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 backround**
  - **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**
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  - **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)**

- ◆ **Unstabile input documents/products**

- ◆ **Improvements not meeting the real work**

- ◆ **. . .**
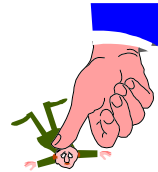
CMM as a helper

There is NO silver bullet !

C M M
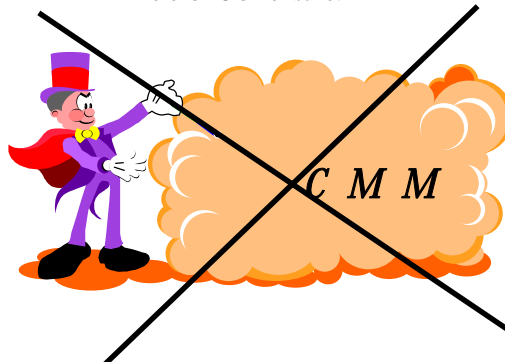
SW crisis

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

Lines of Code	Development structure
1,000 - 5,000 ⇒	Individual programmer
5,000 - 25,000 ⇒	Small team
25,000 - 100,000 ⇒	Large subdivided team
100,000 - 1,000,000 ⇒	Several teams or division
1,000,000 - 10,000,000 ⇒	Several companies
10,000,000 - 100,000,000 ⇒	National undertaking

Mature organisations

◆ Processes are defined, documented and controlled

◆ Roles and responsibilities are clear

◆Products and <u>processes</u> 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

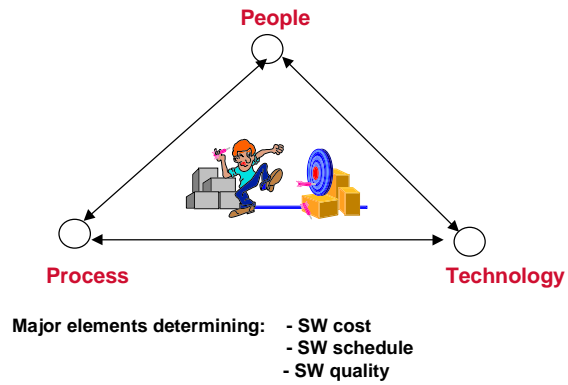## Role of the process

Management

PROCESSES

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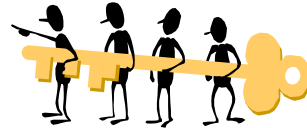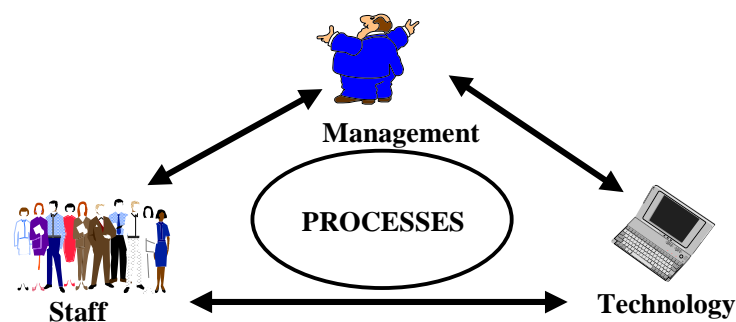
SW Process can be defined as a set of activities, methods, practices and transformations that people use to develop and maintain software and associated products (e.g. project plans, design documents, test plans, user manuals etc.)

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)	—Constitute→	Process maturity

Key process areas (18) —**Constitute**→ Process maturity

Enable ↘ **Process capability** ↙ **Indicates**

Predicts ↓

Process performance
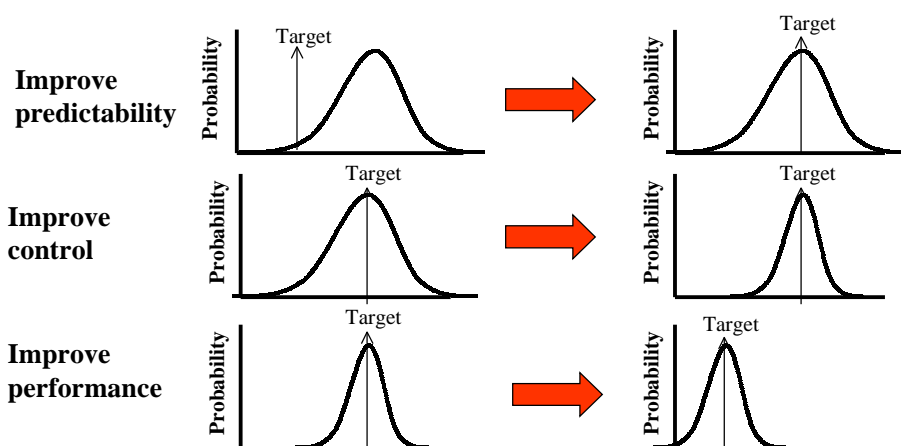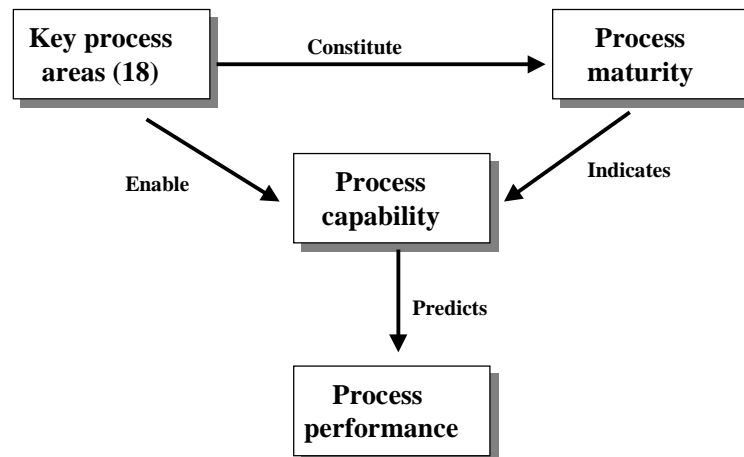
Process maturity framework (2)

Process maturity   **An organisation's ability to consistently <u>follow</u> and improve its process**

Process capability   **The range of results expected from <u>following</u> the process**

Process performance   **The actual results achieved from <u>following</u> the process**
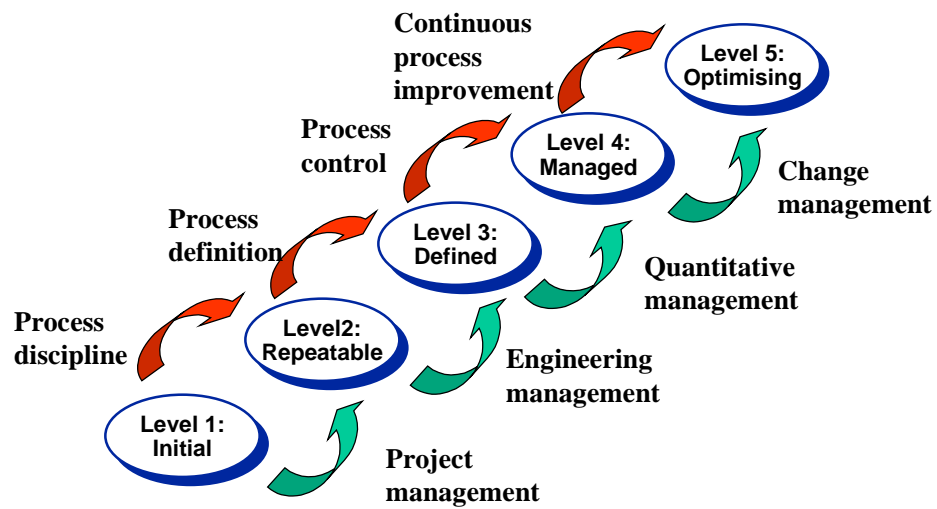
Role of CMM

◆ **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"**
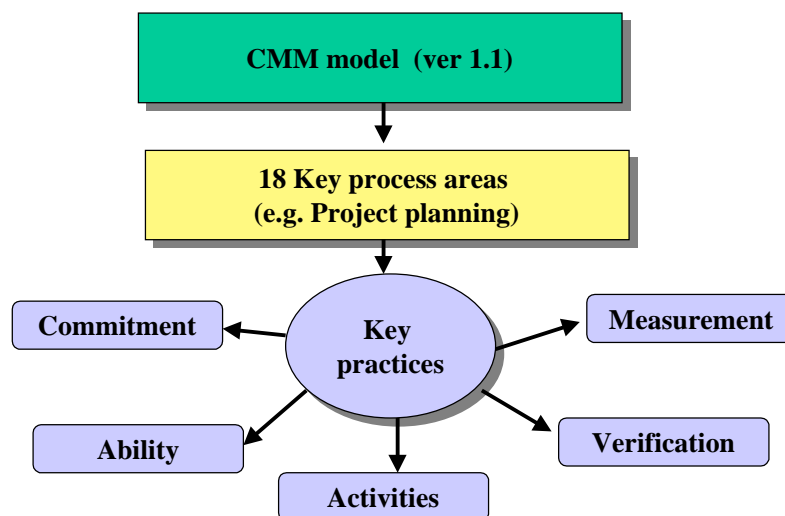

CMM structure (1)

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

(Version 1.1)

Maturity steps

ERICSSON

Continuous process improvement

Process control

Process definition

Process discipline

Level 5: Optimising

Level 4: Managed

Level 3: Defined

Level2: Repeatable

Level 1: Initial

Change management

Quantitative management

Engineering management

Project management

ERICSSON

CMM structure (2)

CMM model (ver 1.1)

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

Commitment
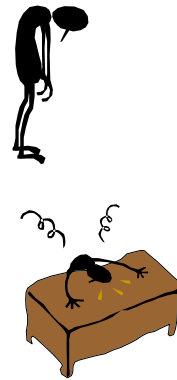
Key practices

Measurement

Ability

Activities

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**

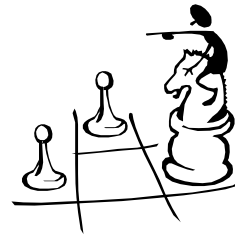## Characteristics for level 2

◆ **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**
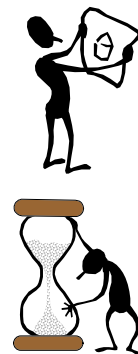
Characteristics for level 3

◆ **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**
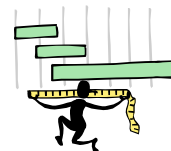
Characteristics for level 5

◆ **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

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 á 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**

CMM Level 2

SEI's maturity survey (1)

Organization Maturity Profile
August 1999

Based on most recent assessment, since 1996, of 734 organizations.

SEI's maturity survey (2)

Software Engineering Institute

Countries where Assessments have been Performed and Reported to the SEI

Argentina	Australia	Barbados	Belgium	Brazil	Canada	Chile	China
Colombia	Denmark	Finland	France	Germany	Greece	Hong Kong	India
Ireland	Israel	Italy	Japan	Korea, Republic Of	Malaysia	Mexico	Netherlands
Philippines	Portugal	Puerto Rico	Saudi Arabia	Singapore	Switzerland	Taiwan	Turkey
United Kingdom	United States

Harri Reiman 9.11.1999

SEI's maturity survey (3)

Software Engineering Institute

Trends in the Community Maturity Profile

Year	Orgs
1987-1991	130
1992-1996	637
1997	795
1998	963
1999	1036

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

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