Capability Maturity Model (CMM) in SW design

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)

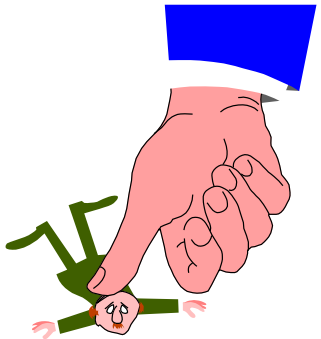
"You need to know
where you are,
before you can decide
where to go!"

Grosby

Common problems in SW projects

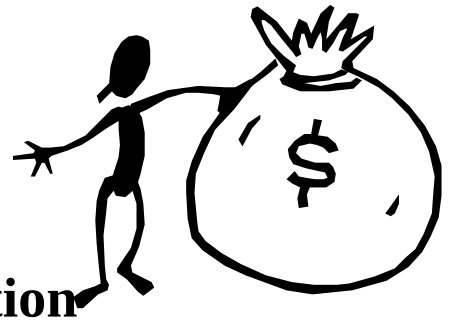
- Project having always resource problems
- Quality criterias not always met
- Not enough competence in all projects
- Unexpected surprises in projects

  (technical & administrative)
- Unstable input documents/products
- Improvements not meeting the real work
- . . .



SW crisis

Factors leading to the establishment of the SEI
(Software Engineering institute) and later on creation of CMM:



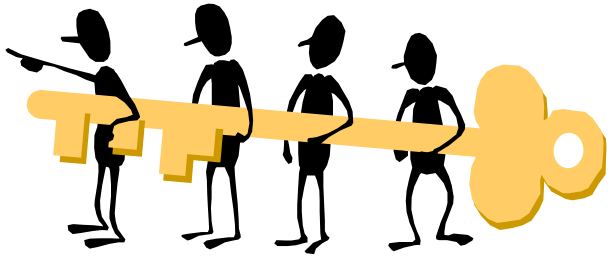
- **Increasing cost of SW**
- **Quality problems in SW products**
- **Cost of SW maintenance**
- **US government put billions of dollars in SW acquisition**
- **USA's competitiveness increasingly dependent on SW**
- **Increasing rate of change in technology and SW environment**
- **Typical SW project 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

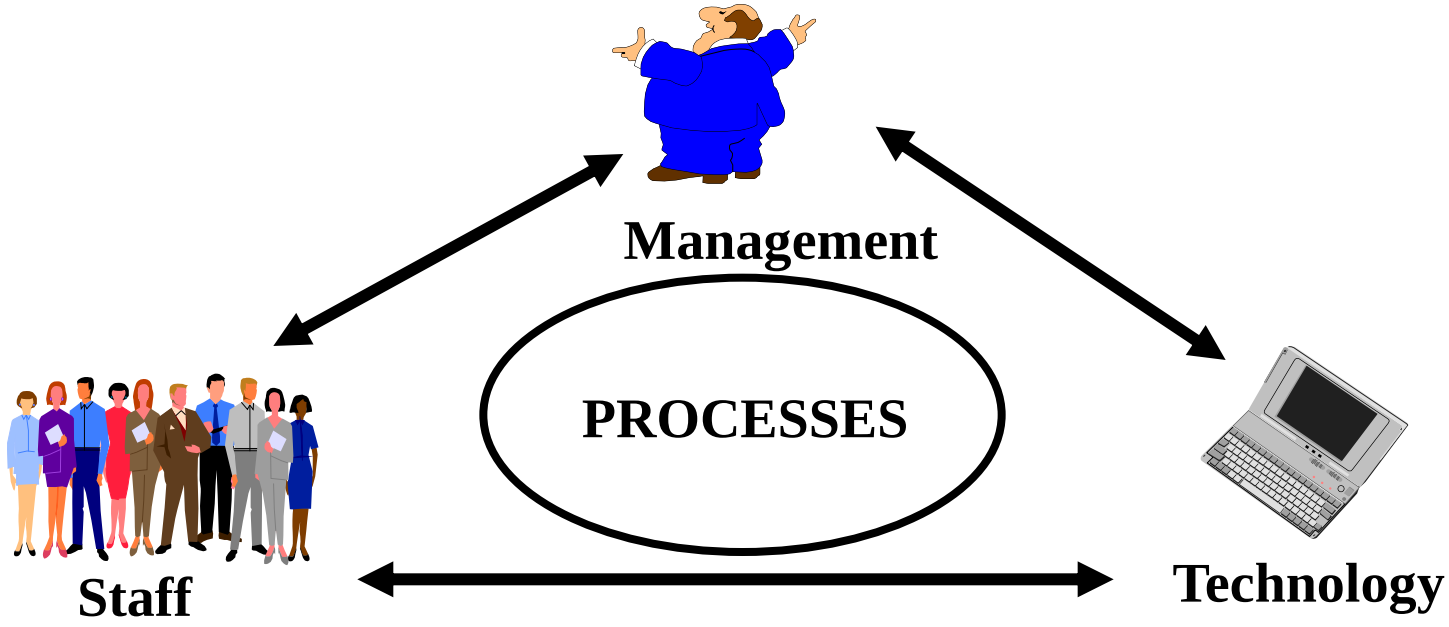
Mature organisations

- Processes are defined, documented and controlled
- Roles and responsibilities are clear
- Products and processes are measured



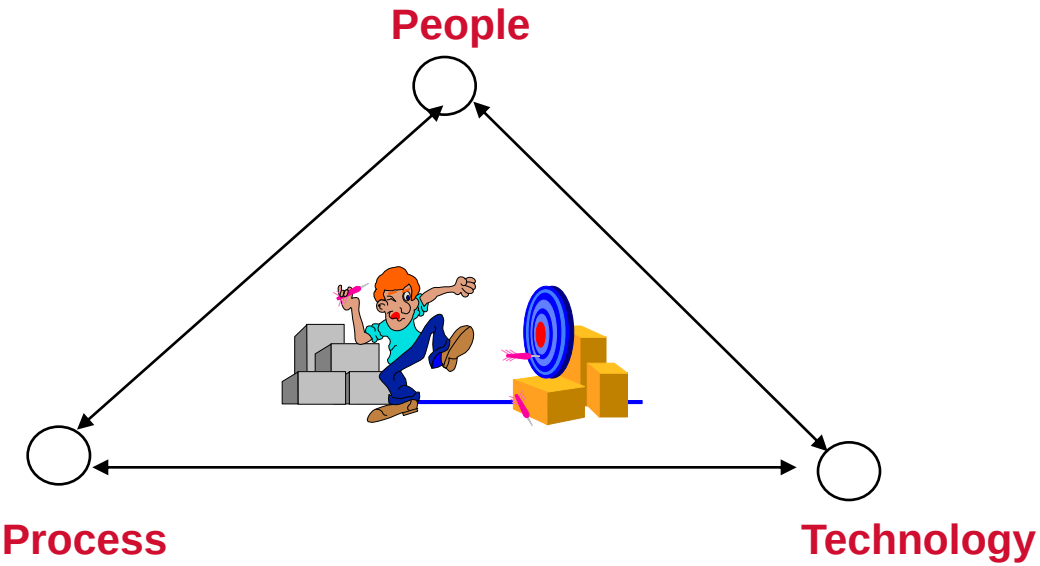
- Quality, costs and schedules are measured and followed-up
- Management is committed to continuous improvement
- Technology is effectively used within organisation’s SW process(es)
- Preventive quality work is a fact

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.)

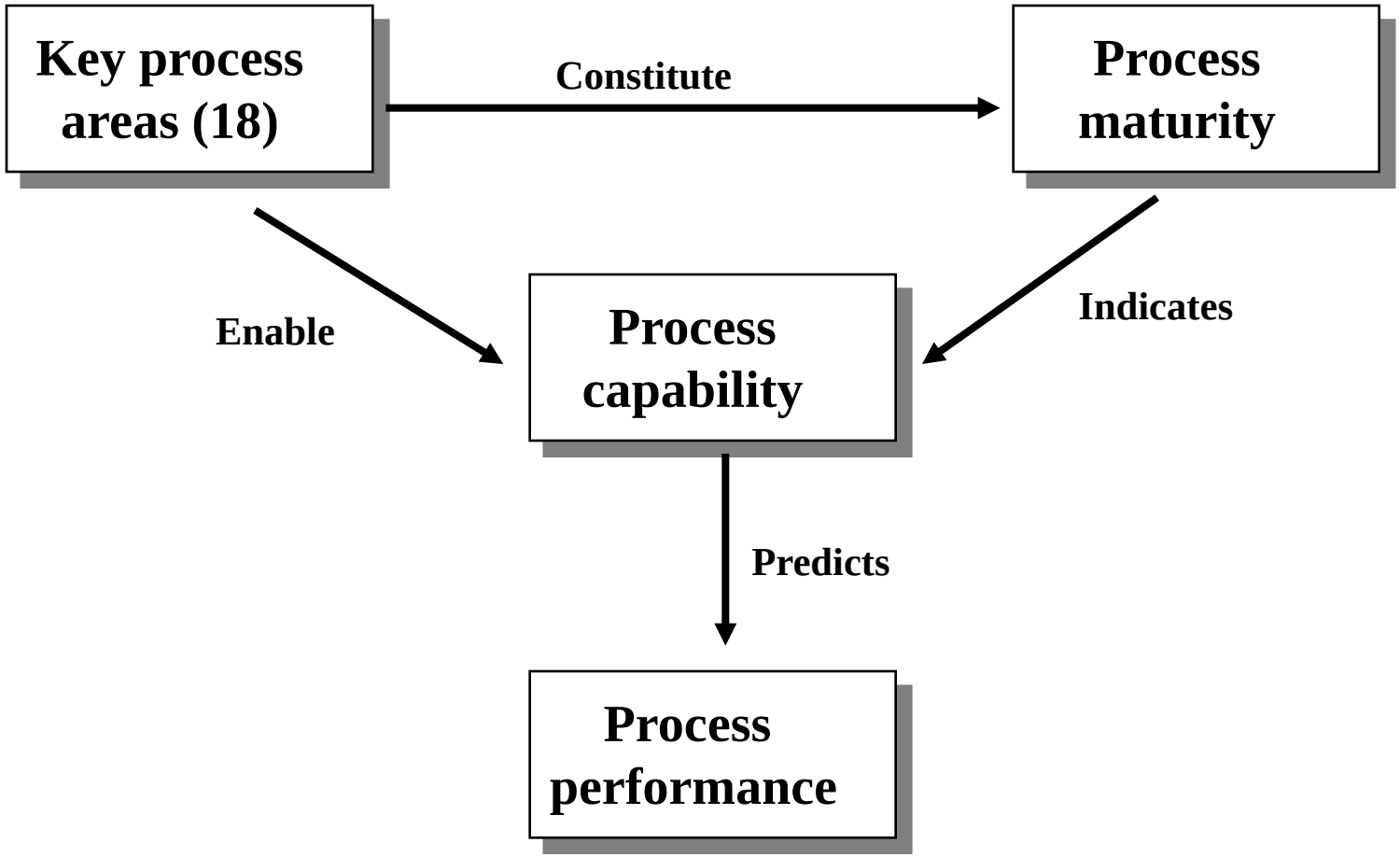
Process: an organisation asset



Major elements determining:

- **SW cost**
- **SW schedule**
- **SW quality**

Process maturity framework (1)



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**

Capability Maturity Model (CMM)

- **CMM was developed at the Software Engineering Institute (SEI) at Carnegie-Melon University in Pittsburgh, funded largely by the U.S. Defense Department.**
- **CMM is design to measure, and thereby improve, the process of software development.**
- **SEI establishes standards; it does not perform evaluations of individual firms.**
- **Evaluations of firms are done by third parties; these third-party evaluators have varying degrees of expertise and creditability.**
- **The highest level of CMM is Level Five; less than a hundred organizations in the world are certified as Level Five.**
- **CMM is similar to ISO 9000 and 9001; but while CMM focuses primarily on improving performance, ISO 9000 and 9001 focus on establishing and maintaining careful documentation, procedures, and standards.**

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"

Capability Maturity Model (CMM)

What are the Five Levels of CMM?

1. ***Initial*** **–** poorly controlled; *ad hoc;* difficult to repeat successful activities; dependent upon the skills of the individual developers.
2. ***Repeatable*** **–** disciplined processes; can repeat successful activities and tasks; developers learn from each other.
3. ***Defined*** **–** standard, consistent processes; a database of development "best practices" is created and maintained; these "best practice" are readily available and understood. This level includes all characteristics defined for level 2.
4. ***Managed*** **–** all development activities follow these corporate "best practices"; compliance with these development standards is mandatory**.** This level includes all characteristics defined for level 3.
5. ***Optimizing*** **–** continuous process of seeking out best practices from around the world; active, continuous improvement. This level includes all characteristics defined for level 4.

Key Process Areas (KPAs)

- The KPAs describe those software engineering functions (e.g., software project planning, requirements management) that must be present to satisfy good practice at a particular level

Each KPA is described by identifying the following characteristics:

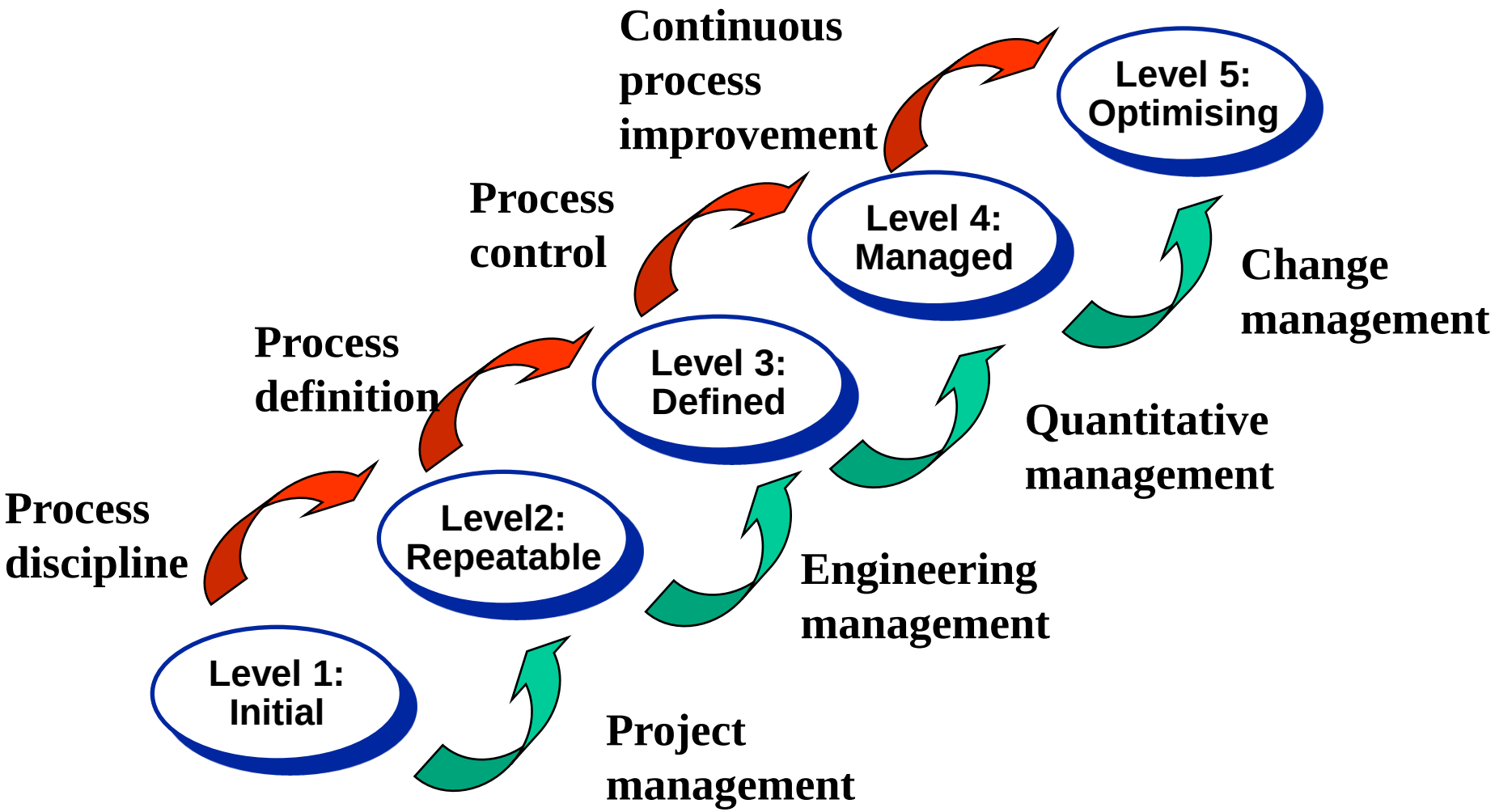
- ***Goals***—the overall objectives that the KPA must achieve.
- ***Commitments***—requirements (imposed on the organization) that must be met to achieve the goals or provide proof of intent to comply with the goals.
- ***Abilities***—those things that must be in place (organizationally and technically) to enable the organization to meet the commitments.
- ***Activities***—the specific tasks required to achieve the KPA function.
- ***Methods for monitoring implementation***—the manner in which the activities are monitored as they are put into place.
- ***Methods for verifying implementation***—the manner in which proper practice for the KPA can be verified.

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

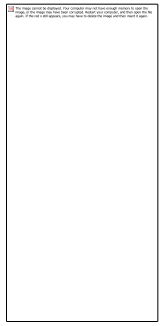
(Version 1.1)

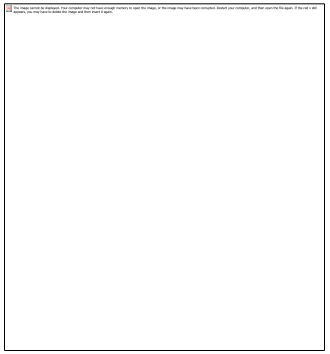
Maturity steps



Characteristics for level 1

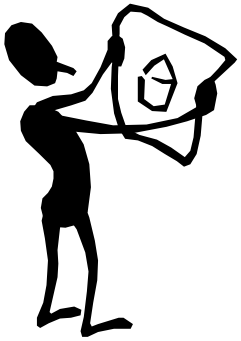
- No key processes
- Weak management practices
- Poorly controlled commitments
- processes are ad hoc
- practices are sacrificed for schedule
- Practitioners resist discipline
- Results are unpredictable

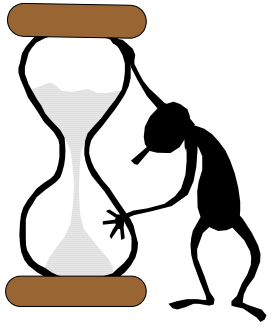




Characteristics for level 2

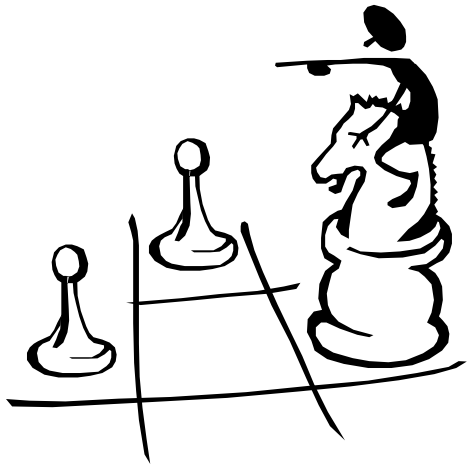
- **Project management is strong and lays foundation for process discipline**
- **Project activities are planned and followed**
- **Project ensures that practices are performed**
- **Corrective actions are made when necessary**
- **Project “own” its commitments**
- **Commitments are clear and communicated**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





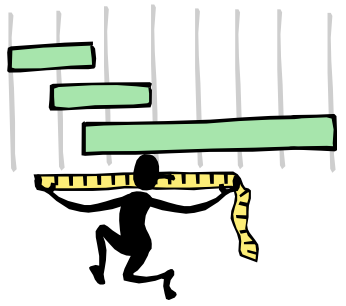
Characteristics for level 3

- 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



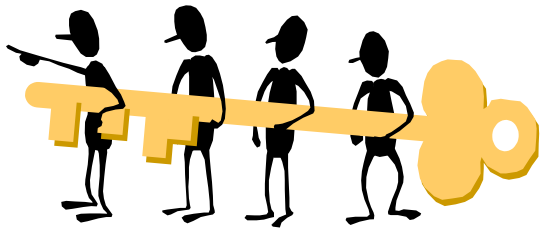
Characteristics for level 4

- 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

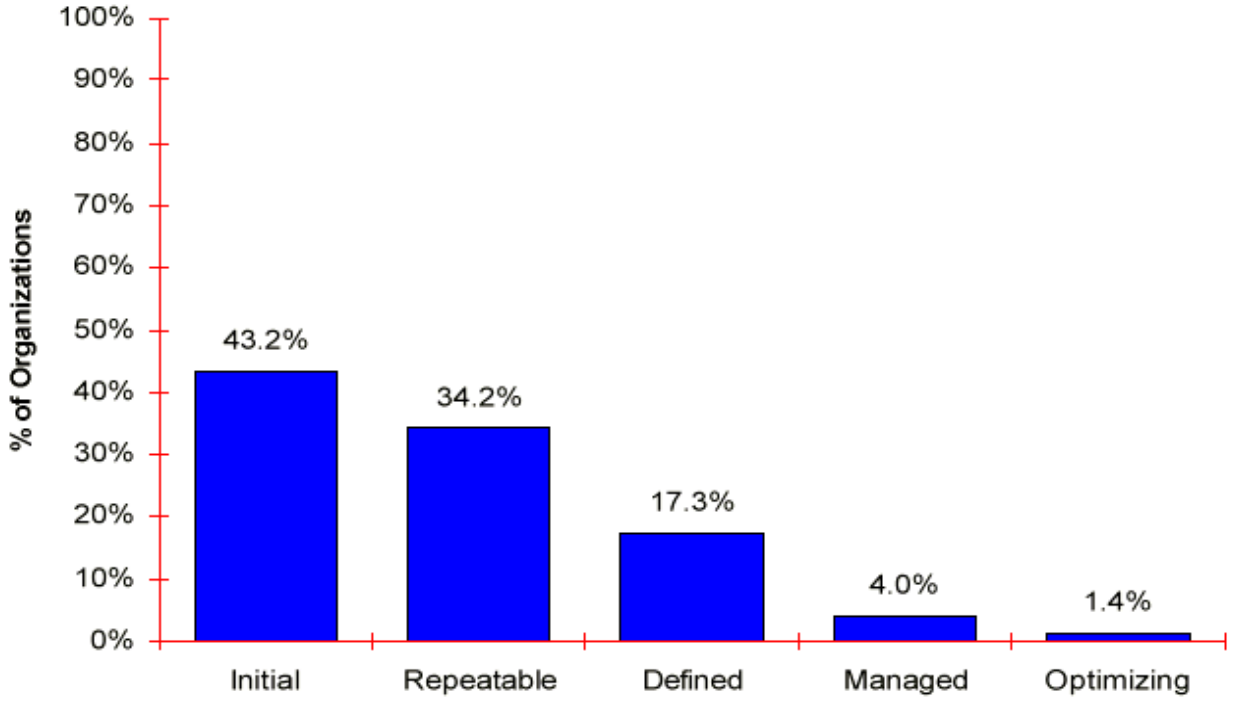


SEI's maturity survey (1)

Carnegie Mellon University
Software Engineering Institute

Organization Maturity Profile

August 1999

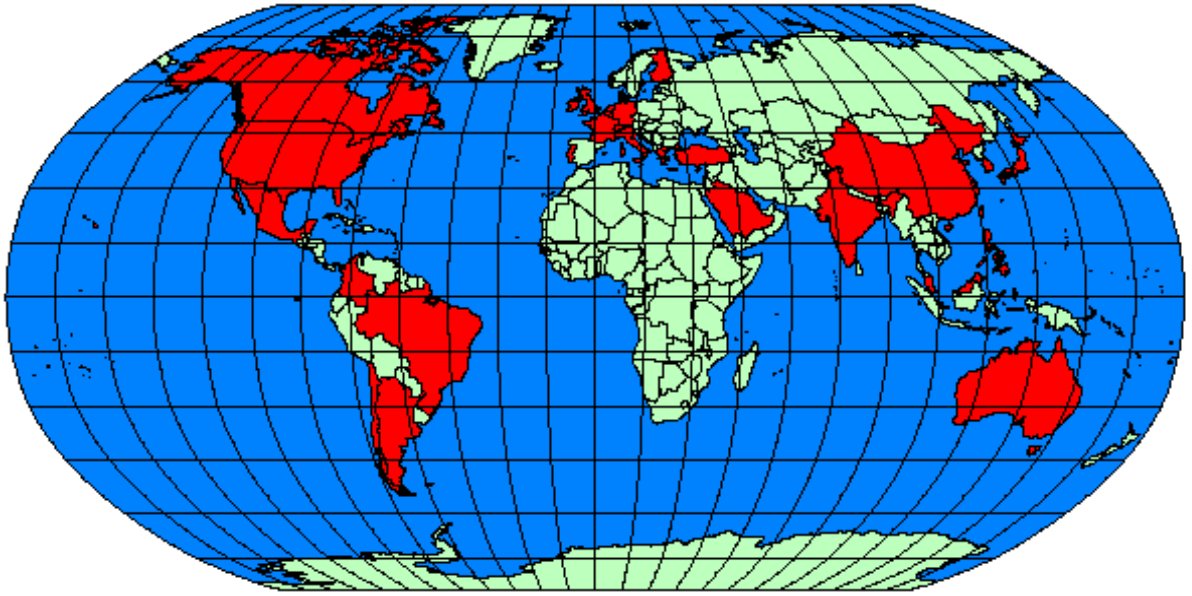


Based on most recent assessment, since 1995, of 734 organizations.

SEI's maturity survey (2)

Carnegie Mellon University
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						

List of Level 5 Companies in India

- Cognizant Technology Solutions
- Infosys Technologies Limited
- Larsen & Toubro Infotech Limited
- Mastek Limited
- NIIT, Software Solutions
- Patni Computer Systems Limited
- Sonata Software Limited
- Syntel
- Siemens Information Systems Limited.,
- Tata Consultancy Services
- Tata Elxsi Limited
- Tata Interactive Systems
- Wipro Technologies
- Software Paradigms International (SPI)

Questions..

- **Explain in detail about different levels of CMM with their characteristics.**
- **Write a note on: CMM**
- **What is the difference between CMM and CMMI.**