<i><b>Mode</b></i>	<i><b>Project size</b></i>	<i><b>Nature of Project</b></i>	<i><b>Innovation</b></i>	<i><b>Deadline of the project</b></i>	<i><b>Development Environment</b></i>
Organic	Typically 2-50 KLOC	Small size project, experienced developers in the familiar environment. For example, pay roll, inventory projects etc.	Little	Not tight	Familiar & In house
Semi detached	Typically 50-300 KLOC	Medium size project, Medium size team, Average previous experience on similar project. For example: Utility systems like compilers, database systems, editors etc.	Medium	Medium	Medium
Embedded	Typically over 300 KLOC	Large project, Real time systems, Complex interfaces, Very little previous experience. For example: ATMs, Air Traffic Control etc.	Significant	Tight	Complex Hardware/ customer Interfaces required

Basic COCOMO model takes the form

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

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

where E is effort applied in Person-Months, and D is the development time in months. The coefficients  $a_b$ ,  $b_b$ ,  $c_b$  and  $d_b$  are given in table.

## Basic COCOMO coefficients

Software Project	$a_b$	$b_b$	$c_b$	$d_b$
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

## Basic COCOMO coefficients

When effort and development time are known, the average staff size to complete the project may be calculated as:

$$\text{Average staff size } (SS) = \frac{E}{D} \text{ Persons}$$

When project size is known, the productivity level may be calculated as:

$$\text{Productivity } (P) = \frac{KLOC}{E} KLOC / PM$$

# Basic COCOMO coefficients

## Cost drivers

### Product Attributes

- Required s/w reliability
- Size of application database
- Complexity of the product

### Hardware Attributes

- Run time performance constraints
- Memory constraints
- Virtual machine volatility
- Turnaround time

## Personal Attributes

- Analyst capability
- Programmer capability
- Application experience
- Virtual m/c experience
- Programming language experience

## Project Attributes

- Modern programming practices
- Use of software tools
- Required development Schedule

# Multipliers of different cost drivers

Cost Drivers	RATINGS					
	Very low	Low	Nominal	High	Very high	Extra high
<b>Product Attributes</b>						
RELY	0.75	0.88	1.00	1.15	1.40	--
DATA	--	0.94	1.00	1.08	1.16	--
CPLX	0.70	0.85	1.00	1.15	1.30	1.65
<b>Computer Attributes</b>						
TIME	--	--	1.00	1.11	1.30	1.66
STOR	--	--	1.00	1.06	1.21	1.56
VIRT	--	0.87	1.00	1.15	1.30	--
TURN	--	0.87	1.00	1.07	1.15	--



## Multipliers of different cost drivers

Cost Drivers	RATINGS					
	Very low	Low	Nominal	High	Very high	Extra high
<b>Personnel Attributes</b>						
ACAP	1.46	1.19	1.00	0.86	0.71	--
AEXP	1.29	1.13	1.00	0.91	0.82	--
PCAP	1.42	1.17	1.00	0.86	0.70	--
VEXP	1.21	1.10	1.00	0.90	--	--
LEXP	1.14	1.07	1.00	0.95	--	--
<b>Project Attributes</b>						
MODP	1.24	1.10	1.00	0.91	0.82	--
TOOL	1.24	1.10	1.00	0.91	0.83	--
SCED	1.23	1.08	1.00	1.04	1.10	--

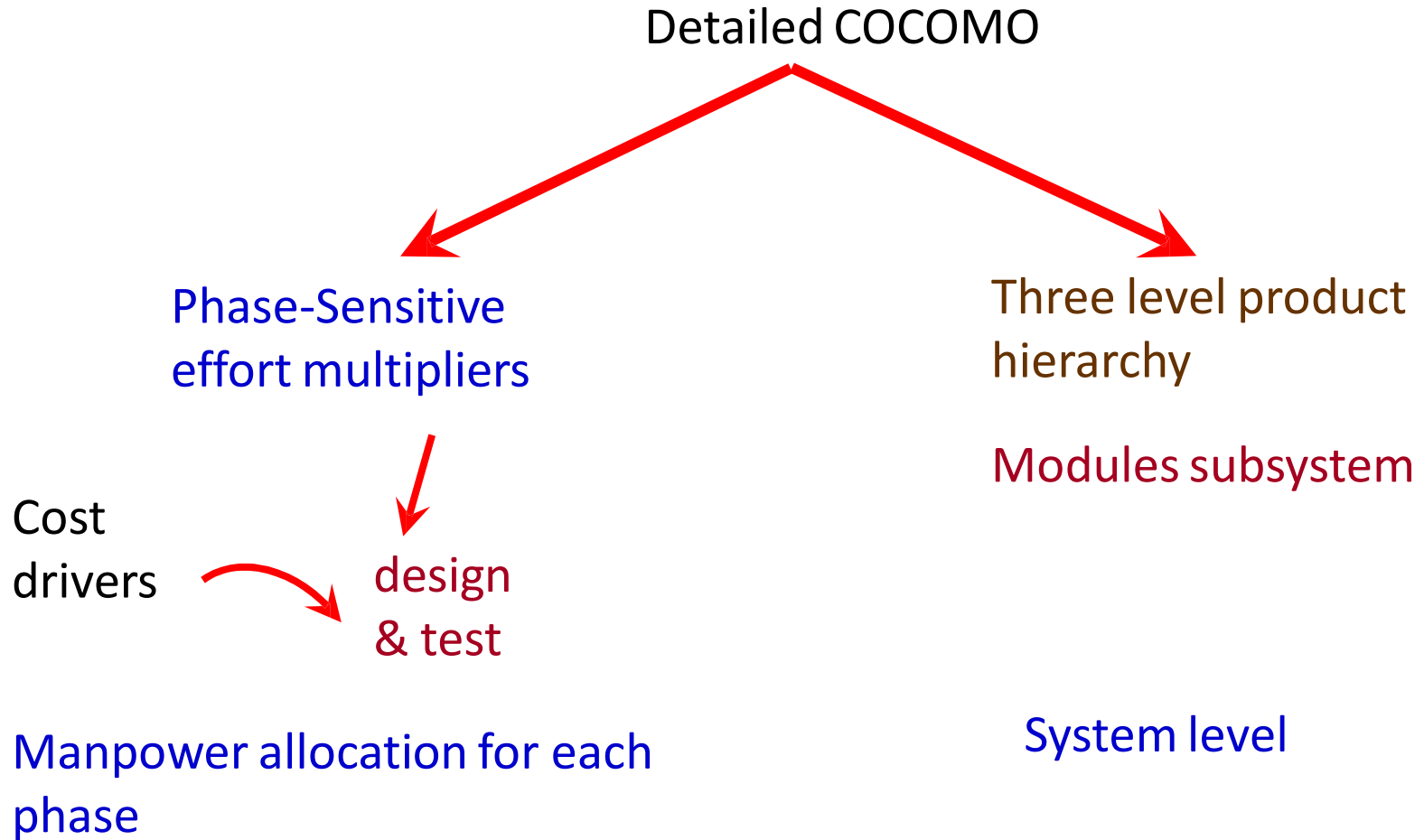
## Intermediate COCOMO equations

$$E = a_i (KLOC)^{b_i} * EAF$$

$$D = c (E)^{d_i}$$

Project	$a_i$	$b_i$	$c_i$	$d_i$
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 Model



# Detailed COCOMO Model

## Development Phase

### Plan / Requirements

EFFORT DEVELOPMENT TIME : 6% to 8%

% depend on mode & size : 10% to 40%

## Detailed COCOMO Model

### Design

Effort	:	16% to 18%
Time	:	19% to 38%

### Programming

Effort	:	48% to 68%
Time	:	24% to 64%

### Integration & Test

Effort	:	16% to 34%
Time	:	18% to 34%

# Detailed COCOMO Model

## Principle of the effort estimate

### Size equivalent

As the software might be partly developed from software already existing (that is, re-usable code), a full development is not always required. In such cases, the parts of design document (DD%), code (C%) and integration (I%) to be modified are estimated. Then, an adjustment factor, A, is calculated by means of the following equation.

$$A = 0.4 \text{ DD} + 0.3 \text{ C} + 0.3 \text{ I}$$

The size equivalent is obtained by

$$S (\text{equivalent}) = (S \times A) / 100$$

$$E_p = \mu_p E$$

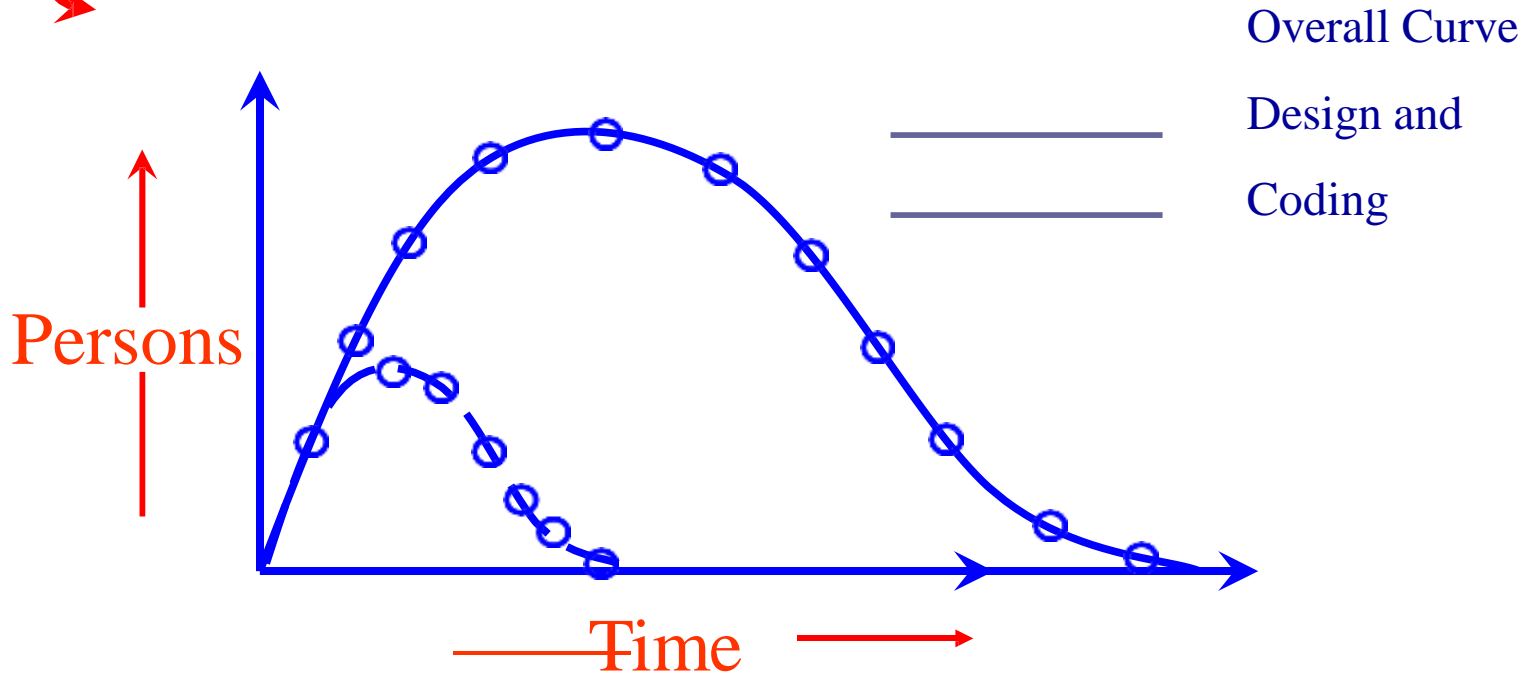
$$D_p = \tau_p D$$

# Resource Allocation Model (CO5)

Norden of IBM

Rayleigh curve

Model for a range of hardware development projects.



The Rayleigh manpower loading curve

## The Norden / Rayleigh Curve

The curve is modeled by differential equation

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

$dt$  = manpower utilization rate per unit time

$a$  = parameter that affects the shape of the curve

$K$  = area under curve in the interval  $[0, \infty]$

$t$  = elapsed time



# Resource Allocation Model

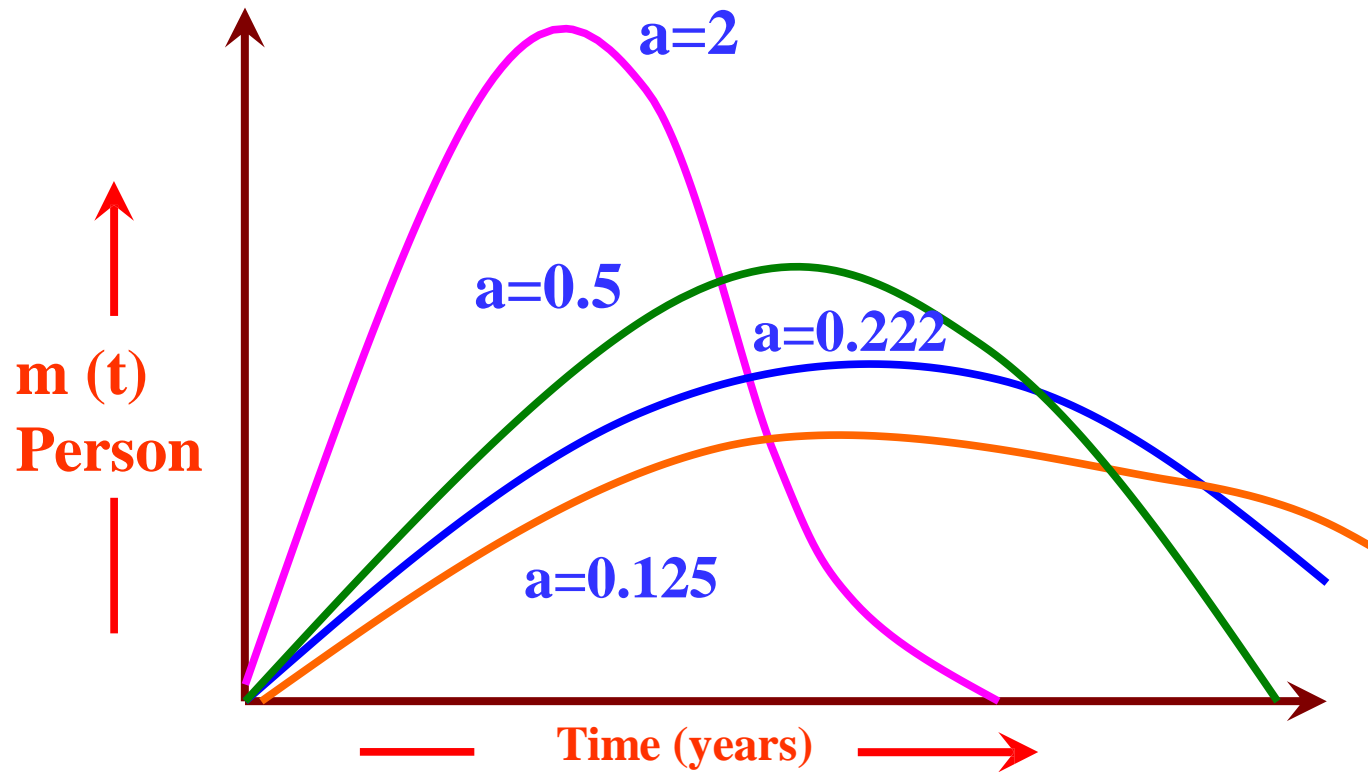


Fig: Influence of parameter 'a' on the manpower distribution

## Risk analysis and management (CO5)

### What is risk ?

Tomorrow's problems are today's risks.

*“Risk is a problem that may cause some loss or threaten the success of the project, but which has not happened yet”.*

# Risk analysis and management

Risk management is the process of identifying addressing and eliminating these problems before they can damage the project.

Current problems &



## Typical Software Risk

Capers Jones has identified the top five risk factors that threaten projects in different applications

### 1. Dependencies on outside agencies or factors.

- Availability of trained, experienced persons
- Inter group dependencies
- Customer-Furnished items or information
- Internal & external subcontractor relationships

## 2. Requirement issues

Uncertain requirements



Wrong product

or

Right product badly

Either situation results in unpleasant surprises and unhappy customers.

## 2. Requirement issues

Uncertain requirements



Wrong product

or

Right product badly

Either situation results in unpleasant surprises and unhappy customers.

## 3. Management Issues

Project managers usually write the risk management plans, and most people do not wish to air their weaknesses in public.

- Inadequate planning
- Inadequate visibility into actual project status
- Unclear project ownership and decision making
- Staff personality conflicts
- Unrealistic expectation
- Poor communication

## 4. Lack of knowledge

- Inadequate training
- Poor understanding of methods, tools, and techniques
- Inadequate application domain experience
- New Technologies
- Ineffective, poorly documented or neglected processes



## 5. Other risk categories

- Unavailability of adequate testing facilities
- Turnover of essential personnel
- Unachievable performance requirements
- Technical approaches that may not work

# Risk analysis and management

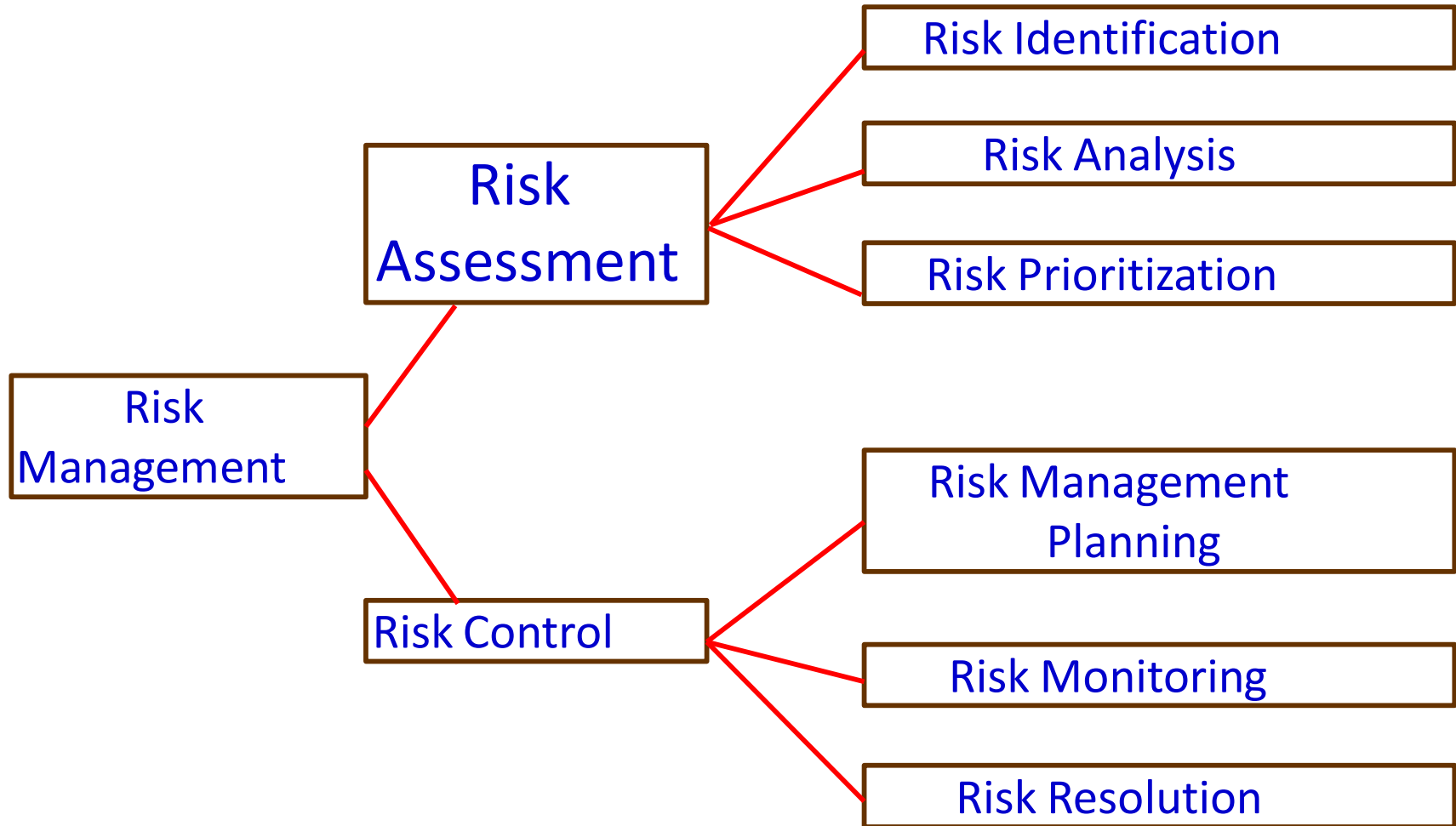


Fig. Risk Management Activities

# Faculty Video Links, Youtube & NPTEL Video Links and Online Courses Details

- <https://nptel.ac.in/courses/106/105/106105182/>
- <https://www.youtube.com/watch?v=RQNZWCl6eXI&list=PLBd76GK9sWTwVXm9FIVHOTXXbGY2vZR8z&index=1>
- <https://www.youtube.com/watch?v=PXYqu-OcBoY>
- <https://www.youtube.com/watch?v=KqDlDubS-OU&list=PL8751DA481F0F0D17&index=21>

1) A COCOMO model is

(a) Common Cost estimation model

**(b) Constructive cost Estimation model**

(c) Complete cost estimation model

(d) Comprehensive Cost estimation model

2) Estimation of software development effort for organic software is COCOMO is

(a)  **$E=2.4(KLOC)1.05PM$**

(b)  $E=3.4(KLOC)1.06PM$

(c)  $E=2.0(KLOC)1.05PM$

(d)  $E=2.4(KLOC)1.07PM$

3) Estimation of size for a project is dependent on

(a) Cost

(b) Schedule

(c) **Time**

**(d) None of the above**

4) CASE Tool is

**(a) Computer Aided Software Engineering** (b) Component Aided Software Engineering

(c) Constructive Aided Software Engineering (d) Computer Analysis Software Engineering

5) The process by which existing processes and methods are replaced by new techniques is:

(a) Reverse engineering

**(b) Business process re-engineering**

(c) Software configuration management

(d) Technical feasibility

6) Adaptive maintenance is related to

- (a) Modification in software due to failure
- (b) Modification in software due to demand of new functionalities
- (c) Modification in software due to increase in complexity
- (d) **Modification in software to match changes in the ever-changing environment.**

7) Perfective maintenance refers to enhancements

- (a) Making the product better
- (b) Making the product faster and smaller
- (c) Making the product with new functionalities
- (d) **All of the above**

8) As per distribution of maintenance effort, which type of maintenance has consumed maximum share?

- (a) Adaptive
- (b) Corrective
- (c) **Perfective**
- (d) Preventive

9) Legacy systems are

- (a) **old systems**
- (b) new systems
- (c) undeveloped systems
- (d) None of the above

10) The process of transforming a model into source code is

- (a) Reverse Engineering
- (b) **Forward engineering**
- (c) Re-engineering
- (d) Restructuring

# Weekly Assignment

1. What is software maintenance? Describe various categories of maintenance. Which category consumes maximum effort and why?
2. What are the implication of maintenance for a one person software production organization?
3. Some people feel that “maintenance is manageable”. What is your opinion about this issue?
4. Discuss various problems during maintenance. Describe some solutions to these problems.
5. Why do you think that the mistake is frequently made of considering software maintenance inferior to software development?
6. Explain the importance of maintenance. Which category consumes maximum effort and why?
7. Explain the steps of software maintenance with help of a diagram.
8. What is self descriptiveness of a program? Explain the effect of this parameter on maintenance activities.
9. Discuss the concept of re-engineering and its importance.

- 1 COCOMO was developed initially by
  - (a) B.W.Bohem
  - (b) Gregg Rothermal
  - (c) B.Beizer
  - (d) Rajiv Gupta
- 2 A COCOMO model is
  - (a) Common Cost estimation model
  - (b) Constructive cost Estimation model
  - (c) Complete cost estimation model
  - (d) Comprehensive Cost estimation model
- 3 Estimation of software development effort for organic software is COCOMO is
  - (a)  $E=2.4(KLOC)^{1.05}PM$
  - (b)  $E=3.4(KLOC)^{1.06}PM$
  - (c)  $E=2.0(KLOC)^{1.05}PM$
  - (d)  $E=2.4(KLOC)^{1.07}PM$
- 4 Estimation of size for a project is dependent on
  - (a) Cost
  - (b) Schedule
  - (c) Time
  - (d) None of the above
- 5 In function point analysis, number of Complexity adjustment factor are
  - (a) 10
  - (b) 20
  - (c) 14
  - (d) 12



- 6 Process of generating analysis and design documents is called
  - (a) Inverse Engineering
  - (b) Software Engineering
  - (c) Reverse Engineering
  - (d) Re-engineering
7. Regression testing is primarily related to
  - (a) Functional testing
  - (b) Data flow testing
  - (c) Development testing
  - (d) Maintenance testing
- 8 Which one is not a category of maintenance ?
  - (a) Corrective maintenance
  - (b) Effective maintenance
  - (c) Adaptive maintenance
  - (d) Perfective maintenance
- 9 The maintenance initiated by defects in the software is called
  - (a) Corrective maintenance
  - (b) Adaptive maintenance
  - (c) Perfective maintenance
  - (d) Preventive maintenance
- 10 Patch is known as
  - (a) Emergency fixes
  - (b) Routine fixes
  - (c) Critical fixes
  - (d) None of the above

# Old Question Papers

Printed Pages : 1

Roll No. 

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ECS602

## B. TECH.

### THEORY EXAMINATION (SEM-VI) 2016-17 SOFTWARE ENGINEERING

Time : 3 Hours

Max. Marks : 100

Note : Be precise in your answer.

#### SECTION – A

1. Attempt all parts of the following questions: 10 x 2 = 20

- (a) What is the software crisis?
- (b) Write major software characteristics.
- (c) Write the methods of requirements elicitation.
- (d) Write the differences between software and software engineering.
- (e) What is the difference between Verification and Validation?
- (f) How software design can be classify?
- (g) Write major software Design Tools.
- (h) Write the names of design principles.
- (i) Write the differences between Top- downs and bottom-up approaches.
- (j) What is software quality?

#### SECTION – B

2. Attempt any five parts of the following questions: 5 x 10 = 50

- (a) What is meant by “Formal Technical Review”? Should it access both programming style as well as correctness of software? Give reasons.
- (b) Compare ISO and SEE-CMI model.
- (c) What is Risk management? How are project risks different from technical risks?
- (d) What is a data flow diagram? Explain rules for drawing good data flow diagrams with the help of a suitable example.
- (e) Explain software quality assurance (SQA) with life cycle.
- (f) Explain software development life cycle. Discuss various activities during SDLC.
- (g) List five desirable characteristics of good SRS document. Discuss the relative advantages of formal and informal requirement specifications.
- (h) What are the characteristics of a software process?

#### SECTION – C

Attempt any two parts of the following questions: 2 x 15 = 30

3. What do you understand by coupling and cohesion? What roles they play in software design? Describe the properties of best coupling and cohesion giving examples of each.
4. What is a Structure Charts? Explain rules for drawing good Structure Charts diagrams with the help of a suitable example.
5. Define the following:
  - (i) Water fall Model
  - (ii) Spiral Model

# Old Question Papers

Printed Pages: 02

Paper Id: 

1	1	0	6	0	2
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Sub Code: NCS602/ECS602

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**B.TECH  
(SEM VI) THEORY EXAMINATION 2017-18  
SOFTWARE ENGINEERING**

*Time: 3 Hours*

*Total Marks: 100*

**Note: 1.** Attempt all Sections. If require any missing data; then choose suitably.

**SECTION A**

**1. Attempt all questions in brief. 2 x 10 = 20**

- a. What do you understand by software crisis?
- b. What are different software quality attributes?
- c. Write the difference between verification and validation.
- d. What is Decision Tree?
- e. Write principles of Software Design.
- f. What is Pseudo Code? How it differs from Algorithm?
- g. Explain Code Inspection.
- h. What are stub and driver?
- i. Define CASE tools.
- j. What is Adaptive and Corrective Maintenance?

**SECTION B**

**2. Attempt any three of the following: 10 x 3 = 30**

- a. Explain Spiral Model? Also write it's advantages and disadvantages.
- b. Explain CMM Model. Compare ISO and CMM.
- c. Explain different methods of verification in detail.
- d. What is Structure Chart? Explain different basic blocks used to build structure chart with suitable example.
- e. What is cost analysis in context of software? Explain COCOMO Model.

**SECTION C**

**3. Attempt any one/two part of the following: 10 x 1 = 10**

- (a) Explain different phases of SDLC.
- (b) Explain Iterative Enhancement Model. Write its advantages and disadvantages.

**4. Attempt any one/two part of the following: 10 x 1 = 10**

- (a) What do you understand by DFD? Explain basic blocks, which are used to build DFD with suitable example.
- (b) What is SRS? Explain characteristics of a good SRS.

**5. Attempt any one/two part of the following: 10 x 1 = 10**

- (a) What is objective of software design? Explain different approaches for software design.
- (b) What is Cyclomatic complexity? Write all methods, which are used to calculate the Cyclomatic complexity of a control, flow graph.

# Old Question Papers

6. Attempt any *one/two* part of the following: 10 x 1 = 10
- (a) What is Regression Testing? Explain the process of test case prioritization in regression testing.
  - (b) What is Integration Testing? Explain different approaches used for integration testing.
7. Attempt any *one/two* part of the following: 10 x 1 = 10
- (a) Explain various software configuration management activities.
  - (b) Explain Software Risks Analysis and Management process.

## Expected Questions for University Exam

1. Discuss various problems during maintenance. Describe some solutions.
2. What is ripple effect? Discuss the various aspects of ripple effect and how does it affect the stability of a program?
3. What is reverse engineering? Discuss levels of reverse engineering
4. compare reverse engineering and re-engineering.
5. What are configuration management activities? Draw the Performa of change request form

Software as an Evolutionary Entity, Need for maintenance,

Categories of Maintenance: Preventive, Corrective and Perfective Maintenance,

Cost of Maintenance, Software ReEngineering, Reverse Engineering.

Software Configuration Management Activities, Change Control Process,

Software Version Control, An Overview of CASE Tools.

Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration

Constructive Cost Models (COCOMO), Resource allocation Models,

Software Risk Analysis and Management.

1. R. S. Pressman, Software Engineering: A Practitioners Approach, McGraw Hill.
2. Rajib Mall, Fundamentals of Software Engineering, PHI Publication.
3. K. K. Aggarwal and Yogesh Singh, Software Engineering, New Age International Publishers.
4. Pankaj Jalote, Software Engineering, Wiley
5. Deepak Jain," Software Engineering: Principles and Practices", Oxford University Press.
6. Munesh C. Trivedi, Software Engineering, Khanna Publishing House
7. N.S. Gill, Software Engineering, Khanna Publishing House