Capability Maturity Model (CMM) in SW design

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Outline

• Basic rules in improvements
• Problems in SW projects - CMM as a helper
• CMM background
  – The SW crisis
  – Increasing SW complexity
  – Success factors
  – Mature organisations
• Process - an important element
  – Role of a process
  – process as an organisational asset
  – Improving the process capability
• CMM as a model
  – Process maturity framework
  – Role of CMM
  – CMM structure, version 1.1
  – Maturity steps
  – Key practices
• Characteristics on each CMM level
  – Levels 1- 5
• CMM usage in process improvements
• CMM assessment
  – What is an an assessment
  – How an assessment is conducted
  – What results are produced in an assessment
• SEI’s maturity survey
Basic rules in improvements (1)

“If you don’t know where you are, a map won’t help”

Watts Humprey

Basic rules in improvements (2)

“You need to know where you are, before you can decide where to go!”

Grosby
Common problems in SW projects

- Project having always resource problems
- Quality criterias not always met
- Not enough competence in all projects
- Unexpected surprises in projects (technical & administrative)
- Unstable input documents/products
- Improvements not meeting the real work
- . . .

CMM as a helper

There is NO silver bullet!
Factors leading to the establishment of the SEI (Software Engineering institute) and later on creation of CMM:

- Increasing cost of SW
- Quality problems in SW products
- Cost of SW maintenance
- US government put billions of dollars in SW acquisition
- USA’s competitiveness increasingly dependent on SW
- Increasing rate of change in technology and SW environment
- Typical SW project was a year late and exceeded two times the budget
- Increasing SW complexity

Increasing SW complexity

<table>
<thead>
<tr>
<th>Lines of Code</th>
<th>Development structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000 - 5,000</td>
<td>Individual programmer</td>
</tr>
<tr>
<td>5,000 - 25,000</td>
<td>Small team</td>
</tr>
<tr>
<td>25,000 - 100,000</td>
<td>Large subdivided team</td>
</tr>
<tr>
<td>100,000 - 1,000,000</td>
<td>Several teams or division</td>
</tr>
<tr>
<td>1,000,000 - 10,000,000</td>
<td>Several companies</td>
</tr>
<tr>
<td>10,000,000 - 100,000,000</td>
<td>National undertaking</td>
</tr>
</tbody>
</table>
Mature organisations

- Processes are defined, documented and controlled
- Roles and responsibilities are clear
- Products and processes are measured
- Quality, costs and schedules are measured and followed-up
- Management is committed to continuous improvement
- Technology is effectively used within organisation’s SW process(es)
- Preventive quality work is a fact

Role of the process

SW Process can be defined as a set of activities, methods, practices and transformations that people use to develop and maintain software and associated products (e.g. project plans, design documents, test plans, user manuals etc.)
Process: an organisation asset

People

Process

Technology

Major elements determining:
- SW cost
- SW schedule
- SW quality

Improving process capability

- Improve predictability
- Improve control
- Improve performance
Process maturity framework (1)

Key process areas (18) → Process maturity

Enable → Process capability

Constitute → Indicates

Predicts → Process performance

Process maturity framework (2)

Process maturity: An organisation's ability to consistently follow and improve its process

Process capability: The range of results expected from following the process

Process performance: The actual results achieved from following the process
Role of CMM

◆ Provides a guide for measuring an organisation’s SW process capability
◆ Sets goals and priorities for SW process improvements
◆ Assists improvement action planning
◆ Outlines a method for applying process management and quality improvement concepts to SW development and maintenance
◆ Guides an organisation from ad hoc working environment to software “engineering excellence”

CMM structure (1)

<table>
<thead>
<tr>
<th>Level</th>
<th>Key Process Areas</th>
<th>Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Optimizing</td>
<td>Defect Prevention Technology Innovation Process Change Management</td>
<td>Continuous process improvement</td>
</tr>
<tr>
<td>4 Managed</td>
<td>Quantitative Process Management SW Quality Management</td>
<td>Product and process quality managed by facts</td>
</tr>
<tr>
<td>3 Defined</td>
<td>Organisation Process Focus Organisation Process Definition Peer Reviews Training Program Intergroup Coordination SW Product Engineering Integrated SW Management</td>
<td>Standardised SW engineering process</td>
</tr>
<tr>
<td>2 Repeatable</td>
<td>SW Project Planning SW Project Tracking SW Subcontract Management SW Quality Assurance SW Configuration Management Requirements Management</td>
<td>Disciplined project management The commitment process</td>
</tr>
<tr>
<td>Initial</td>
<td>Heroes</td>
<td></td>
</tr>
</tbody>
</table>
Maturity steps

Level 1: Initial
- Process discipline
- Process definition
- Project management

Level 2: Repeatable
- Continuous process improvement
- Process control
- Process definition
- Engineering management

Level 3: Defined
- Level 3: Defined
- Level 3: Defined

Level 4: Managed
- Level 4: Optimising
- Change management
- Quantitative management

Level 5: Optimising
- Level 5: Optimising

CMM structure (2)

CMM model (ver 1.1)

18 Key process areas (e.g. Project planning)

Key practices

Commitment

Ability

Activities

Measurement

Verification
Characteristics for level 1

- No key processes
- Weak management practices
- Poorly controlled commitments
- Processes are ad hoc
- Practices are sacrificed for schedule
- Practitioners resist discipline
- Results are unpredictable

Characteristics for level 2

- Project management is strong and lays foundation for process discipline
- Project activities are planned and followed
- Project ensures that practices are performed
- Corrective actions are made when necessary
- Project “own” its commitments
- Commitments are clear and communicated
- Necessary baselines are build and controlled
Characteristics for level 3

◆ Organisation focus on process definition and process usage
◆ Process management infrastructure exists
◆ Process work is part of organisation’s business
◆ Organisational SW process exists
  - collection of best practices
  - tailored for each project
  - integrates different processes
  - basis for comparable measurement results
◆ Training plans are created and followed
  (project and organisation levels)
◆ More systematic technical coordination between different project groups

Characteristics for level 4

◆ Processes and products are on statistical control
◆ Quantitative limits are established for process performance
◆ Process performance is managed (I.e quantitatively controlled)
◆ Predictability is improved
◆ Data is actively used as a base in decision making
◆ Process capability baseline is established
Characteristics for level 5

◆ Continuous process improvement in place
◆ Processes and technology are continuously evaluated
◆ Individuals are empowered to improve their processes
◆ The causes of defects are eliminated as part of preventive quality work
◆ New technologies can be utilised effectively to improve process capability

CMM usage in process improvements

- Business goals
- Quality goals
- Capabilities
- Lead time goals
- KPA goals
- Maturity
- CMM level
- Key practices
- Institutionalization
- Own practices
CMM assessment - What is an assessment

- Small number of high potential improvements are identified
- Consensus of improvement areas and needs is developed
- Motivation is created for improvement needs
- CMM model is used as a framework and reference to identify weaknesses
- Maturity questionnaires are used to define assessment scope
- Organisation’s goals are essential part of an assessment process

GOAL:
Most benefit for organisation’s improvement planning and execution

CMM assessment - How an assessment is conducted

- An appraisal made by 4-8 experienced SW professionals
- Organisations maturity is assessed through 3-5 projects
- In-depth discussions with project leaders and practitioners to collect facts about the organisation’s practices
- Running time 5-10 days
- Both documentation and practices are evaluated
- Strict confidentiality rules apply
CMM assessment - What are produced in an assessment

- Findings on different Key Process areas
  - weaknesses
  - strengths
  - observations (non-CMM related)
- Recommendations for addressing the findings

SEI’s maturity survey (1)
SEI's maturity survey (2)

Countries where Assessments have been Performed and Reported to the SEI

SEI's maturity survey (3)

Trends in the Community Maturity Profile

Based on the most recent assessments of the organisations up through the year indicated. No data is shown for data aging performed for recent years. This accounts for the difference in the figures on page 18.