Software Configuration Management

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Software Configuration Management

Outline

- CM and SCM Definitions
- SCM History
- CMMI and SCM
- SCM Tools
- SCM/Dynamic Systems
- SCM/Software Architecture
- Resources
Software Configuration Management
Definitions

Configuration Management (CM):
- “The discipline of managing change in large, complex systems” [2]
  • Manage and control numerous corrections, extensions, and adaptations that are applied to a system over its lifetime

Software Configuration Management (SCM):
- “The discipline that enables us to keep evolving software products under control, and thus contributes to satisfying quality and delay constraints.” [3]
  • Configuration Management of Software Systems
  • “The objective of SCM is to ensure a systematic and traceable software development process in which all changes are precisely managed, so that a software system is always in a well-defined state at all times.” [2]
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SCM Tool Responsibilities

• Dart separated CM concerns into 8 categories:
  – Components, Structure, Construction, Auditing, Accounting, Controlling, Process and Team

• SCM can be broken down into three main responsibilities:
  1. Component Repository: Versioning & System Models
  2. Tool Support: Workspace Control & Building
  3. Process control

• How do these main responsibilities cover the concerns:
  • Component Repository:
    – Components, Controlling
  • Tool Support:
    – Construction, Auditing, Controlling
  • Process Control:
    – Accounting, Process, Team
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History [2][3]

• 1950s – CM initiated in aerospace industry when production of spacecraft experienced difficulties caused by inadequately documented engineering changes
• 1960s – special ‘correction cards’ were used on the UNIVAC-1100 EXEC-8 operating system
• 1970s – first version control system providing history, delta, multi-user management and merging facilities
  – first version control system
  – appearance of CM tools SCCS, Diff, RCS, Make, and Sablème
• 1980s – debates on the most efficient type of storage and retrieval mechanism
  – resulted in text-based delta algorithms
  – “programming in the large” (versioning, rebuilding, composition)
  – SEI Fellow Watts S. Humphrey created CMM in 1987
  – Some resulting applications:
    – DSEE: only serious commercial product introducing system model concept which was an Architecture Description Language ancestor
    – NSE: workspace and cooperative work control
    – Adele: specialized product model with automatic configuration building
    – Aides de Camp: introducing change set
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History [2][3] continued

• 1990s
  – Management of non-textual objects and new algorithms for storing and retrieving objects
    – “programming in the many” (process support, concurrent engineering)
    – “programming in the wide” (web remote engineering)
    – Some resulting applications:
      – ClearCase (DSEE successor): virtual file system
      – Continuus: explicit process support

• 2000
  – Inexpensive disk storage, faster CPUs, and more nontextual objects
  – More advanced SCM systems
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CMM and CMMI

CMM: Capability Maturity Model
• Developed by Software Engineering Institute (SEI)
• “the quality of a system or product is highly influenced by the quality of the process used to develop and maintain it”

CMMI: Capability Maturity Model Integration
• Result of the evolution of three source models:
  1. The Capability Maturity Model for Software (SW-CMM) v2.0 draft C
  2. The Systems Engineering Capability Model (SECM)
  3. The Integrated Product Development Capability Maturity Model (IPD-CMM) v0.98

WHY CMM?
“Process improvement maturity model for the development of products and services. It consists of best practices that address development and maintenance activities that cover the product lifecycle from conception through delivery and maintenance.” [1]

Provides a means for measuring an organization on process maturity
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CMM and CMMI [5]

Figure 6.13  Maturity levels and associated key process areas (Source: M.C. Paulk et al., The Capability Maturity Model, ©Addison-Wesley Longman 1995. Reproduced with permission)
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CMM Representations Capability vs Maturity Levels [1]

Continuous Representation

<table>
<thead>
<tr>
<th>Level</th>
<th>Continuous Representation Capability Levels</th>
<th>Staged Representation Maturity Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 0</td>
<td>Incomplete</td>
<td>N/A</td>
</tr>
<tr>
<td>Level 1</td>
<td>Performed</td>
<td>Initial</td>
</tr>
<tr>
<td>Level 2</td>
<td>Managed</td>
<td>Managed</td>
</tr>
<tr>
<td>Level 3</td>
<td>Defined</td>
<td>Defined</td>
</tr>
<tr>
<td>Level 4</td>
<td>Quantitatively Managed</td>
<td>Quantitatively Managed</td>
</tr>
<tr>
<td>Level 5</td>
<td>Optimizing</td>
<td>Optimizing</td>
</tr>
</tbody>
</table>
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CMMI Process Areas

There are 22 process areas [1]:

• Causal Analysis and Resolution (CAR)
• Configuration Management (CM)
• Decision Analysis and Resolution (DAR)
• Integrated Project Management + Integrated Product and Process Development (IPM+IPPD)
• Measurement and Analysis (MA)
• Organizational Innovation and Deployment (OID)
• Organizational Process Definition + IPPD (OPD+IPPD)
• Organizational Process Focus (OPF)
• Organizational Process Performance (OPP)
• Organizational Training (OT)
• Product Integration (PI)
• Project Monitoring and Control (PMC)
• Project Planning (PP)
• Process and Product Quality Assurance (PPQA)
• Quantitative Project Management (QPM)
• Requirements Development (RD)
• Requirements Management (REQM)
• Risk Management (RSKM)
• Supplier Agreement Management (SAM)
• Technical Solution (TS)
• Validation (VAL)
• Verification (VER)
These 22 process areas can be grouped into four categories:

- Process Management
- Project Management
- Engineering
- Support

Configuration Management is considered part of the Support category. Its purpose is to establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits.

**Specific Goal and Practice Summary:**

**SG1 Establish Baselines**

- **SP 1.1** Identify Configuration Items
- **SP 1.2** Establish a Configuration Management System
- **SP 1.3** Create or Release Baselines

**SG2 Track and Control Changes**

- **SP 2.1** Track Change Requests
- **SP 2.2** Control Configuration Items

**SG3 Establish Integrity**

- **SP 3.1** Establish Configuration Management Records
- **SP 3.2** Perform Configuration Audits
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Configuration Management Plan

- CM Plan document describes methods to identify configuration items, to control change requests, and to document the implementation of those change requests.
- Contents of plan can be found in IEEE Standard for Software Configuration Management Plans, IEEE Std 828-1990. [IEE90b]
- Configuration or Change Control Board (CCB)
- Main sections [5]:
  - Management: This section describes how the project is being organized. Particular attention is paid to responsibilities which directly affect configuration management; how are change requests being handled, how are development phases closed, how is the status of the system maintained, how are interfaces between components identified? Also, the relationship with other functional organizations, such as software development and quality assurance, is delineated.
  - Activities: this section describes how a configuration will be identified and controlled and how its status will be accounted and reported. A configuration is identified by a baseline: a description of the constituents of that configuration. Such a configuration must be formally approved by the parties involved.
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Example of Configuration Management Plan [5]

1 Introduction
   a. Purpose
   b. Scope
   c. Definitions and acronyms
   d. References
   e. Tailoring
2 SCM management
   a. Organization
   b. SCM responsibilities
   c. Applicable policies, directives and procedures
3 SCM Activities
   a. Configuration Identification
   b. Configuration Control
   c. Configuration Status Accounting
   d. Configuration Auditing and Review
   e. Interface Control
   f. Subcontractor/vendor control
4 SCM Milestones
5 SCM Resources/Training
6 SCM Plan Maintenance
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SCM Tools/Products

- IBM Rational ClearCase
- Perforce
- PureCM
- Microsoft Visual SourceSafe
- SourceGear Vault
- Telelogic Synergy/CM
- Concurrent Versions Systems (CVS):
- Subversion (SVN)
Dynamic Change Management:
- Separating structural concerns from component application concerns
- Managing change without knowing what could change in the future as the system is extended (new functions, updated functions)

Objectives of an application independent configuration management facility [4]:
- Changes should be specified in terms of the system structure
- Change specifications should be declarative
- Change specifications should be independent of the algorithms, protocols, and states of the application
- Changes should leave the system in a consistent state
- Changes should minimize the disruption to the application system
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SCM/Software Architecture

- Involvement of stakeholders
- Components need to be identified
- Relationships amongst components must be addressed
- Process to set up SCM and Software Architecture
- Control of SCM and Architecture
- Way to resolve change (CCB teams)
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References


