

# Configuration Management Tuotteenhallinta ohjelmistoprojektissa

1. Objectives
2. Problems & Motivation
3. CM Concept
4. Making CM system to work
5. Present CM Standards and Terms
6. CM Benefits and Summary
7. References
8. Discussion

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## What Are Software Developers Facing?

"If builders built like programmers program a  
woodpecker could destroy civilization."

- Gerald Weinberg

# 1. OBJECTIVES

- Get an overview of configuration management
- Learn the basic elements of CM
- Understand the importance of CM

# 2. PROBLEMS & MOTIVATION

- Mid size project
  - About 100 Modules
  - 2 versions of each modules
  - 10 programmers
  - each programmer changes one module per day
- Assumption:
  - when a system is configured, it is not known whether to use the old or new version of the module
- Result:
  - about  $10^{30}$  possible configurations

## CM Problems

- This program worked yesterday - what happened?
- The document and the program do not match
- I fixed the bug last week. Why did it reappear?
- I can not reproduce the bug in this delivery
- The executable does not match the sources!
- I forgot to compile a module!

## CM Problems ...

- Whole configuration is unclear
- Workspaces are not controlled
- New requirements just appear
- No metrics can be used
- No clear knowledge what has been tested and how
- Delivery contains untested modules
- The traceability of SW changes is poor

## CM Problems ...

- Several designers must work on this component. How to avoid confusions?
- Building the system takes many days
- We must bring the system of last year into operation
- What is the impact of that change to the system?
- What is the effect of installing the new version of the support software?
- What is the impact of changing the OS  
to the customer base  
to the product spectrum?

## From SEI Definition

What is CM?

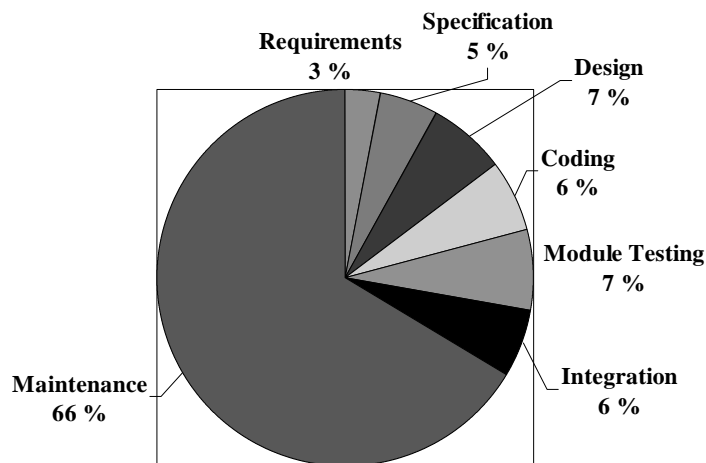
- Identification: identifying components, structure
- Control: controlling releases and changes
- Status accounting: recording, reporting status
- Audit and Review: validating completeness
- Manufacture: managing construction, building
- Process modeling: ensuring life-cycle model
- Team work: controlling team interactions

source: SEI

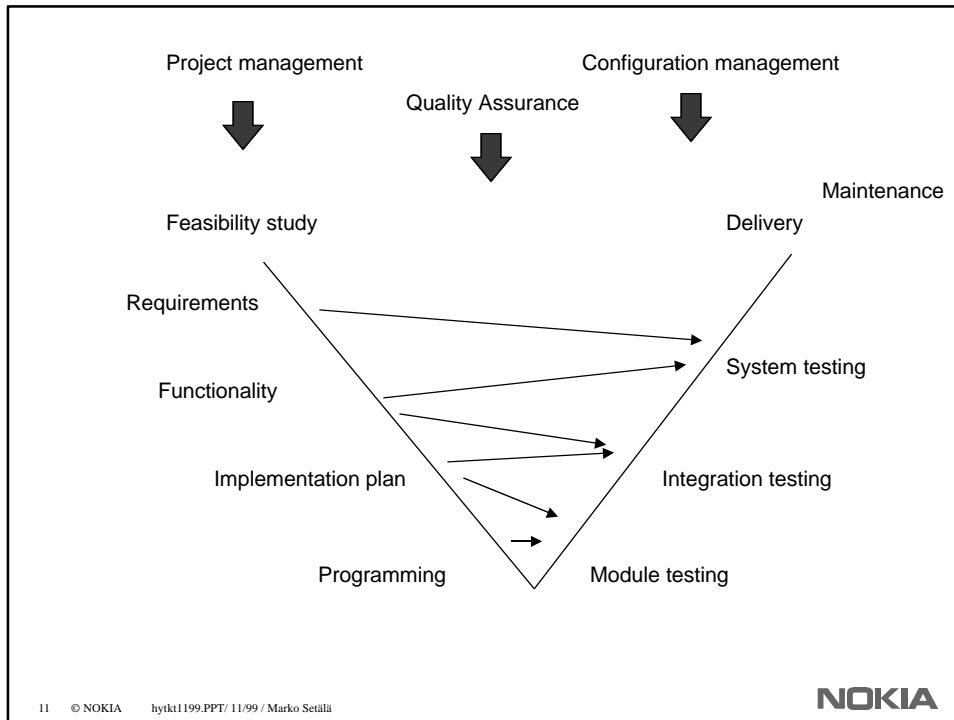
## Motivation Summary

- Every software system evolves into a system family with multiple versions due to corrections, adaptations and extensions
- Changes occur concurrently
- Good methods and techniques must be used to control the software system during and after development process. This guarantee the acceptable costs of SW development and maintenance.

## Life Cycle Costs



source : Schach / Haikala, Märijärvi: Ohjelmistotuotanto



### 3. CM CONCEPT

- Version Management
- Workspace Management
- SW Build Management
- Change Control

# Version Management

Traditional cm tools

- Versionable files
- Version history and version graph
- Branching - merging
- Operational model - locking
- Configurations

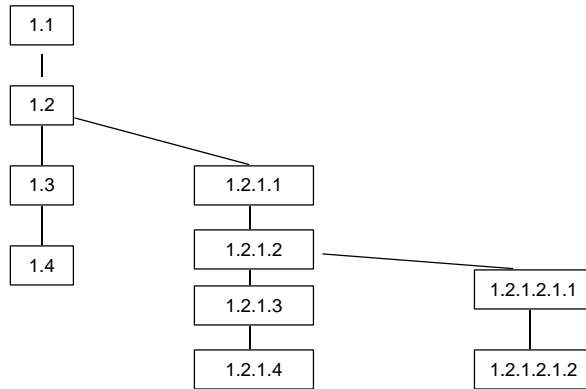
# Version History

Abstract file

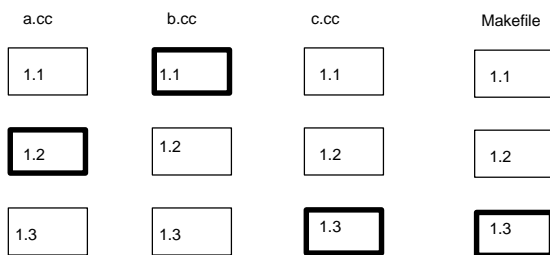
1
2
3
4
5
6

Change record  
-who made the change  
-date  
-changed lines  
-comment

# Version Management



# CONFIGURATION



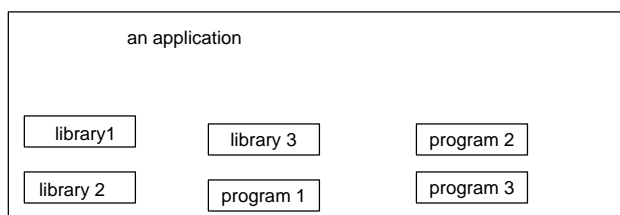
x.lib  
Module configuration list

```
a.cc 1.2  
b.cc 1.1  
c.cc 1.3  
Makefile 1.3
```



# Application

... is composed of modules (libraries and processes) which are versionable.



# Why Branching?

- Variants - different implementations of abstract files for instance, branches for Intel 486 and Pentium
- Bug fixes
- Temporary development
- Concurrent update - locking domain of abstract files

## The Purpose of Version Management

- Identifying the configuration of the software (i.e., selected software products and their descriptions) at given points of time.
- Systematically controlling changes to the configuration.
- Maintaining the integrity and traceability of the configuration throughout the software life cycle.
- Create and manage baselines

## Workspace Management

- Workspace management is to help the developers to do their jobs.
- Workspace management focuses on:
  - Concurrent access to same configuration items
  - Workspace capacity consumption
  - Risk of loosing work in progress
  - Status accounting of work in progress
  - Limiting change notification traffic
  - Development tools management

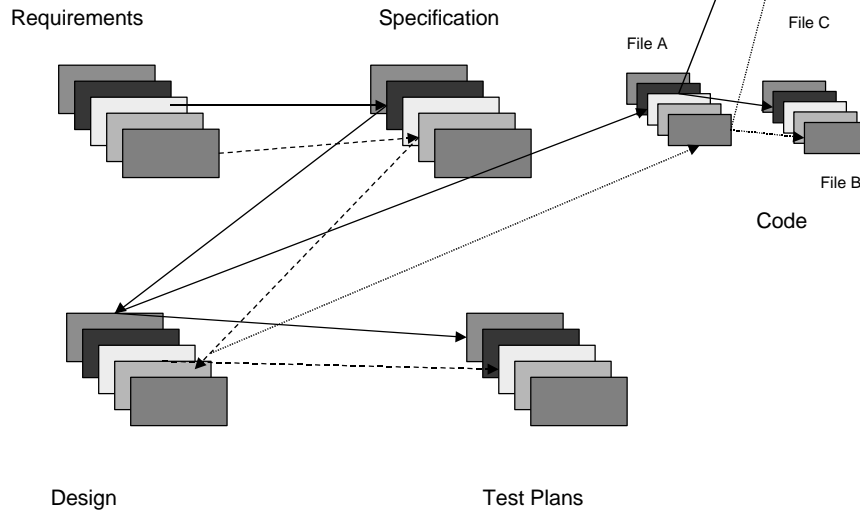
## SW Build Management

- Needed versions of the files are fetched from the version management database.
- SW builds must be able to regenerate
- SW builds are made for different purposes
  - developing
  - testing
  - deliveries
  - maintenance

## Change Control

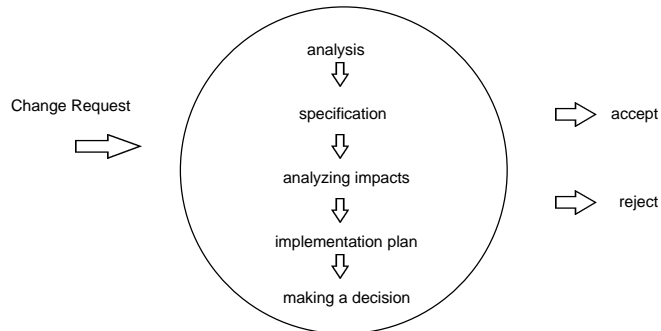
- Baselines must be able to be changed. To avoid losing consistency of the configuration the change control procedure must be used. Note, that each type of the configuration item may have a change control procedure of its own.
- SWCB (Software Control Board) takes care of the change control.
- A generic procedure can be used.

# Baseline and Versions



# Change control ...

## A generic change control procedure



## 4. MAKING CM SYSTEM TO WORK

- Write first CM plan
  - it helps you to think about the CM
  - basis for further development
  - organizing CM work is easier
- Do not forget the support functions
  - manuals
  - training
  - motivating developers and other relevant people
- Get the needed commitment

## Decide Before Development:

- WHO is responsible for some activity
- WHAT must be done
- WHEN some activity must be done
- HOW these activities are performed

## 5. PRESENT CM STANDARDS AND TERMS

- ISO 9000
- IEEE Std 828-1998 (IEEE Standard for Software Configuration Management Plans)
- IEEE Std 1042-1987 (IEEE Guide to Software Configuration Management)
- SEI: CMM Model, Level 2
- ISO 12207 Software Life Cycle Processes

## CMM Level 2 Key Process Areas

- Software project planning
- Software project tracking and oversight
- Software subcontract management
- Software quality assurance
- **Software configuration management**
- Software requirements management

## Terms

**baseline** - A specification or product that has been formally reviewed and agreed upon, that thereafter serves as the basis for further development, and that can be changed only through formal change control procedures. [IEEE-STD-610]

**baseline configuration management**- The establishment of baselines that are formally reviewed and agreed on and serve as the basis for further development. Some software work products, e.g., the software design and the code, should have baselines established at predetermined points, and formal change control process should be applied these items. These baselines provide control and stability when interacting with the customer

## Terms cont...

**baseline management**- In configuration management, the application of technical and administrative direction to designate the documents and changes to those documents that formally identify and establish baselines at specific times during the life cycle of a configuration item. [IEEE-STD-610]

**configuration** - In configuration management, the functional and physical characteristics of hardware or software as set forth in technical documentation or achieved in a product. [IEEE-STD-610]

**configuration control** - An element of configuration management, consisting of the evaluation, co-ordination, approval or disapproval, and implementation of changes to configuration items after formal establishment of their configuration identification. [IEEE-STD-610]

## Terms cont...

**configuration identification** - An element of configuration management, consisting of selecting the configuration items for a system and recording their functional and physical characteristics in technical documentation. [IEEE-STD-610]

**configuration item** - An aggregation of hardware, software, or both, that is designated for configuration management and treated as a single entity in the configuration management process. [IEEE-STD-610]

**configuration management** - A discipline applying technical and administrative direction and surveillance to identify and document the functional and physical characteristics of a configuration item, control changes to those characteristics, record and report change processing and implementation status, and verify compliance with specified requirements. [IEEE-STD-610]

## Terms cont...

**Configuration Management Process** - A process of applying administrative and technical procedures throughout the software life cycle to: identify, define, and baseline software items in a system; control modifications and releases of the items; record and report the status of the items and modification requests; ensure the completeness, consistency, and correctness of the items; and control storage, handling, and delivery of items. [ISO 12207]

**configuration unit** - The lowest level entity of a configuration item or component that can be placed into, and retrieved from, a configuration management library system



## Terms cont...

**software configuration control board** - A group responsible for evaluating and approving or disapproving proposed changes to configuration items, and for ensuring implementation of approved changes.

**Variant** - A version of a program resulting from the application of software diversity.

**Version** - A semantically meaningful snapshot of a versionable item at a point in time.

A version can be seen as an evolution

A Variant can be seen as an option

## 6. CM BENEFITS AND SUMMARY

- General improvement in development - developers can focus on the actual development work
- Shortening in development times
- Possibility to customize the product for different customers or platforms
- Helps to manage and do large SW projects
- Increased reliability on deliveries
- Maintenance work can be done efficiently
- Money can be saved

## Summary

- CM methods give a framework to the software engineering. They ensure the consistency of the configuration during the whole life cycle of the software.
- Different contexts influence on how the CM procedures are implemented within different organizations.
- Make sure that CM will be planned and used in your organization.
- Changes will happen all the time.

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- <http://www.ieee.org/>