Configuration Management & Control

Agenda

- Configuration Management
  - Identification
  - Management
  - Status Accounting
  - Audit
- Change Control
- Summary
Configuration Management

• The purpose of Software Configuration Management is to establish and maintain the integrity of the products of the software project throughout the project's software life cycle.

• Software Configuration Management involves identifying the configuration of the software (i.e., selected software works products and their descriptions) at given points in time, systematically controlling changes to the configuration, and maintaining the integrity and traceability of the configuration throughout the software lifecycle.

• Standards (approved by ANSI)
  – IEEE 828: Software Configuration Management Plans

Source: The CMM Software Capability Maturity Model (version 1.1)

Why Software Configuration Management?

• The problem:
  – Multiple people have to work on software that is changing
  – More than one version of the software has to be supported:
    • Released systems
    • Custom configured systems (different functionality)
    • System(s) under development
  – Software must run on different machines and operating systems

• Need for coordination

• Software Configuration Management
  manages evolving software systems
  controls the costs involved in making changes to a system
Managing Software Configurations

- Software Configuration Management is a **project function** (as defined in the software project management plan) with the goal to make technical and managerial activities more effective.
- Software Configuration Management can be staffed in several ways:
  - A single team performs all software configuration management activities for the whole organization
  - A separate configuration management team is set up for each project
  - All the software configuration management activities are performed by the developers themselves
  - Mixture of all of the above

Software Configuration Management Planning

- Software configuration management planning starts during the early phases of a project
- The outcome of the SCM planning phase is the **Software Configuration Management Plan (SCMP)** which might be extended or revised during the rest of the project
- The SCMP can either follow a public standard like the IEEE 828, or an internal (e.g. company specific) standard
The Software Configuration Management Plan

- Defines the *types of documents* to be managed and a document naming scheme
- Defines *who takes responsibility* for the CM procedures and creation of baselines
- Defines *policies for change* control and version management
- Describes the *tools* which should be used to assist the CM process and any limitations on their use
- Defines the *configuration management database* used to record configuration information

Configuration Management Activities

- Identification
- Audit
- Status Accounting
- Management
Identification

- The task of identifying (documenting or baselining) the artifacts or items that make up the system.
- Artifacts include:
  - Life cycle documentation
  - Software
  - Hardware
- These are commonly called Configuration Items (CI)

Configuration Items

- A **configuration item (CI)** is any part of the development and/or deliverable system which needs to be independently identified, stored, tested, reviewed, used, changed, delivered and/or maintained.
- CIs can differ widely in complexity and may contain other CIs in a hierarchy.
- Includes code, modules, and documentation
  - all type of code files
  - drivers for tests
  - analysis or design documents
  - user or developer manuals
  - system configurations (e.g. version of compiler used)
Finding Configuration Items

- Large projects typically produce thousands of entities (files, documents, data ...) which must be uniquely identified.
- Any entity managed in the software engineering process can potentially be brought under configuration management control.
- But not every entity needs to be under configuration management control all the time.
- Two Issues:
  - *What*: Selection of Configuration Items to be under configuration control.
  - *When*: When do you start to place entities under configuration control?

Finding Configuration Items (continued)

- Some items must be maintained for the lifetime of the software.
- An entity naming scheme should be defined so that related documents have related names.
- Selecting the right configuration items is a skill that takes practice.
  - Very similar to object modeling in object-oriented design.
  - Use techniques similar to object modeling for finding CIs!
    - Find the CIs.
    - Find relationships between CIs.
Which of these Entities should be Configuration Items?

- Problem Statement
- Software Project Management Plan (SPMP)
- Requirements Analysis Document (RAD)
- System Design Document (SDD)
- Project Agreement
- Object Design Document (ODD)
- Dynamic model
- Object model
- Functional model
- Unit tests
- Integration test strategy
- Source code
- API Specification
- Input data and data bases
- Test plan
- Test data
- Support software (part of the final system)
- Support software (not part of the final system)
- User manual
- Administrator manual

Possible Selection of Configuration Items

- Problem Statement
- Software Project Management Plan (SPMP)
  ✓ Requirements Analysis Document (RAD)
  ✓ System Design Document (SDD)
  ✓ Project Agreement
  ✓ Dynamic Model
  ✓ Object model
  ✓ Functional Model
  ✓ Unit tests
  ✓ Integration test strategy
- Source code
  ✓ API Specification
  ✓ Input data and data bases
  ✓ Test plan
  ✓ Test data
  ✓ Support software (part of the product)
  ✓ Support software (not part of the product)
  ✓ User manual
  ✓ Administrator manual

Once the Configuration Items are selected, they are usually organized in a tree.
Baseline

- A specification or product that has been formally reviewed and agreed upon, that serves as the basis for further development, and that can be changed only through formal change control procedures
- Examples:
  - Baseline A: All the APIs have completely been defined; the bodies of the methods are empty
  - Baseline B: All data access methods are implemented and tested
  - Baseline C: The GUI is implemented

Management

- The introduction of controls (procedures and quality gates) to ensure the ERP evolves appropriately
- Example areas to focus on:
  - Deployment of releases
  - Issue tracking practices
  - Change request practices
  - Asset management practices
  - System management practices
Status Accounting

• The capture of CM data, the processing of the data and the utilization of the information
  – You need to provide sufficient information to support management and decision making
  – Status accounting benefits accrue to:
    • Project managers
    • Quality assurance team
    • others

Audit

• The review of the project team’s process against the defined/required standards
  – Adherence to implementation process
  – Conformance to security
  – Configuration verification
• A good audit is a critical review that leads to recommendations and corrective updates to the process
  – Think continuous improvement
Establishing Configuration Management

- Establish a Change Control Board
  - Responsible for owning the change management process.
  - Proactively control change
  - Ensure process reviews
  - Ensure configuration reviews
  - Ensure CM process optimizes

- Use Tools

Change Control

- The processes, authorities for, and procedures to be used for all changes that are made to the computerized system and/or the system's data
- Change control is a vital subset of the Quality Assurance QA program within an establishment and should be clearly described in the establishment's SOPs
Change Management

- Change management is the handling of change requests
  - A change request leads to the creation of a new release
- General change process
  - The change is requested (this can be done by anyone including users and developers)
  - The change request is assessed against project goals
  - Following the assessment, the change is accepted or rejected
  - If it is accepted, the change is assigned to a developer and implemented
  - The implemented change isaudited
- The complexity of the change management process varies with the project. Small projects can perform change requests informally and fast while complex projects require detailed change request forms and the official approval by one more managers

Configuration Management

- Define configuration items
- Define labeling of files
- Define configuration management policies
- Define promotion of builds and releases
- Define audit report formats
Outline of a Software Configuration Management Plan (SCMP, IEEE 828-1990)

1. Introduction
   – Describes purpose, scope of application, key terms and references

2. Management (WHO?)
   – Identifies the responsibilities and authorities for accomplishing the planned configuration management activities

3. Activities (WHAT?)
   – Identifies the activities to be performed in applying to the project.

4. Schedule (WHEN?)
   – Establishes the sequence and coordination of the SCM activities with project milestones.

5. Resources (HOW?)
   – Identifies tools and techniques required for the implementation of the SCMP

6. Maintenance
   – Identifies activities and responsibilities on how the SCMP will be kept current during the life-cycle of the project.

SCMP Section 1: Introduction

1.1 Simplified overview of the configuration management activities
1.2 Scope:
   – Overview description of the project
   – Identification of the CI(s) to which software configuration management will be applied
1.3 Identification of other software to be included as part of the SCMP (support software and test software)
1.4 Relationship of SCM to hardware of system configuration management activities
1.5 Degree of formality and depth of control for applying SCM to project
1.6 Limitations and time constraints for applying SCM to this project
1.7 Assumptions that might have an impact on the cost, schedule and ability to perform defined SCM activities
SCMP Section 2: Management

2.1 Organization
- Organizational context (technical and managerial) within which the SCM activities are implemented. Identifies
  - All organizational units (client, developers, managers) that participate in an SCM activity
  - Functional roles of these people within the project
  - Relationship between organizational units

2.2. Responsibilities
- For each SCM activity list the name or job title to perform this activity
- For each board performing SCM activities, list
  - purpose and objectives
  - membership and affiliations
  - period of effectivity, scope of authority
  - operational procedures

3. Applicable Policies
- External constraints placed on the SCMP

Typical Configuration Management Roles

- Configuration Manager
  - Responsible for identifying configuration items. The configuration manager can also be responsible for defining the procedures for creating promotions and releases
- Change control board member
  - Responsible for approving or rejecting change requests
- Developer
  - Creates promotions triggered by change requests or the normal activities of development. The developer checks in changes and resolves conflicts
- Auditor
  - Responsible for the selection and evaluation of promotions for release and for ensuring the consistency and completeness of this release
SCMP Section 3: Activities

3.1 Configuration Identification
3.2 Configuration Control
3.3 Configuration Status Accounting
3.4 Configuration Audits and Reviews
3.5 Interface Control

3.2 Configuration Control

Defines the following steps

3.2.1 How to identify the need for a change
(layout of change request form)
3.2.2 Analysis and evaluation of a change request
3.2.3 Approval or disapproval of a request
3.2.4 Verification, implementation and release of a change
3.2.1 Change Request

• Specifies the procedures for requesting a change to a baselined CI and the information to be documented:
  – Name(s) and version(s) of the CI(s) where the problem appears
  – Originator’s name and address
  – Date of request
  – Indication of urgency
  – The need for the change
  – Description of the requested change

3.2.2 Evaluation of a Change

• Specifies the analysis required to determine the impact of proposed changes and the procedure for reviewing the results of the analysis.
3.2.3 Change Approval or Disapproval

- This section of the SCMP describes the organization of the configuration control board (CCB).
- Configuration Control Board (CCB)
  - Can be an individual or a group.
  - Multiple levels of CCBs are also possible, depending on the complexity of the project.
- Multiple levels of CCBs may be specified.
  - In small development efforts one CCB level is sufficient.
- This section of the SCMP also indicates the level of authority of the CCB and its responsibility.
  - In particular, the SCMP must specify when the CCB is invoked.

3.2.4 Implementing Change

- This section of the SCMP specifies the activities for verifying and implementing an approved change.
- A completed change request must contain the following information:
  - The original change request(s)
  - The names and versions of the affected configuration items
  - Verification date and responsible party
  - Identifier of the new version
  - Release or installation date and responsible party
- This section must also specify activities for
  - Archiving completed change requests
  - Planning and control of releases
  - How to coordinate multiple changes
  - How to add new CIs to the configuration
  - How to deliver a new baseline
3.3 Configuration Status Accounting

• This section of the SCMP must contain the following sections
  – What elements are to be tracked and reported for baselines and changes?
  – What types of status accounting reports are to be generated? What is their frequency?
  – How is information to be collected, stored and reported?
  – How is access to the configuration management status data controlled?

3.4 Configuration Audits and Reviews

• This section of the SCMP identifies audits and reviews for the project.
  – An audit determines for each Configuration Item if it has the required physical and functional characteristics.
  – A review is a management tool for establishing a baseline.
• For each audit or review the plan has to define:
  – Objective
  – The Configuration Items under review
  – The schedule for the review
  – Procedures for conducting the review
  – Participants by job title
  – Required documentation
  – Procedure for recording deficiencies and how to correct them
  – Approval criteria
Conformance to the IEEE Standard 828-1990

- Presentation format & Minimum information
  - A separate document or a section embedded in another document titled “Software Configuration Management Plan”
  - 6 Sections: Introduction, Management, Activities, Schedules, Resources and Plan Maintenance
- Consistency Criteria:
  - All activities defined in the SCMP (Section 3.1 to 3.6) are assigned to an organizational unit or person and they are associated with resources to accomplish the activities
  - All Configuration items identified in Section 2.1 have defined processes for baseline establishment and change control (Section 3.2)
- If the above criteria are met, the SCMP can include the following sentence: “This SCMP conforms with the requirements of IEEE Std 828-1990.”
- Note: The consistency criteria can also be used at a SCMP review meeting

Tailoring the SCMP

- The IEEE standard allows quite a bit flexibility for preparing an SCMP
- A SCMP may be
  - tailored upward:
    - to add information
    - to use a specific format
  - tailored downward
    - Some SCMP components might not apply to a particular project
    - Instead of omitting the associated section, mention its applicability
    - Information that has not been decided on at the time the SCMP is approved should be marked as “to be determined”
Tools for Software Configuration Management

- Software configuration management is normally supported by tools
- Examples:
  - RCS
    - very old but still in use; only version control system
  - CVS (Concurrent Version Control)
    - based on RCS, allows concurrent working without locking
    - http://www.cvshome.org/
    - CVSWeb: Web Frontend to CVS
  - Perforce
    - Repository server; keeps track of developer’s activities
    - http://www.perforce.com
  - ClearCase
    - Multiple servers, process modeling, policy check mechanisms

Tasks for the Configuration Manager

- Define configuration items
- Define promote /release policy
- Define activities and responsibilities
- Set up configuration management system

SCMP following the IEEE 828-1990 standard
Summary

- Software Configuration Management: Important part of project management to manage evolving software systems and coordinate changes to them.
- Software Configuration Management consists of several activities:
  - Promotion and Release management
  - Change Management
- Public standard for SCM plans: IEEE 828
- The standard can be tailored to a particular project:
  - Large projects need detailed plans to be successful
  - Small projects should not be burdened with the bureaucracy of detailed SCM plans
- SCM should be supported by tools: These range from
  - Simple version storage tools
  - Sophisticated systems with automated procedures for policy checks and support for the creation of SCM documents