CMM & Process Improvement

SWEN 256 – Software Process & Project Management

Process Improvement

- Understanding existing processes

- Introducing process changes to achieve organisational objectives which are usually focused on quality improvement, cost reduction and schedule acceleration

- Most process improvement work so far has focused on defect reduction. This reflects the increasing attention paid by industry to quality

- However, other process attributes can be the focus of improvement

The Software Engineering Institute

- US Defence Dept. funded institute associated with Carnegie Mellon

- Mission is to promote software technology transfer particularly to defence contractors

- Maturity model proposed in mid-1980s, refined in early 1990s.

- Work has been very influential in process improvement

The SEI Process Maturity Model

Level 5
Optimizing

Level 4
Managed

Level 3
Defined

Level 2
Repeatable
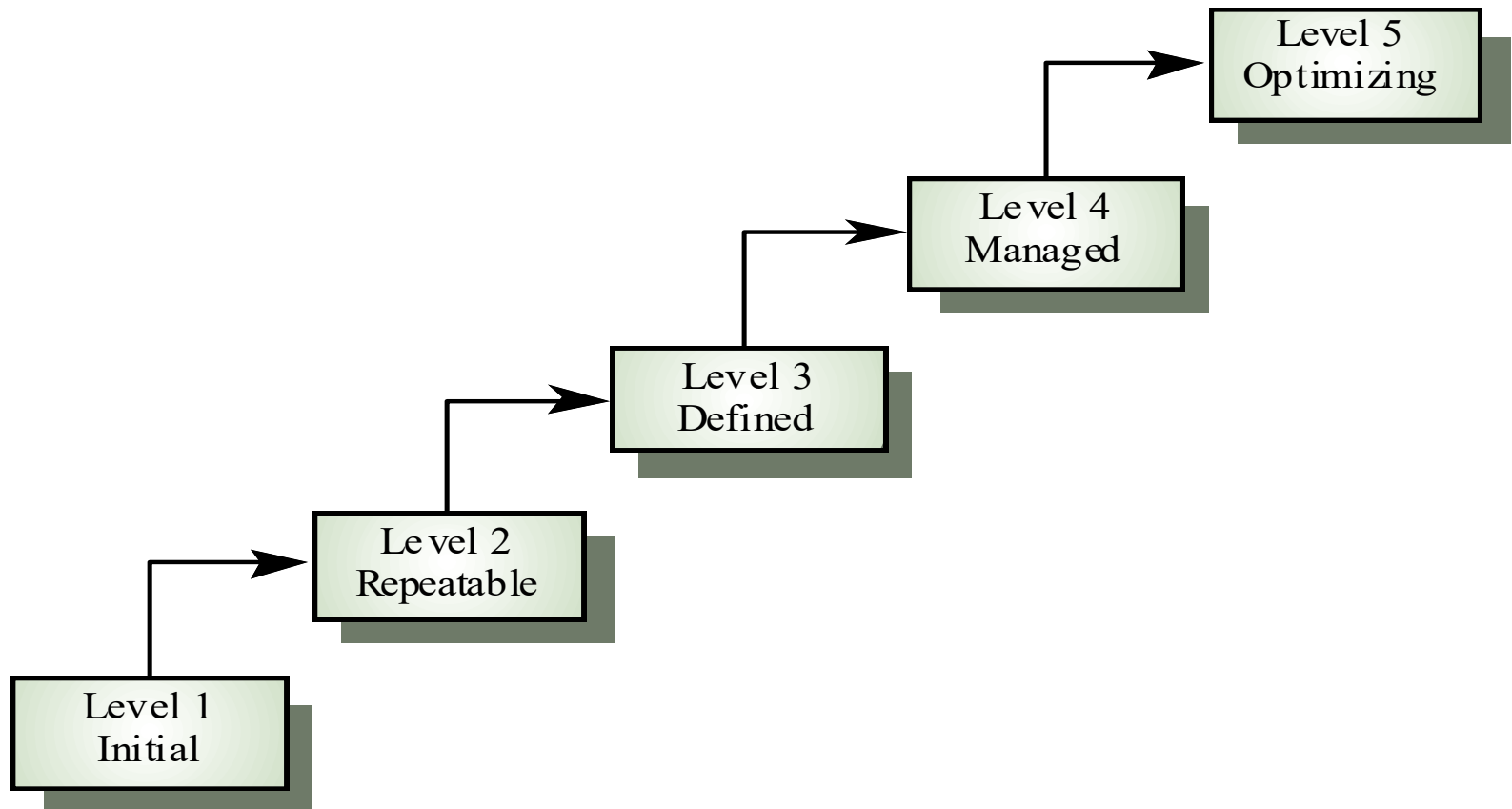
Level 1
Initial

CMM Levels

- Initial
  - Essentially uncontrolled
- Repeatable
  - Product management procedures defined and used
- Defined
  - Process management procedures and strategies defined and used
- Managed
  - Quality management strategies defined and used
- Optimising
  - Process improvement strategies defined and used

The CMM and ISO 9000(1)

- There is a clear correlation between the key processes in the CMM and the quality management processes in ISO 9000

- The CMM is model for software development and management and includes a framework for improvement

- Organisations rated as level 2 or higher in the CMM are likely to be ISO 9000 compliant

- CMM: Define what you do, and then do it (with proof)
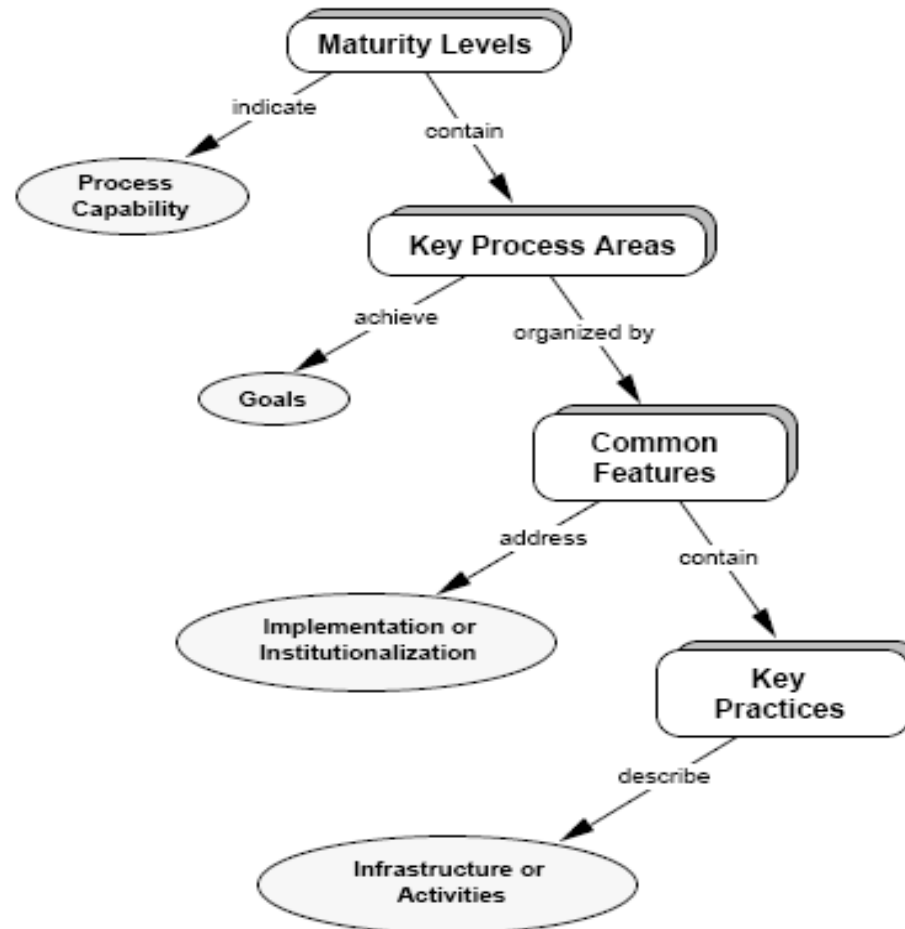
- ISO: Detailed Quality Management and certification

The CMM Essence

ɛ∂ The CMM (Capability Maturity Model) for Software describes the principles and practices underlying software process maturity.

ɛ∂ It is intended to help software organizations improve the maturity of their software processes in terms of an evolutionary path from ad hoc, chaotic processes to mature, disciplined software processes.

   o The focus is on identifying key process areas and the exemplary practices that may comprise a disciplined software process.

ɛ∂ The ultimate goal is to improve software development and maintenance in the areas of <u>cost</u>, <u>schedule</u> and <u>quality</u>.

CMM Structure & Organization

- The SW-CMM is organized into a set of well-defined "maturity levels".

- A <u>maturity level</u> is a well-defined evolutionary plateau toward achieving a mature software process.
  - Each maturity level provides a layer in the foundation for continuous process improvement.
  - Structurally a maturity level is made up of a set of key process areas.

- Each <u>key process area</u> (KPA) identifies a cluster of related activities that, when performed collectively, achieve a set of goals considered important for enhancing process capability.

CMM Structure & Organization

Levels — Defining Characteristics

Level	Focus	Decription
5: Optimizing	Continuous Process Improvement	Continuous process improvement is enabled by quantitative feedback from the process and from piloting innovative ideas and technologies.
4: Managed	Product and Process Quality	Detailed measures of the software process and product quality are collected. Both the software process and products are quantitatively understood and controlled.
3: Defined	Engineering Process	The software process for both management and engineering activities is documented, standardized, and integrated into a standard software process for the organization. All projects use an approved, tailored version of the organization's standard software process for developing and maintaining software.
2: Repeatable	Project Management	Basic project management processes are established to track cost, schedule, and functionality. The necessary process discipline is in place to repeat earlier successes on projects with similar applications.
1: Initial	No Focus	Project success primary depends on individuals and their heroics.

Key Process Areas

Level	Focus	Key Process Area
5: Optimizing	Continuous Process Improvement	• Defect Prevention • Technology Change Management • Process Change Management
4: Managed	Product and Process Quality	• Quantitative Process Management • Software Quality Management
3: Defined	Engineering Process	• Organizational Process Focus • Organizational Process Definition • Integrated Software Management • Training Program • Software Product Engineering • Intergroup Coordination • Peer Reviews
2: Repeatable	Project Management	• Requirements Management • Software Project Planning • Software Project Tracking and Oversight • Software Subcontract Management • Software Quality Assurance • Software Configuration Management

CMM Example

Defect Prevention Process Area

Example Key Process: DP - Goals

- The purpose of <u>Defect Prevention</u> (DP) is to identify the cause of defects and prevent them from recurring.

- Goal 1
  - Defect prevention activities are planned.

- Goal 2
  - Common causes of defects are sought out and identified.

- Goal 3
  - Common causes of defects are prioritized and systematically eliminated.

Example: DP - Commitment to Perform

- Commitment 1
  - The organization follows a written policy for defect prevention activities.

- Commitment 2
  - The project follows a written organizational policy for defect prevention activities.

Example: DP - Ability to Perform

- Ability 1
  - An organization-level team to coordinate defect prevention activities exists.
- Ability 2
  - A team to coordinate defect prevention activities for the software project exists.
- Ability 3
  - Adequate resources and funding are provided for defect prevention activities at the project and organization levels.
- Ability 4
  - Members of the software engineering group and other software related groups receive required training to perform their defect prevention activities.

Example: DP - Activities Performed

- Activity 1
  - The software project develops and maintains a plan for its defect prevention activities.
- Activity 2
  - At the beginning of a software task, the members of the team performing the task meet to prepare for the activities of that task and the related defect prevention activities.
- Activity 3
  - Causal analysis meetings are conducted according to a documented procedure.
- Activity 3
  - Each of the teams assigned to coordinate defect prevention activities meets on a periodic basis to review and coordinate implementation of action proposals from the causal analysis meetings.

Example: DP - Activities Performed (2)

- Activity 5
  - Defect prevention data are documented and tracked across the teams coordinating defect prevention activities.
- Activity 6
  - Revisions to the organization's standard software process resulting from defect prevention actions are incorporated according to a documented procedure.
- Activity 7
  - Revisions to the project's defined software process resulting from defect prevention actions are incorporated according to a documented procedure.
- Activity 8
  - Members of the software engineering group and software-related groups receive feedback on the status and results of the organization's and project's defect prevention activities on a periodic basis.

Example: DP - Measurement and Analysis

- Measurement 1
  - Measurements are made and used to determine the status of the defect prevention activities.

Example: DP - Verifying Implementation

 Verification 1

  o The organization's activities for defect prevention are reviewed with senior management on a periodic basis.

 Verification 2

  o The software project's activities for defect prevention are reviewed with the project manager on both a periodic and event driven basis.

 Verification 3

  o The software quality assurance group reviews and/or audits the activities and work products for defect prevention and reports the results.
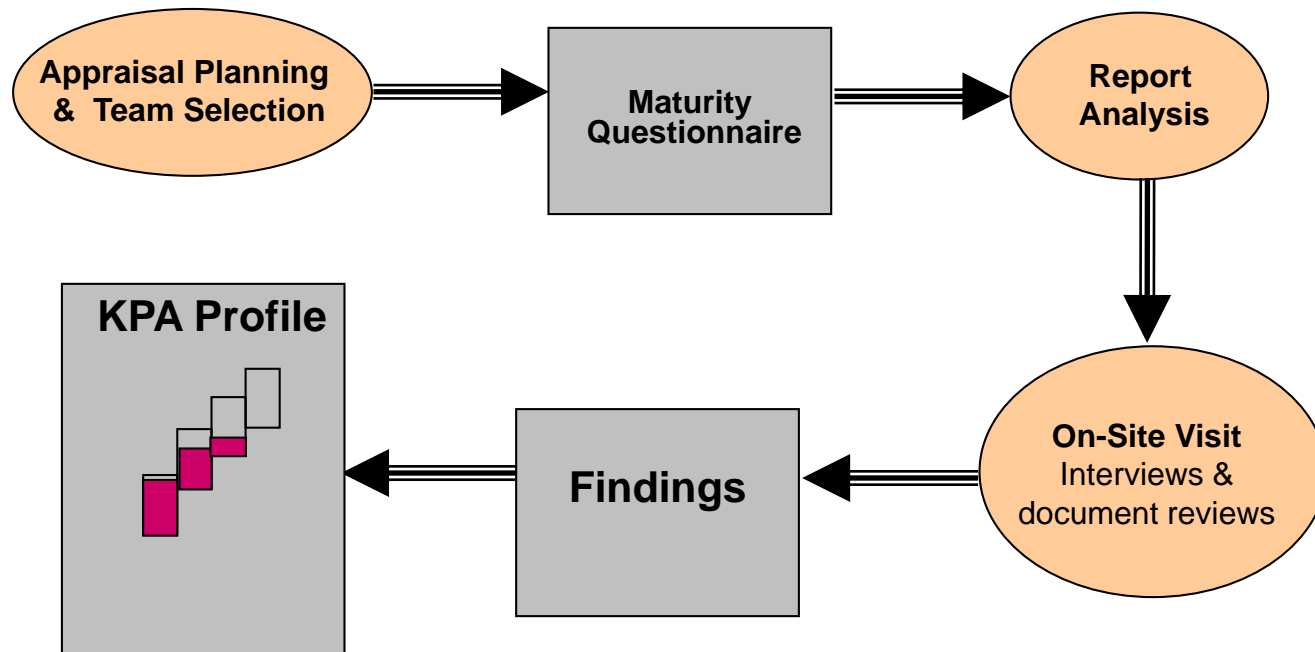
The CMM Appraisal

Appraisal Activities

֍ Appraisals activities can be grouped into three phases:

- Plan and Prepare for Appraisal
- Conduct Appraisal
- Report Results

Software Process Assessments

- Software process assessments focus on identifying improvement priorities within an organization's own software process.

- Assessment teams use the CMM to guide them in identifying and prioritizing findings.

  - These findings, along with guidance provided by the key practices, would typically be used by the SEPG (software engineering process group) to plan an improvement strategy for the organization.

Software Capability Evaluations

- Software capability evaluations are focused on identifying the risks associated with a particular project or contract for building high-quality software, on schedule, and within budget.
- During the acquisition process, software capability evaluations may be performed on bidders.
  - The findings of the evaluation, as structured by the CMM, may be used to identify the risks in selecting a particular contractor.
- Evaluations may also be performed on existing contracts to monitor their process performance, with the intent of identifying potential improvements in the software process of the contractor.

Assessment Team

- The assessment team must be led by an authorized SEI Lead Assessor.

- The team shall consist of from 4 to 10 members. At least one team member must be from the organization being assessed.

- All team members must receive the SEI's Introduction to the CMM course, or its equivalent, and the SEI's CBA IPI team training course.

- Team members must meet the selection guidelines relative to software engineering and management experience.

Assessment Plan

- An assessment plan needs to be created that, at a minimum, contains the following:
  - the goals for the assessment
  - the CMM scope (KPAs to be examined) and the organization scope for the assessment including selected projects and assessment participants
  - a schedule for assessment activities and identification of the resources to perform the activities
  - the assessment outputs and any anticipated follow-on activities
  - planned tailoring of the assessment method
  - risks and constraints associated with execution of the assessment
  - the sponsor's authorization for the assessment to be conducted

Data Collection

- Assessment data must be classified with respect to four data collection categories (instruments, presentations, interviews, and documents) and at a minimum contain the following:
  - instrument data (maturity questionnaire responses) from at least the project leaders from the selected projects
  - interview data from project leaders from selected projects via individual interviews
  - interview data from functional area representatives (practitioners) and middle managers via group interviews
  - document data for each of the KPA goals within the CMM scope of the assessment
  - presentation data via a review of the draft findings with the assessment participants

Maturity Questionnaire

The following are example questions from the Maturity Survey [Zubrow 1994] for the Peer Review KPA:

		Yes	No	Does Not Apply	Don't Know
1	Are peer reviews planned?	☐	☐	☐	☐
	Comments:				
2	Are actions associated with defects that are identified during peer reviews tracked until they are resolved?	☐	☐	☐	☐
	Comments:				
3	Does the project follow a written organizational policy for performing peer reviews?	☐	☐	☐	☐
	Comments:				

Interview Questions

- Software Project Planning
  - Can you describe your process for software planning and estimation on the project?
  - How do you track your estimates?
  - Can you provide me with some estimates?
  - Describe your process or estimating critical computer resources.
  - Please describe your process for identifying and managing risks on the project.
  - Is there an overall project plan for the project?

Data Validation

- Data must be validated using the following rules and must sufficiently cover the CMM components within the assessment scope, the organization, and the software development life cycle.
  - Observations are based on data from at least two independent sources (e.g., two separate people or a person and a document).
  - Observations are based on data obtained during at least two different data gathering sessions.
  - Observations are confirmed by at least one data source reflecting work actually being done (e.g., an implementation level document or an interview with a person who is performing the work).

Ratings

There are three components of the CMM reference model that can be rated: goals, KPAs, and maturity level. A KPA or goal is:

- <u>satisfied</u> if it is implemented and institutionalized either as defined in the CMM, or with an adequate alternative.
- <u>unsatisfied</u> if there are significant weaknesses in its implementation or institutionalization.
- <u>not applicable</u> if the KPA is not applicable in the organization's environment.
- <u>not rated</u> if it falls outside the scope of the appraisal.

Summary

What the CMM Does Not Do

෯ The CMM is not a silver bullet [Brooks 1995].

෯ The SW-CMM does not address all of the issues that are important for successful projects.

  o does not address expertise in particular application domains

  o advocate specific software technologies

  o suggest how to select, hire, motivate, and retain competent people

෯ *There are other versions of the CMM and related documents that do address some of these issues.*

Messages to Remember

- The SW-CMM provides a hierarchical structure for evolutionary software process improvement.
- The CMM is based on study and analysis of software engineering best practices.
- CMM documentation provides support for SPI at the organizational and project levels.
- The CMM provides a "framework for SPI, not specific details of how a software process should be defined and implemented. "

Questions/Discussion

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