Software Project Management

Durga Prasad Mohapatra
Professor
CSE Deptt.
NIT Rourkela

Software quality cont…

SEI Capability Maturity Model (CMM)

- Developed by Software Engineering Institute (SEI) of the Carnegie Mellon University, USA:
  - To assist the U.S. Department of Defence (DoD) in software acquisition.
  - The rationale was to include:
    - Likely contractor performance as a factor in contract awards.

SEI Capability Maturity Model

- Major DoD contractors began CMM-based process improvement initiatives:
  - As they vied for DoD contracts.
- SEI CMM helped organizations:
  - Helped Improve quality of software they developed
  - Realized adoption of SEI CMM model had significant business benefits.
- Other organizations adopted CMM.

SEI Capability Maturity Model

- In simple words:
  - CMM is a model for apprising the software process maturity of a contractor into different levels.
  - Can be used to predict the most likely outcome to be expected:
    - from the next project that the organization undertakes.

SEI Capability Maturity Model

- Can be used in two ways:
  - Capability evaluation
  - Software process assessment.

Capability Evaluation

- Provides a way to **assess** the software process capability of an organization:
  - Helps in selecting a contractor
  - Indicates the likely contractor performance.

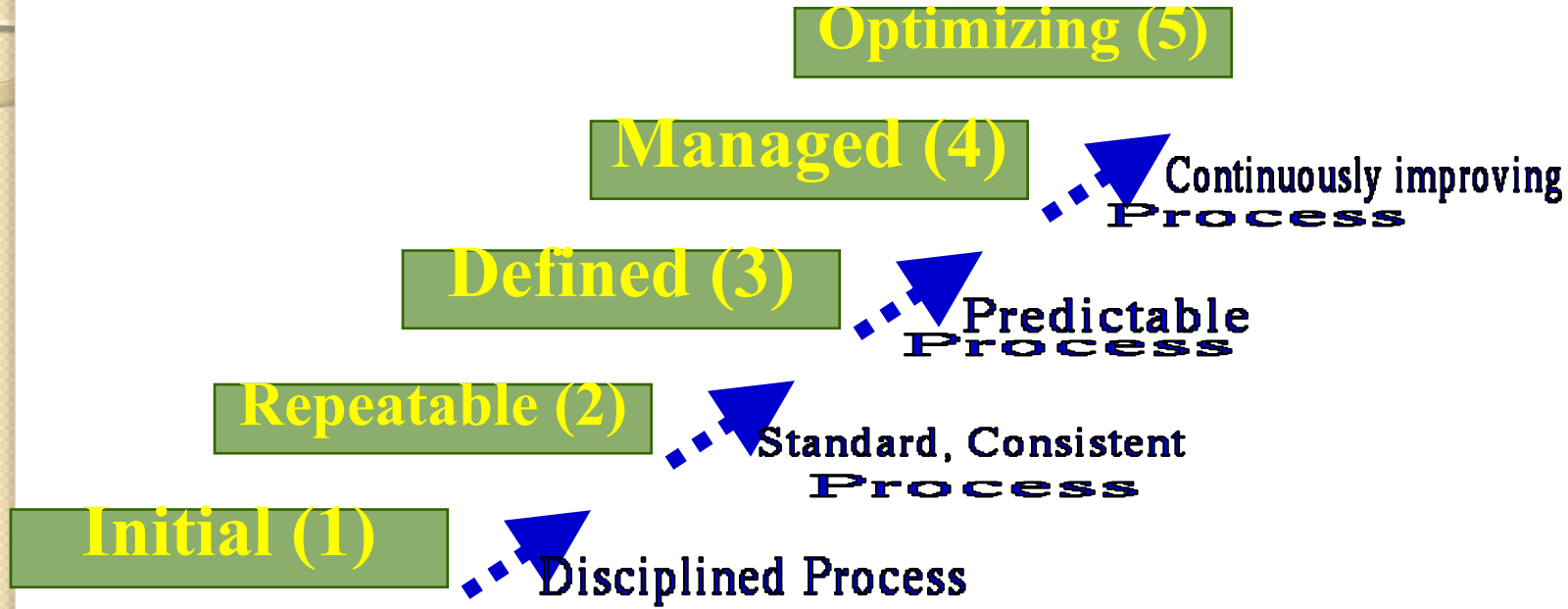
Software Process Assessment

- Used by an organization to assess its current process:
  - Suggests ways to improve the process capability.
  - This type of assessment is for purely internal use.

SEI Capability Maturity Model

- The SEI CMM classifies software development industries into:
  - Five maturity levels.
  - Stages are ordered so that improvements at one stage provide foundations for the next.
  - Based on the pioneering work of Philip Crosby.

SEI Capability Maturity Model



Level 1: (Initial)

- Organization operates
  - Without any formalized process or project plans
- An organization at this level is characterized by
  - Ad hoc and often chaotic activities.

Level 1: (Initial)

- Software production processes are not defined,
  - Different engineers follow their own process
  - Development efforts become chaotic.
  - The success of projects depend on individual efforts and heroics.

Level 2: (Repeatable)

- Basic project management practices
  - Tracking cost, schedule, and functionality are followed.
- Size and cost estimation techniques:
  - Function point analysis, COCOMO, etc. used.
- Production process is ad hoc:
  - Not formally defined
  - Also not documented.

Level 2: (Repeatable)

- Process used for different projects might vary between projects:
  - Earlier success on projects with similar applications can be repeated.
  - Opportunity to repeat process exist when a company produces a family of products.

Level 3: (Defined)

- Management and development activities:
  - Defined and documented.
  - Common organization-wide understanding of activities, roles, and responsibilities.

Level 3: (Defined)

- The process though defined:
  - Process and product qualities are not measured.
- ISO 9001 aims at achieving this level.

Level 4: (Managed)

- Quantitative quality goals for products are set.
- Software process and product quality are measured:
  - The measured values are used to control the product quality.
  - Results of measurement used to evaluate project performance:
    - Rather than improve process.

Level 4: (Managed)

- Organization sets quantitative quality goals.
- World-wide about 100 organizations assessed at this level.

Level 5: (Optimizing)

- Statistics collected from process and product measurements are analyzed:
  - Continuous process improvement based on the measurements.
    - Known types of defects are prevented from recurring by tuning the process
    - Lessons learned from specific projects incorporated into the process

Level 5: (Optimizing)

- Identify best software engineering practices and innovations:
  - Tools, methods, or process are identified.
  - Transferred throughout the organization.
- World-wide about 500 organizations have been assessed at this level.

Key Process Areas

- Each level is associated with a key process area (KPA) which identifies:
  - Where an organization at the previous level must focus to reach this level.

Level 2 KPAs

- Software project planning:
  - Size, cost, schedule.
  - Project monitoring
- Configuration management
- Subcontract management

Level 3 KPAs

- Process definition and documentation.
- Reviews
- Training program

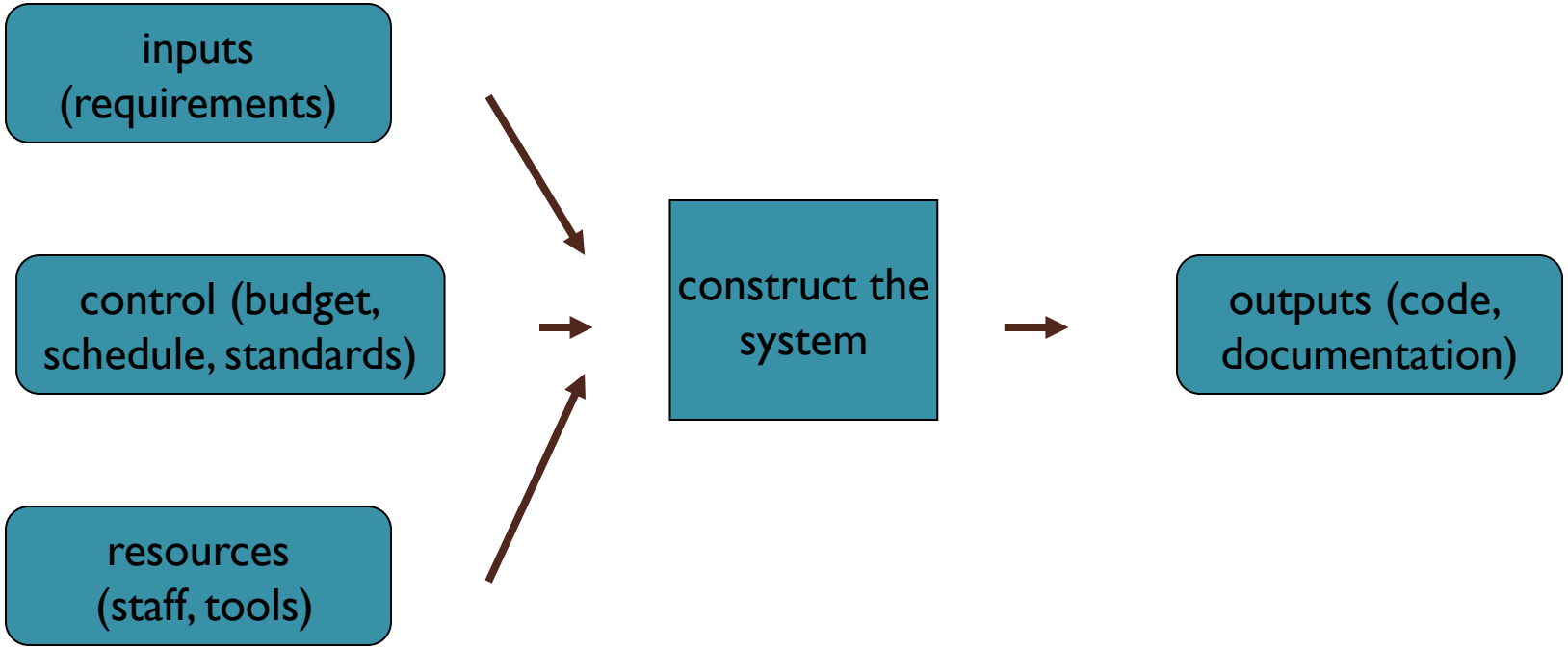
Level 4 KPAs

- Quantitative measurements.
- Process management.

Level 5 KPAs

- Defect prevention.
- Technology change management.
- Process change management.

A repeatable model

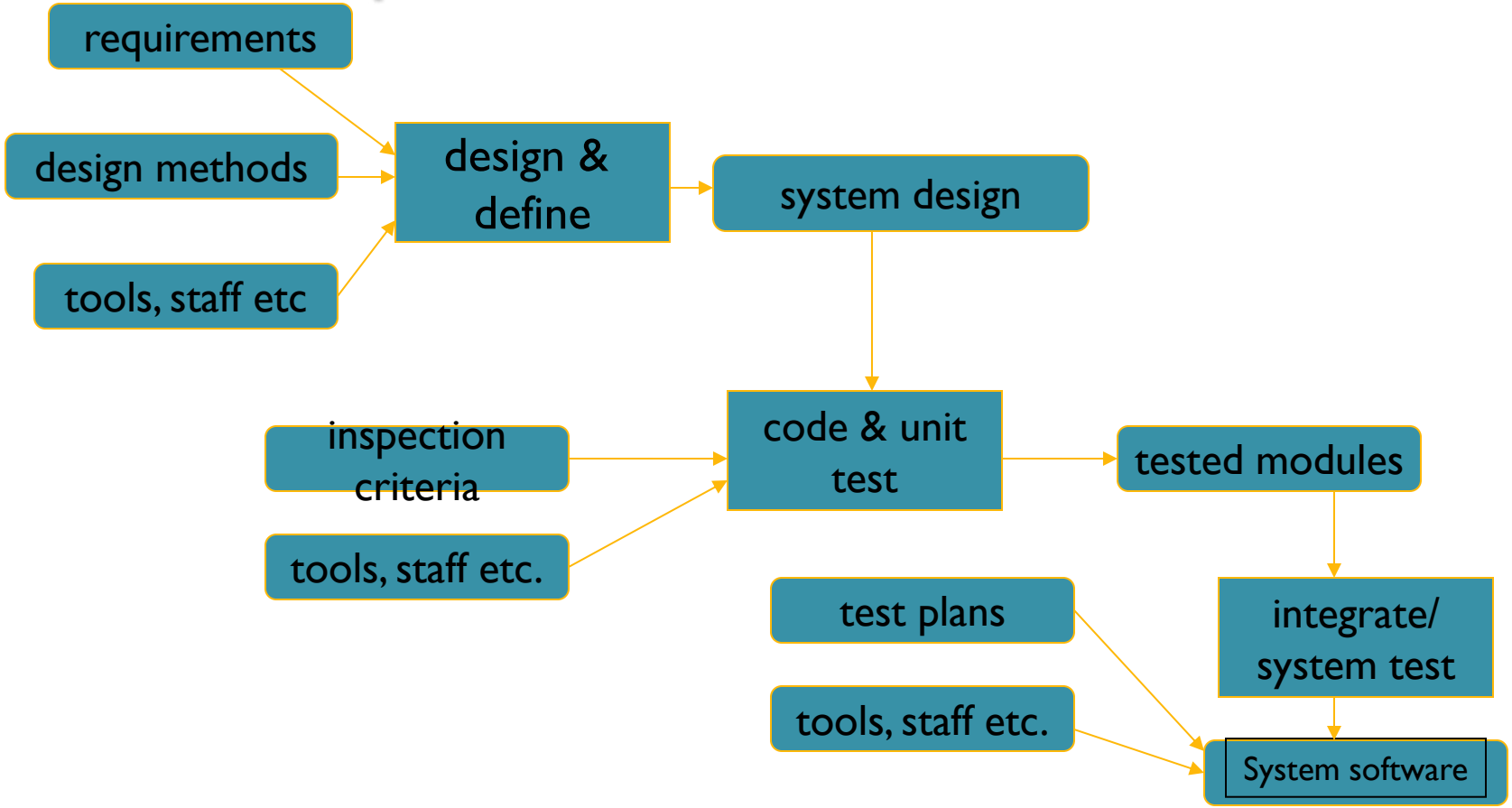


Repeatable model KPAs

To move to this level concentrate on:

- Configuration management
- Quality assurance
- Sub-contract management
- Project planning
- Project tracking and oversight
- Measurement and analysis

A defined process

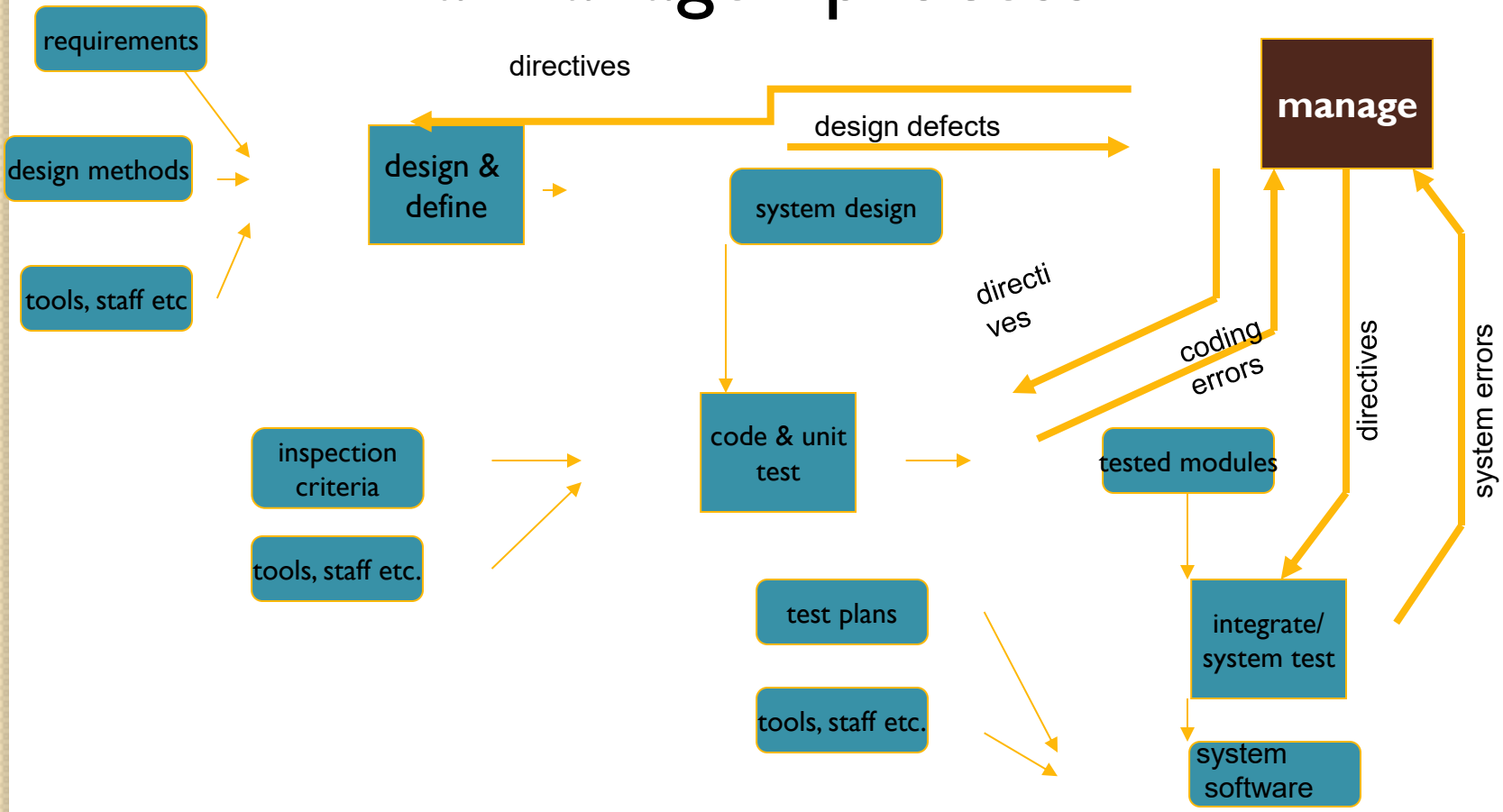


Repeatable to defined KPAs

Concentrate on

- Requirements development and technical solution
- Verification and validation
- Product integration
- Risk management
- Organizational training
- Organizational process focus (function)
- Decision analysis and resolution
- Process definition
- Integrated project management

a managed process

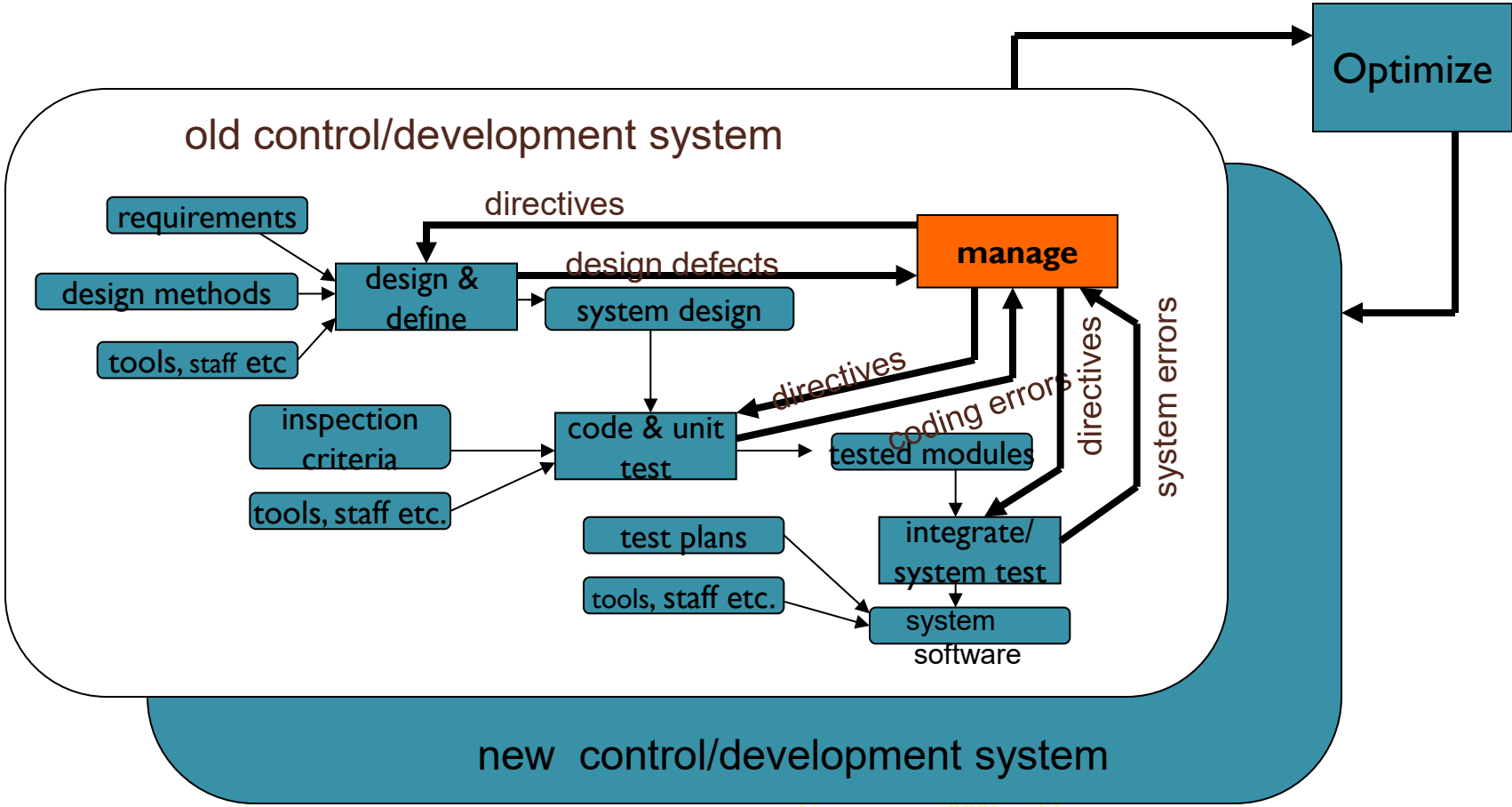


Defined to managed KPAs

Concentrate on:

- Organizational process performance
- Quantitative project management

Optimizing


Optimize
old control/development system
requirements
directives
design methods
design & define
design defects
manage
system design
tools, staff etc
directives
coding errors
directives
system errors
inspection criteria
code & unit test
tested modules
tools, staff etc.
test plans
integrate/ system test
tools, staff etc.
system software
new control/development system

Managing to optimizing: KPAs

concentrate on:

- Causal analysis and resolution
- Organizational innovation and deployment

Comparison Between ISO 9001 and SEI CMM

- ISO 9001 awarded by an international standards body:
  - Can be quoted in official documents and communications.
- SEI CMM assessment is purely for internal use.

Comparison Between ISO 9001 and SEI CMM

- SEI CMM was developed specifically for software industry:
  - Addresses many issues specific to software industry.
- SEI goes beyond quality assurance
  - Aims for TQM.
  - ISO 9001 correspond to SEI level 3.

Comparison Between ISO 9001 and SEI CMM

- SEI CMM provides a list of key areas:
  - On which to focus to take an organization from one level to the other
- Provides a way for gradual quality improvements over several stages.
  - e.g trying to implement a defined process before a repeatable process:
    - Counterproductive as managers are overwhelmed by schedule and budget pressure.

CMMI (CMM Integration)

- CMMI is the successor of the CMM.
- The CMM was developed from 1987 until 1997.
- In 2002, CMMI Version 1.1 was released.
  - Version 1.2 followed in August 2006.
- The goal of the CMMI to integrate many different models into one framework.
  - It was created by members of industry, government and the SEI.

Some questions about CMMI

- suitable only for large organizations
  - e.g. need for special quality assurance and process improvement groups
- defining processes may not be easy with new technology
  - how can we plan when we've not used the development method before?
- higher CMM levels easier with maintenance environments
- can you jump levels? (HP level 5 in India)

Remarks on Quality Model Usage

- Highly systematic and measured approach to software development process which suits certain circumstances
  - Negotiated software, safety-critical software, etc.
- What about small organizations?
  - Typically handle applications such as internet, e-comm.
  - Without an established product range,
  - Without revenue base, experience on past projects, etc.
  - CMM may be incompatible

Summary

- Discussed the basic concepts of SEI CMM.
- Compared between ISO and SEI CMM.

References :

1. B. Hughes, M. Cotterell, R. Mall, *Software Project Management*, Sixth Edition, McGraw Hill Education (India) Pvt. Ltd., 2018.
2. R. Mall, *Fundamentals of Software Engineering*, Fifth Edition, PHI Learning Pvt. Ltd., 2018.

Thank you