



# Moving to CMMI-SE/SW

## Module 1

## Introduction



# Content

- Introductions
- Expectations and objectives
- Evolution of CMMs

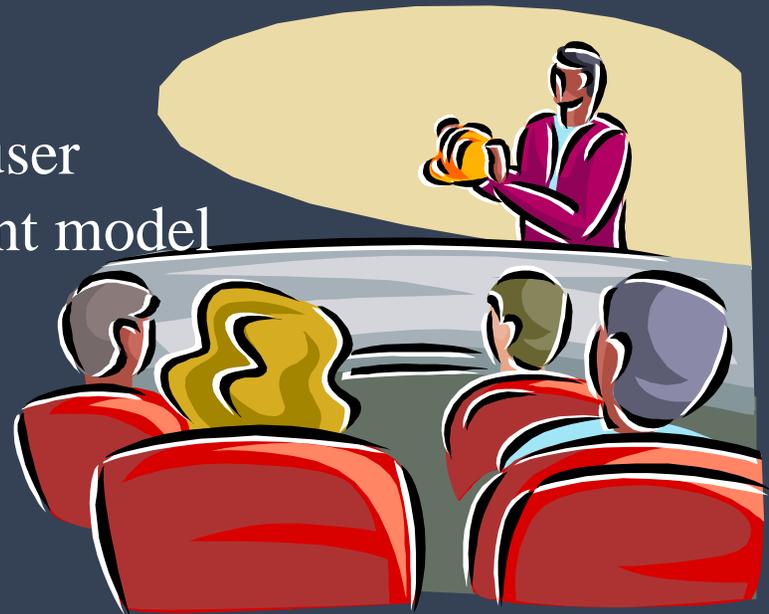


# Introductions

## Presenters

## The audience

- new to PI
- SW-CMM beginner
- SW-CMM experienced user
- user of other improvement model





# Logistics





# Tutorial Approach

- Workshop format
  - Based on CMMI-SE/SW v1.0 model content released Aug 11, 2000
  - Presentations
  - Questions and Answers
  - Discussions





# Expectations

- What do you expect to get out of this course?



# Tutorial Objectives

- An awareness of :
  - the models, representations and disciplines that are/will be part of the CMMI
  
- An overview of:
  - the CMMI-SE/SW continuous representation
  - the differences between the SW-CMM v1.1 and the CMM-SE/SW
  - the Process Areas in the CMMI-SE/SW



# Audience

People who are

- responsible for improving development processes in an organization

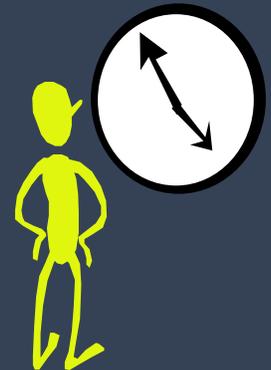
and

- familiar with the SW-CMM v1.1
  - Managers
  - SEPG members
  - Engineers
  - Assessors



# Schedule

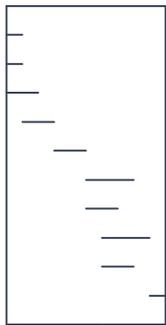
Introductions and Expectations	8.30 - 8.45
History and Evolution of CMMs	8.45 - 9.00
The Disciplines	9.00 - 9.15
The Structure of the CMMI	9.15 - 9.30
The Generic Components	9.30 - 10.00
Coffee Break	10.00 - 10.30
Process Areas - A Brief Summary	10.30 - 11.30
Using the Model	11.00 - 12.00
Questions/Discussion	12.00 - 12.30





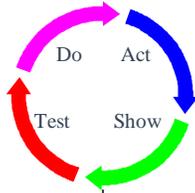
# From Henry Gantt to SW-CMM

(Gantt)



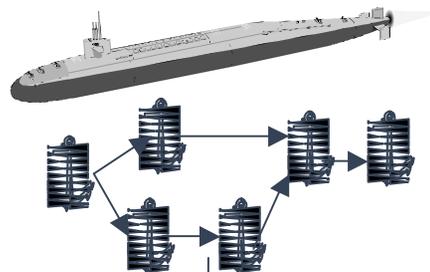
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Shewart



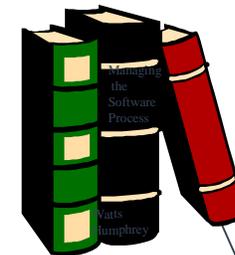
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(PERT)

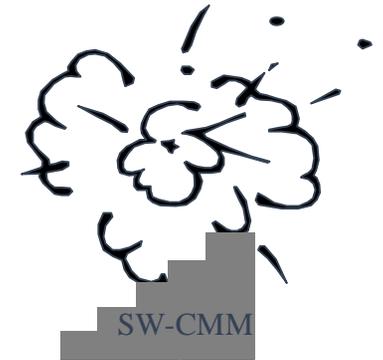


'50

Humphrey



'80



'90

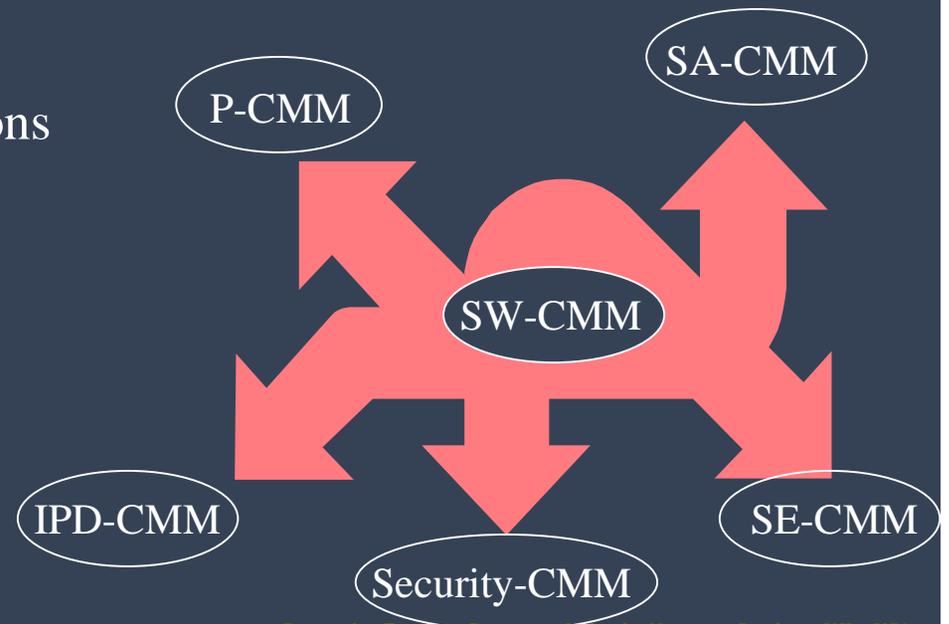
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## The Current Situation -

- Explosion of CMMs and CMM-like models
- Multiple models within an organization
  - Conflicting terminology
  - Different contents
  - Different representations
- Multiple assessments
- Multiple training
- Multiple expenses





# Why do we care?

ROI  
Time To Market  
Cost  
Improvement  
Pride

.....





# What are Capability Maturity Models?

- Organized collections of best practices
- Based on work by Crosby, Deming, Juran, Humphrey...
- Systematic ordered approach to process improvement.
- Means of measuring organizational maturity.
- Proven to bring significant return on investment in productivity and quality.

*All models are wrong,  
but some are useful....*



## Use of CMMs

- Goals rather than Procedures
- Normative rather than Prescriptive
- Ten Commandments rather than the law





# Integration

**Representations**

Staged	SW-CMM v1.1 v2.0c			SA-CMM v1.01		P-CMM
Contin- uous		EIA 731 (SE-CMM +SECM)	IPD-CMM v0.9			
	Software Eng.	Systems Eng.	Concur- rent Eng.	Acquisition	Security	People Mgmt

**Disciplines**

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# CMMI-SE/SW The Core

Staged	SW-CMM v1.1 v2.0c			SA-CMM v1.01		P-CMM
Contin- uous		EIA 731 (SE-CMM +SECM)	IPD-CMM v0.9			
	Software Eng.	Systems Eng.	Concur- rent Eng.	Acquisition	Security	People Mgmt

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# CMMI-SW

## One discipline Only

Staged	SW-CMM v1.1 v2.0c			SA-CMM v1.01		P-CMM
Contin- uous		EIA 731 (SE-CMM +SECM)	IPD-CMM v0.9			
	Software Eng.	Systems Eng.	Concur- rent Eng.	Acquisition	Security	People Mgmt

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# CMMI-SE

## One discipline Only

Staged	SW-CMM v1.1 v2.0c	EIA 731 (SE-CMM +SECM)	IPD-CMM v0.9	SA-CMM v1.01		P-CMM
Contin- uous	Software Eng.	Systems Eng.	Concur- rent Eng.	Acquisition	Security	People Mgmt

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# CMMI-SE/SW/IPPD Additions

Staged	SW-CMM v1.1 v2.0c			SA-CMM v1.01		P-CMM
Contin- uous		EIA 731 (SE-CMM +SECM)	IPD-CMM v0.9			
	Software Eng.	Systems Eng.	Concur- rent Eng.	Acquisition	Security	People Mgmt

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# CMMI-SE/SW/A Additions

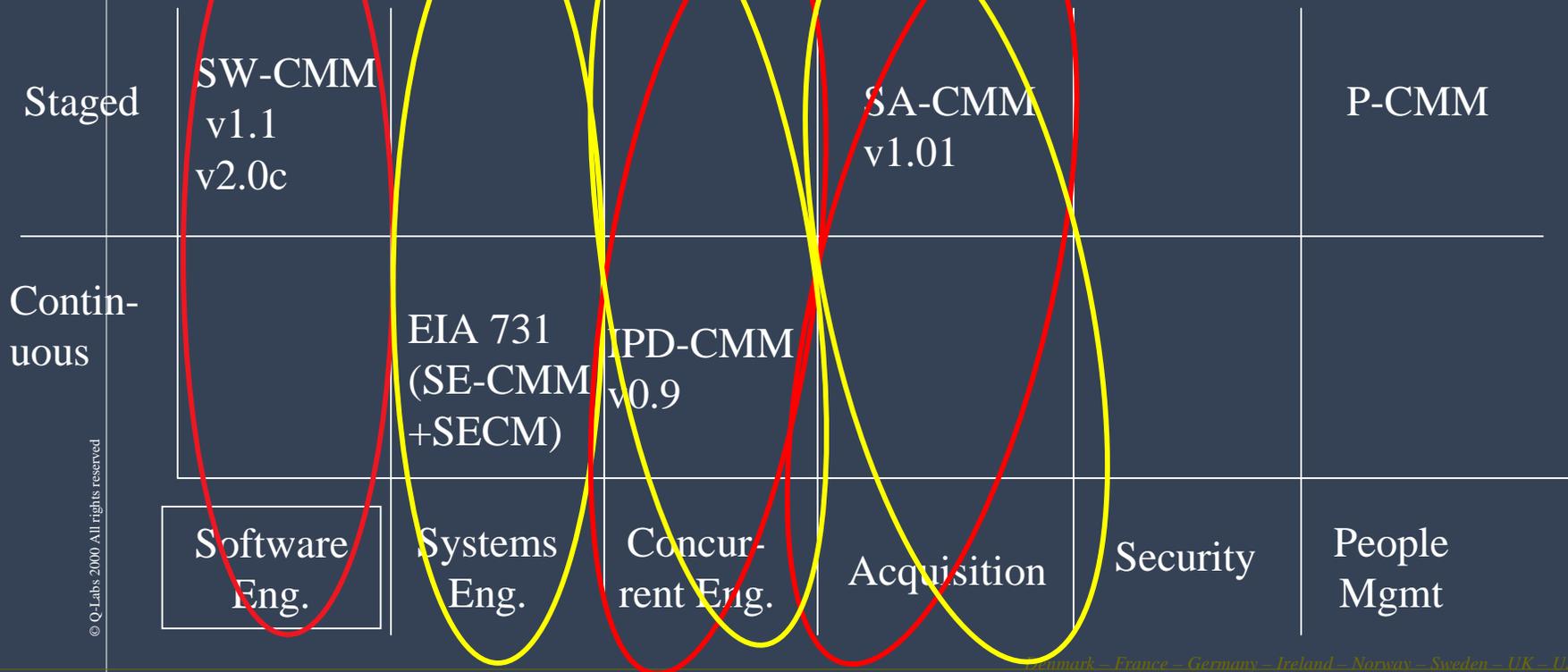
Staged	SW-CMM v1.1 v2.0c			SA-CMM v1.01		P-CMM
Contin- uous		EIA 731 (SE-CMM +SECM)	IPD-CMM v0.9			
	Software Eng.	Systems Eng.	Concur- rent Eng.	Acquisition	Security	People Mgmt

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# CMMI-SW

## Six other possible combinations



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Denmark - France - Germany - Ireland - Norway - Sweden - UK - USA



# CMMI Products

## ■ The Models

- CMMI - SW
- CMMI - SE
- CMMI - SE / SW
- CMMI - SE / SW / IPPD
- CMMI - SE/IPPD
- CMMI - SW/IPPD
- CMMI - SE / SW / A
- CMMI - SE / SW / IPPD / A

Staged &  
Continuous  
representations

## ■ Training

## ■ Assessment method

Backward Compatible



# Source and reference models

## ■ Source Models

- SW-CMM v 2.0 draft C
- EIA/IS 731
  - merger of INCOSE SECAM and EPIC SE-CMM
- IPD-CMM v0.9

## ■ Reference Models

- FAA-iCMM
- ISO/IEC 15504



# Moving to CMMI-SE/SW

## Module 2

## The Disciplines



# Content

- Software Engineering
- Systems Engineering
  - Concurrent Engineering
- Acquisition

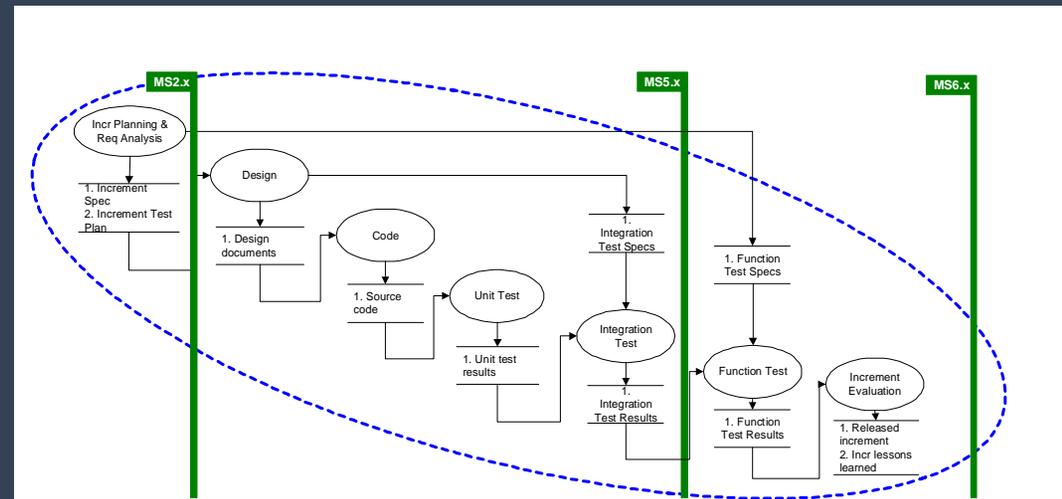


# Software Engineering

## ■ What is Software Engineering?



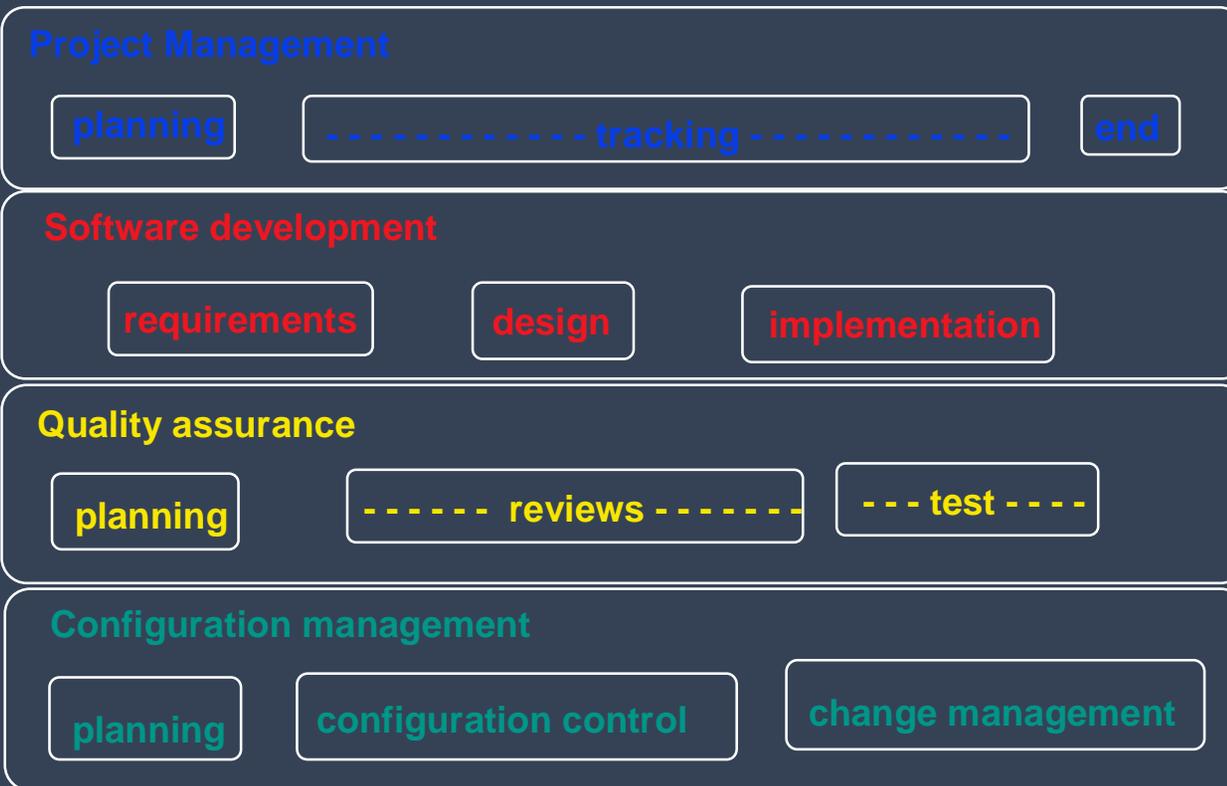
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# Software Processes

a combination of several processes





# SW-CMM V2.0 draft C

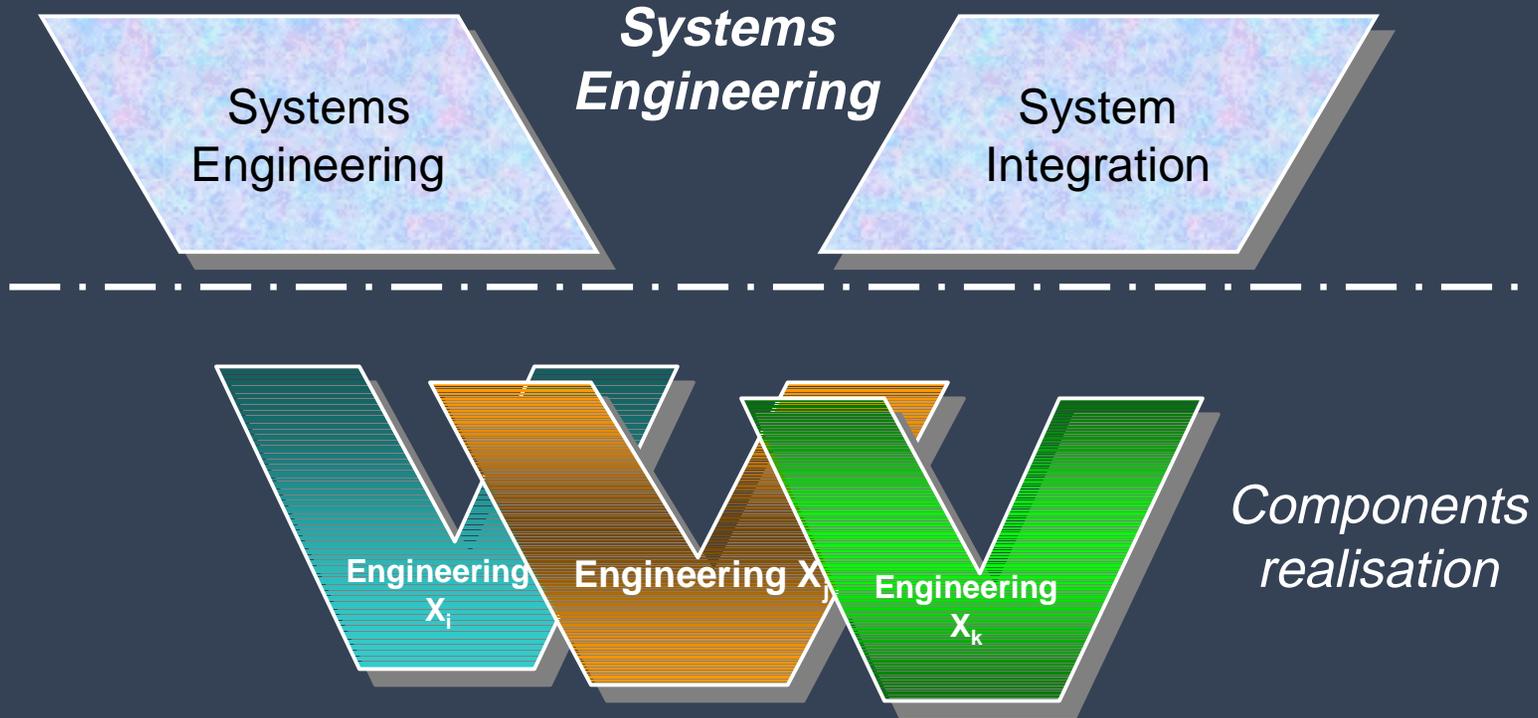


Level	Focus	Key Process Areas
<b>5</b> <b>Optimizing</b>	<i>Continuous process improvement</i>	Org Improvement Deployment Org Process and Tech Innovation Defect Prevention
<b>4</b> <b>Quantitatively Managed</b>	<i>Quantitative management</i>	Organization Process Performance Statistical Process Management Org Software Asset Commonality
<b>3</b> <b>Defined</b>	<i>Process Standardization</i>	Peer Reviews Project Interface Coordination Software Product Engineering Organization Training Program Organization Process Definition Organization Process Focus
<b>2</b> <b>Repeatable</b>	<i>Basic Project Management</i>	Software Configuration Management Software Quality Assurance Software Acquisition Management Software Project Control Software Project Planning Requirements Management
<b>1</b> <b>Initial</b>	<i>Competent people and heroics</i>	

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# Systems Engineering Components





# What is Systems Engineering

## Complicated Systems

- Many subsystems
- Many components
- Many decomposition levels
- Many functions to implement

## Complex Systems

- Many flow transfers
- Many retroactive loops
- Emerging properties
- Complex dynamics and evolvability
- Subsystem structural complexity
- Model and modelling complexity

## Heterogeneous Systems

- Different technologies and energies
- Different subcontractors
- Different standards
- Different life-cycles & development processes

**Impossible without a systematic process-driven approach**



# An Information Management and Organisation Problem

- Document-driven
- Too much detail but not the essentials
- Compiled knowledge
  - Different detail levels at each system decomposition level
- Large amount of heterogeneous information and many dependencies



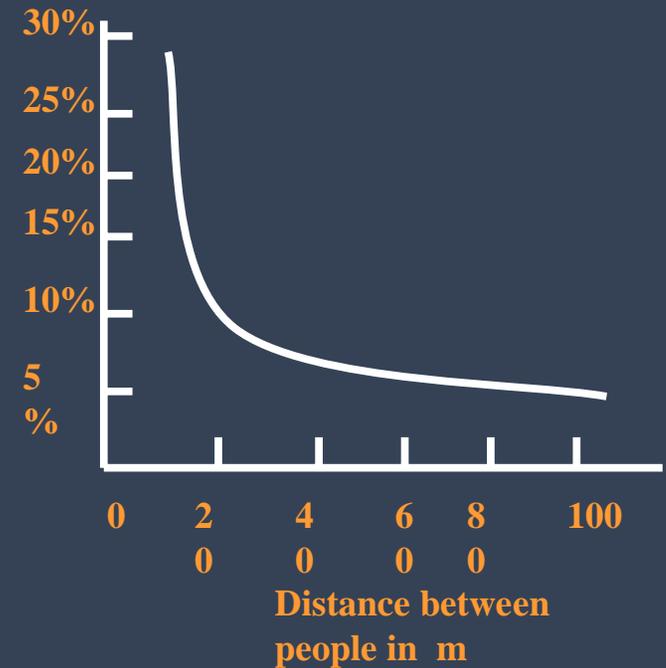


## A Communication Problem (1/2)

- A social communication problem
- AT&T rule: Communication decreases by 80% if teams are separated by more than 50 yards



Probability of communicating at least once each week

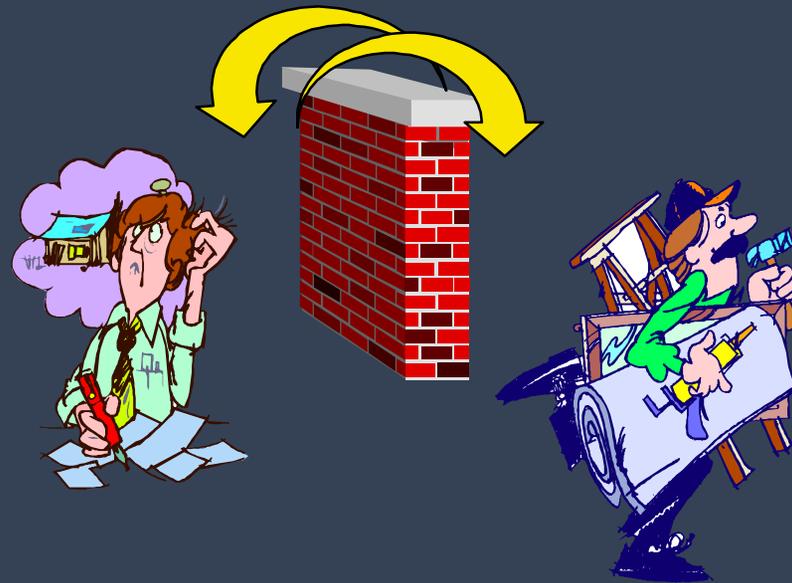


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## A Communication Problem (2/2)

- Communication problems are reinforced by organisational choices





## A Decision-Making Problem (1/2)

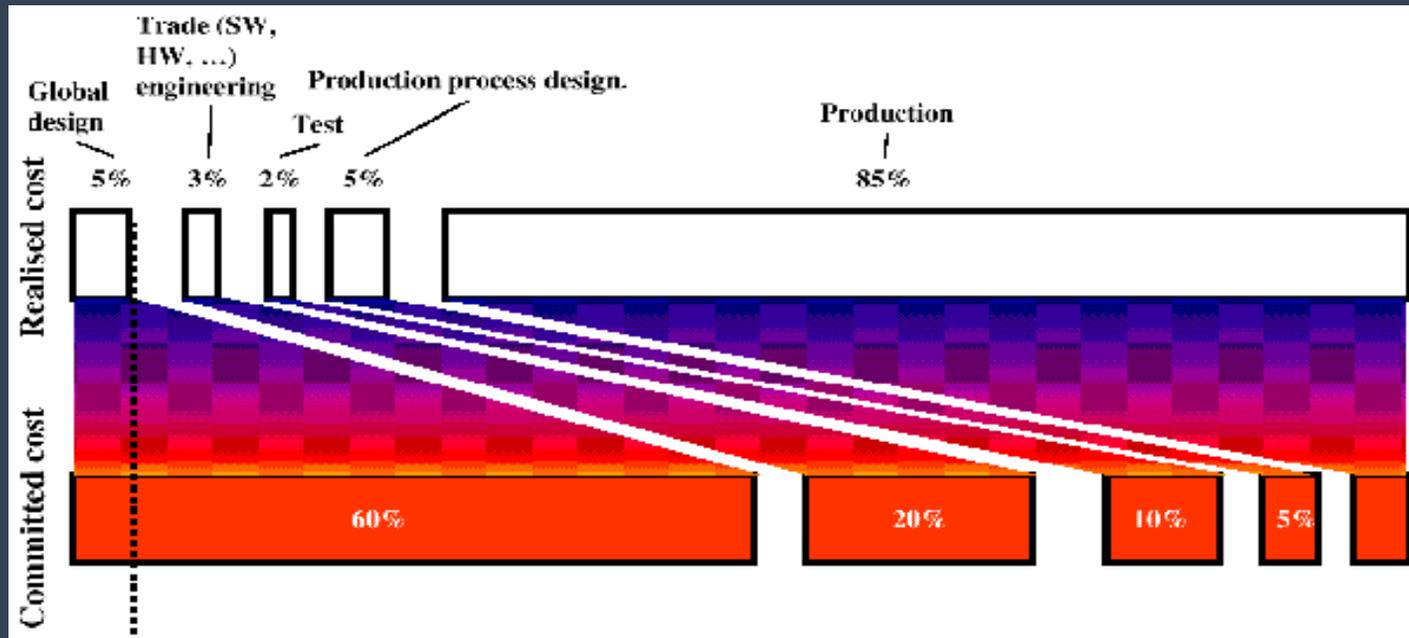
- There are no purely technical decisions
- Any decision impacts all sorts of resources





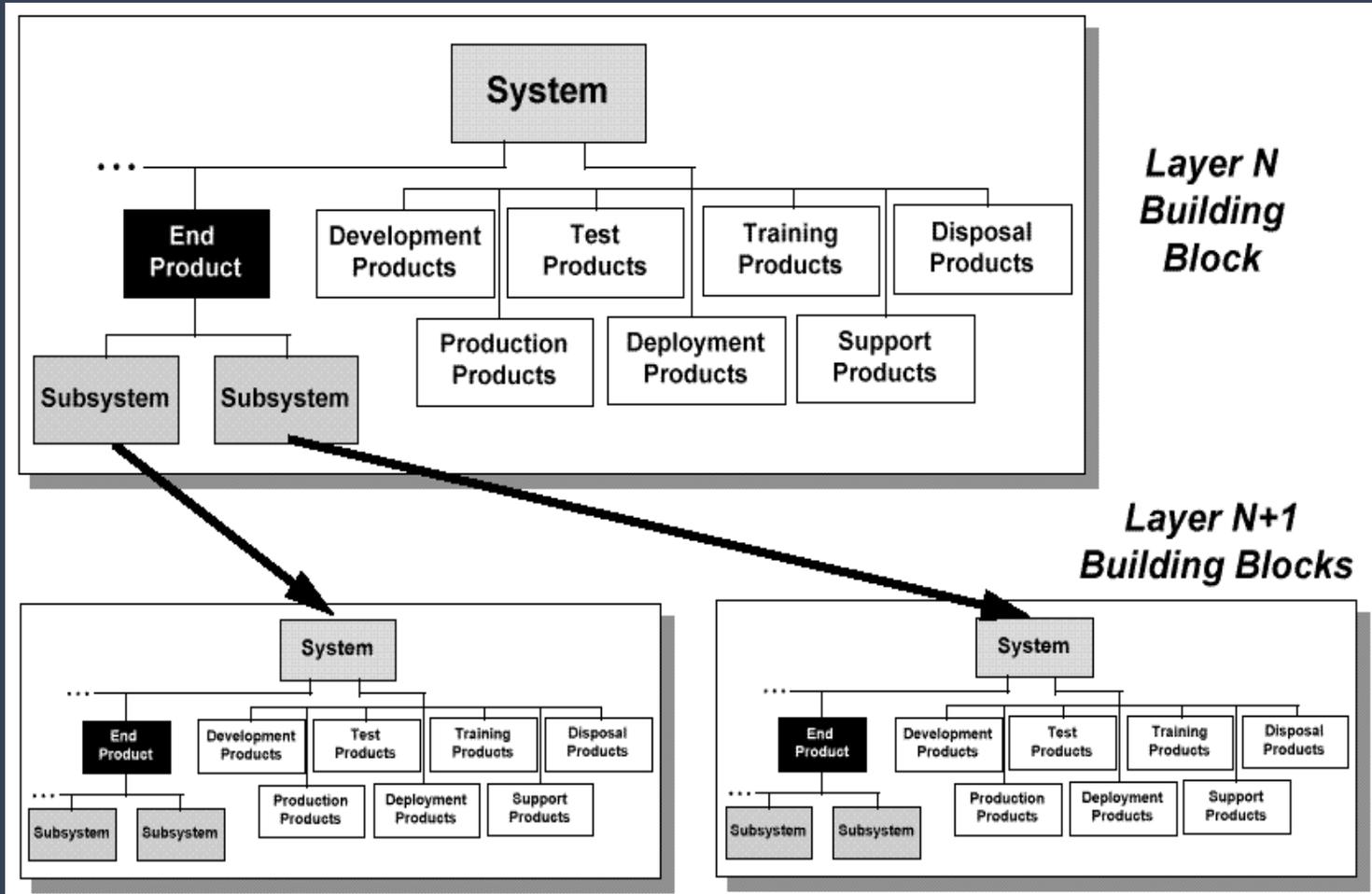
## A Decision-Making Problem (2/2)

- Major commitments are made during the first 10% of the project time
- Decisions must be explicit and documented





# Levels of Systems



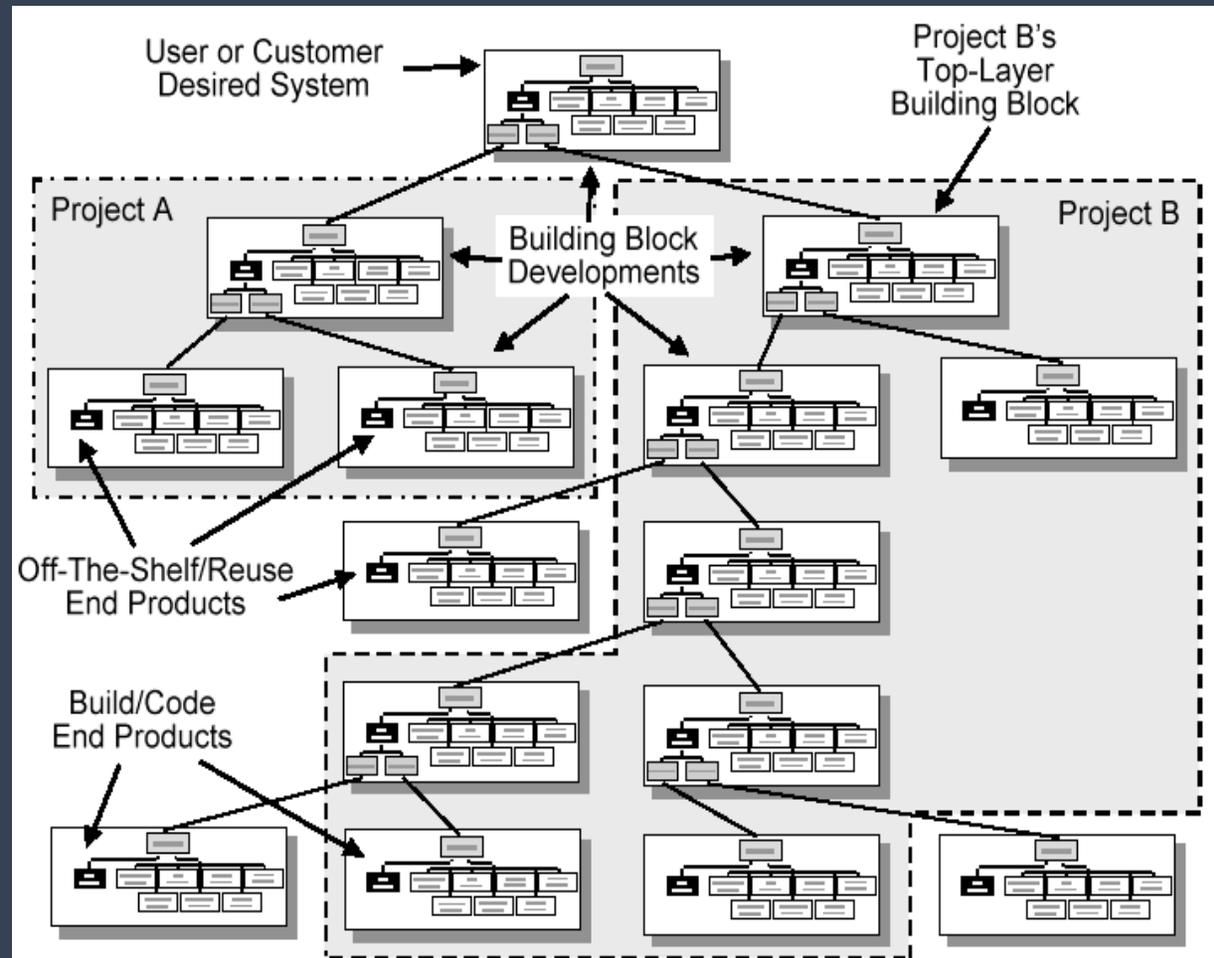


# What is Concurrent Engineering

- **A systematic approach to product development**
  - **that increases customer satisfaction**
  - **and shortens time to market**
  - **through a timely collaboration of necessary disciplines**
  - **throughout the product life cycle**



# Concurrent Projects and Products





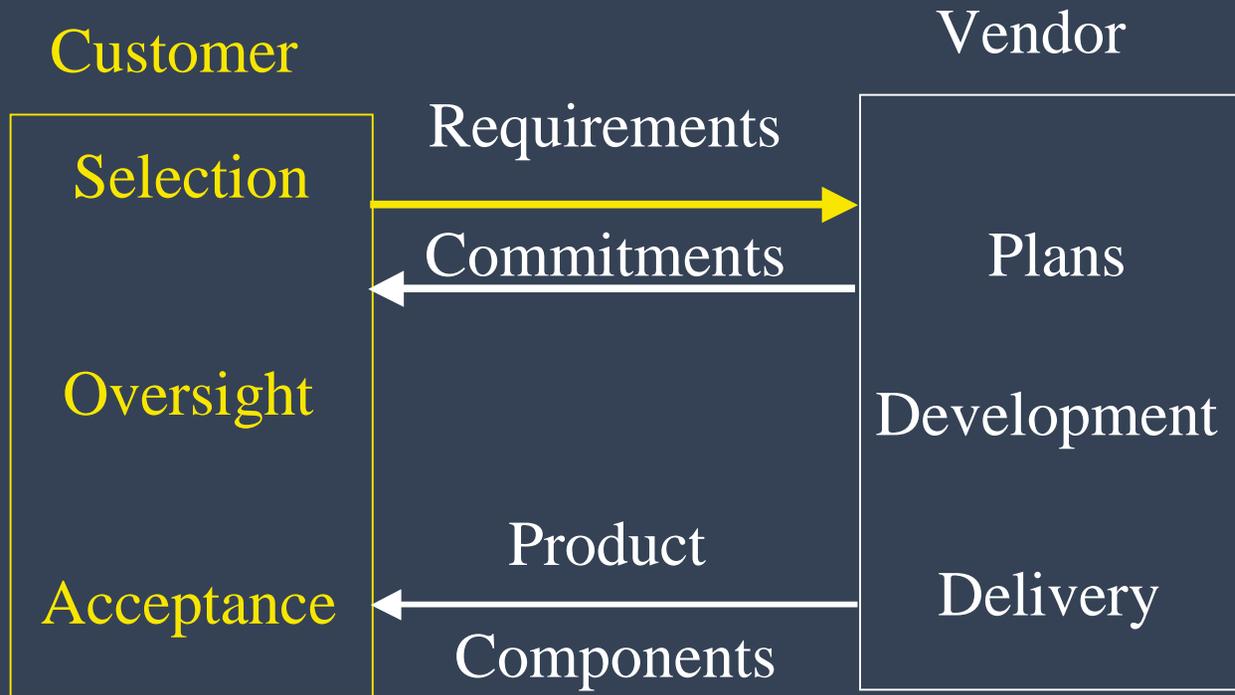
# What is Acquisition?

## ■ Acquisition

to plan, perform and monitor the acquisition of products and services from sources external to the project to satisfy the requirements of agreements

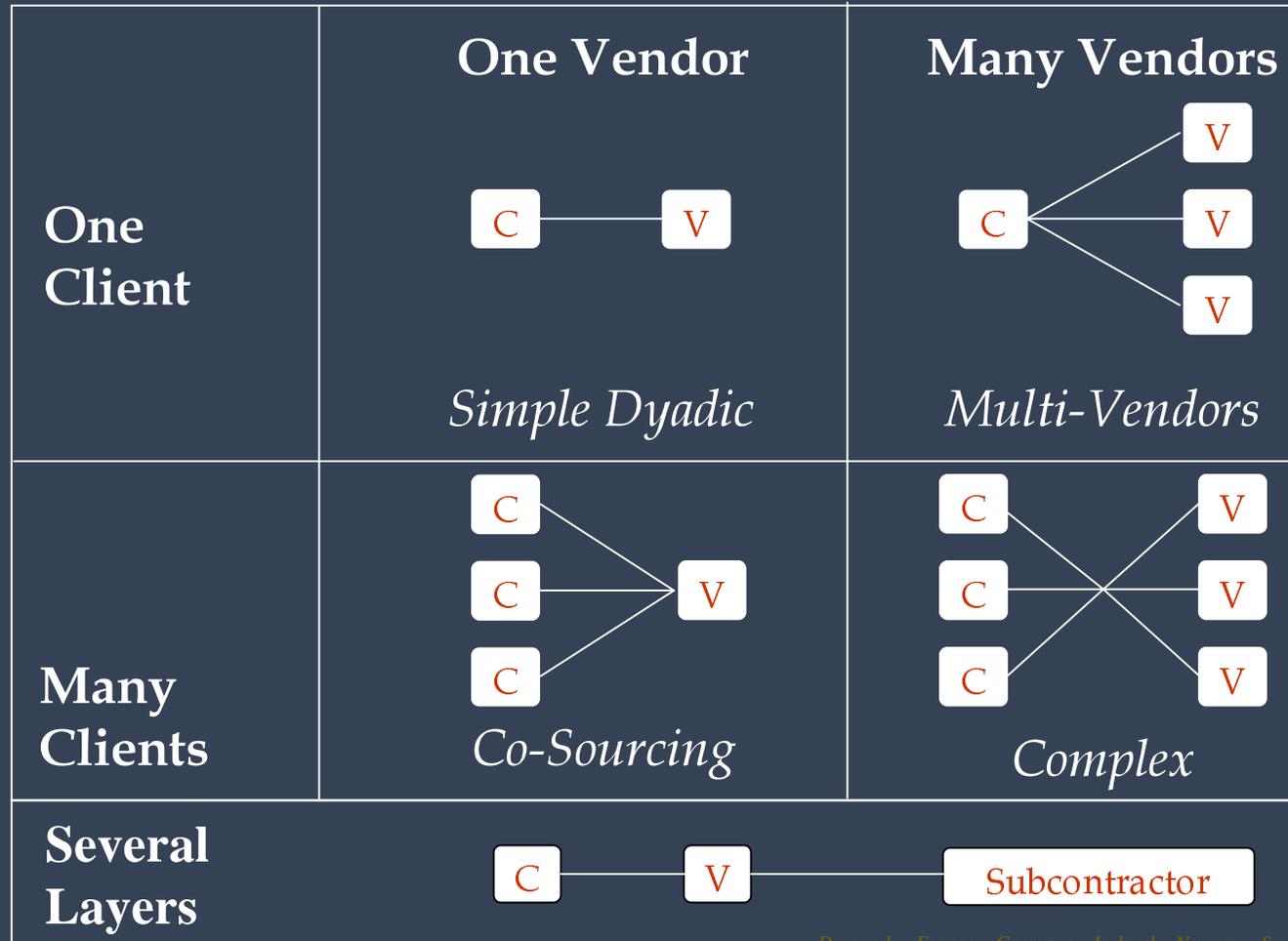


# Acquisition





# Acquisition Situations



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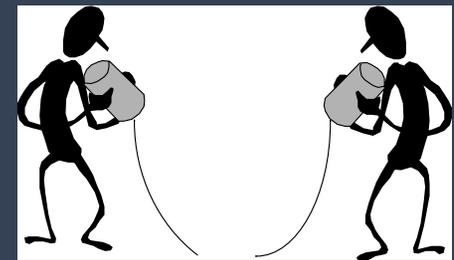
## Typical Acquisition Problems (1/2)

- Laissez-faire attitude
- Administrivia
- Creeping functionality
- Fragmentation
- Goldplating
- “I’m the engineer”
- Missing indicators
- Who is in charge?
- Lack of competence



## Typical Acquisition Problems (2/2)

- No user involvement
- Poorly defined requirements
- Over-promising
- Lack of discipline
- Unrealistic expectations
- Inadequate resources
- No clear objectives
- Ineffective communication
- Friction





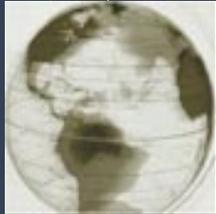
# Error Management

- Errors can be made but must be caught early
- Industrial error culture is ambiguous
  - Managers “if you work well, you make no errors”
  - Practitioners “I will get incentives if I solve errors, not if I avoid them”. “Anyway, others will have to deal with errors I caused”.
- implicit decisions and little knowledge management (elicitation, analysis and verification) of requirements and design are major sources of errors



# Summary

- Engineering
  - Software
  - Systems
    - Concurrent
- Acquisition



# Moving to CMMI-SE/SW

## Module 3

### The Structure of the CMMI

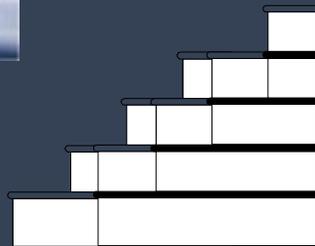


# Content

- Representations
- Model structure
- Document content
- Generic practices and common features

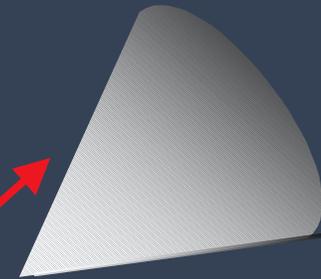


# Representations



Staged

Maturity Levels  
of an organization

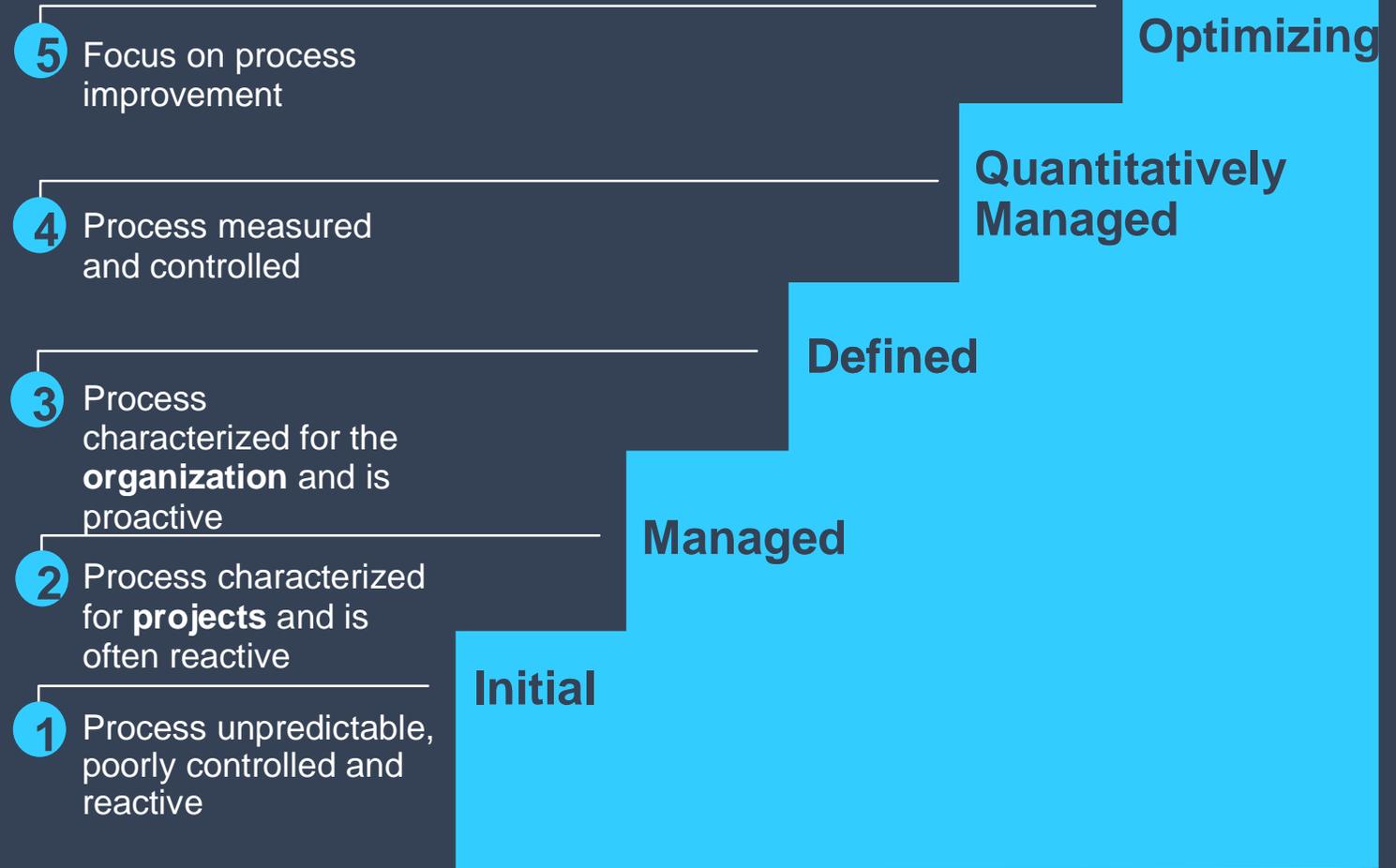


Continuous

Capability Levels  
of a process area



# The Maturity Levels



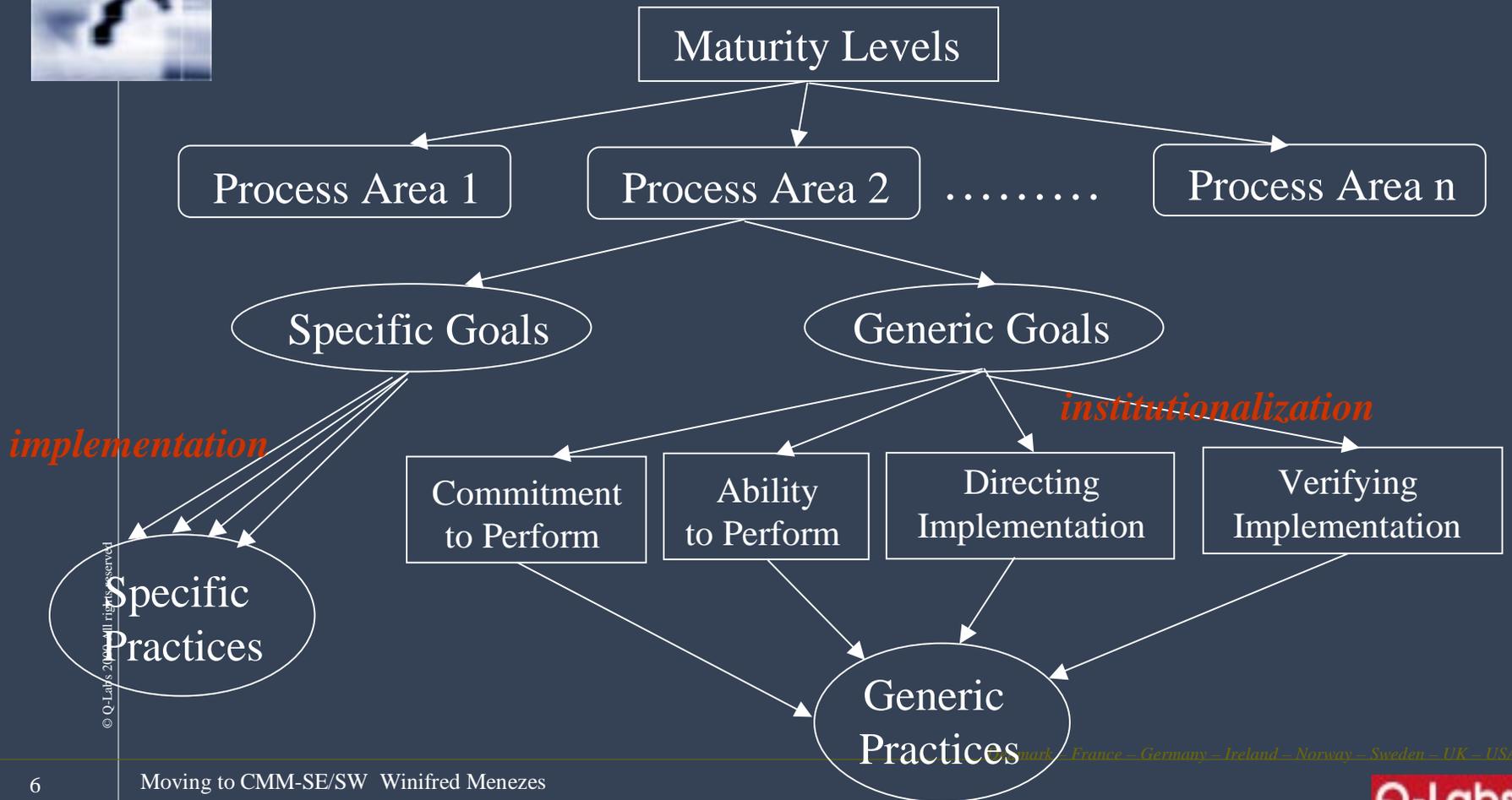


Level	Focus	Process Areas
5 Optimizing	<i>Continuous process improvement</i>	Causal Analysis and Resolution Organizational Innovation and Deployment
4 Quantitatively Managed	<i>Quantitative management</i>	Quantitative Project Management Organizational Process Performance
3 Defined	<i>Process standardization</i>	Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Management Risk Management Decision Analysis and Resolution Requirements Development Technical Solution Product Integration Verification Validation
2 Managed	<i>Basic project management</i>	Requirements Management Project Planning Project Monitoring and Control Measurement and Analysis Process and Product Quality Assurance Configuration Management Supplier Agreement Management
1 Initial		

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# Structure of the Staged Representation





# SW-CMM v1.1 → CMMI (1/4)

## Maturity Level 2

Requirements Management  
Software Project Planning  
Software Project Tracking &  
Software Subcontract Mgmt  
Software Quality Assurance  
Assurance  
Software Configuration Mgmt

Requirements Management  
Project Planning  
Project Monitoring and Oversight  
Control  
Supplier Agreement Mgmt  
Process & Product Quality  
Configuration Management  
**Measurement and Analysis**





# SW-CMM v1.1 → CMMI (2/4)

## Maturity Level 3

Organization Process Focus

Organization Process Definition

Training Program

Integrated Software Mgmt

Intergroup Coordination

Software Product Engineering

Peer Reviews

Organization Process Focus

Organization Process Definition

Organizational Training

Integrated Project Mgmt

Risk Management

**Requirements Definition**

**Technical Solution**

**Product Integration**

**Verification**

**Validation**

**Decision Analysis and Resolution**



# SW-CMM v1.1 → CMMI (3/4)

## Maturity Level 4

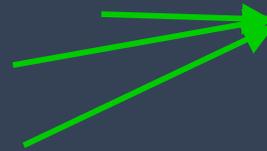




# SW-CMM v1.1 → CMMI (4/4)

## Maturity Level 5

Defect Prevention  
Technology Change Mgmt  
Technology Innovation  
Process Change Mgmt

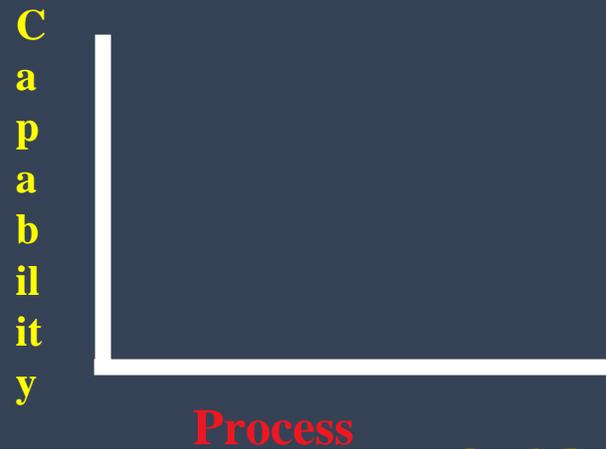


Causal Analysis and Resolution  
Organizational Innovation and  
Deployment



# Continuous Representation

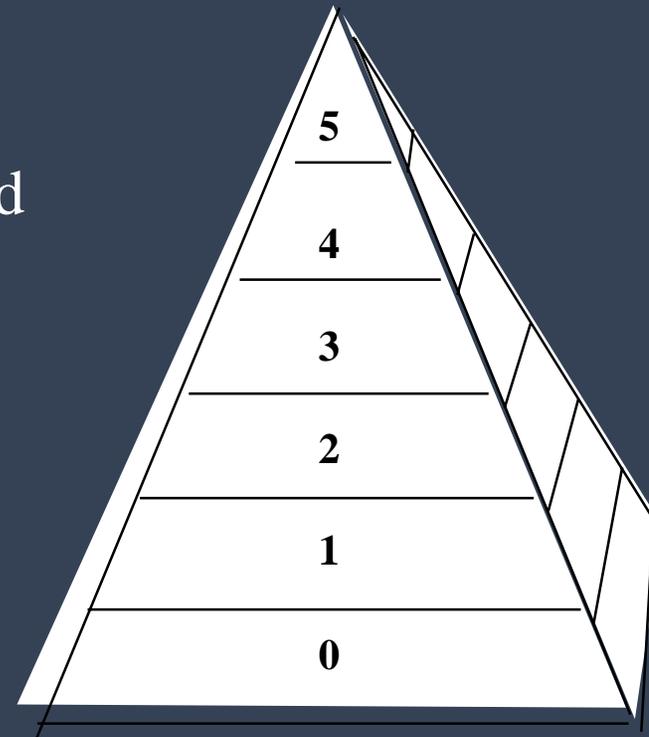
- An organization's process maturity may be represented by a set of points in two dimensions:
  - the *process dimension*
    - “What” you do
  - the *capability dimension*
    - “How well” you do it





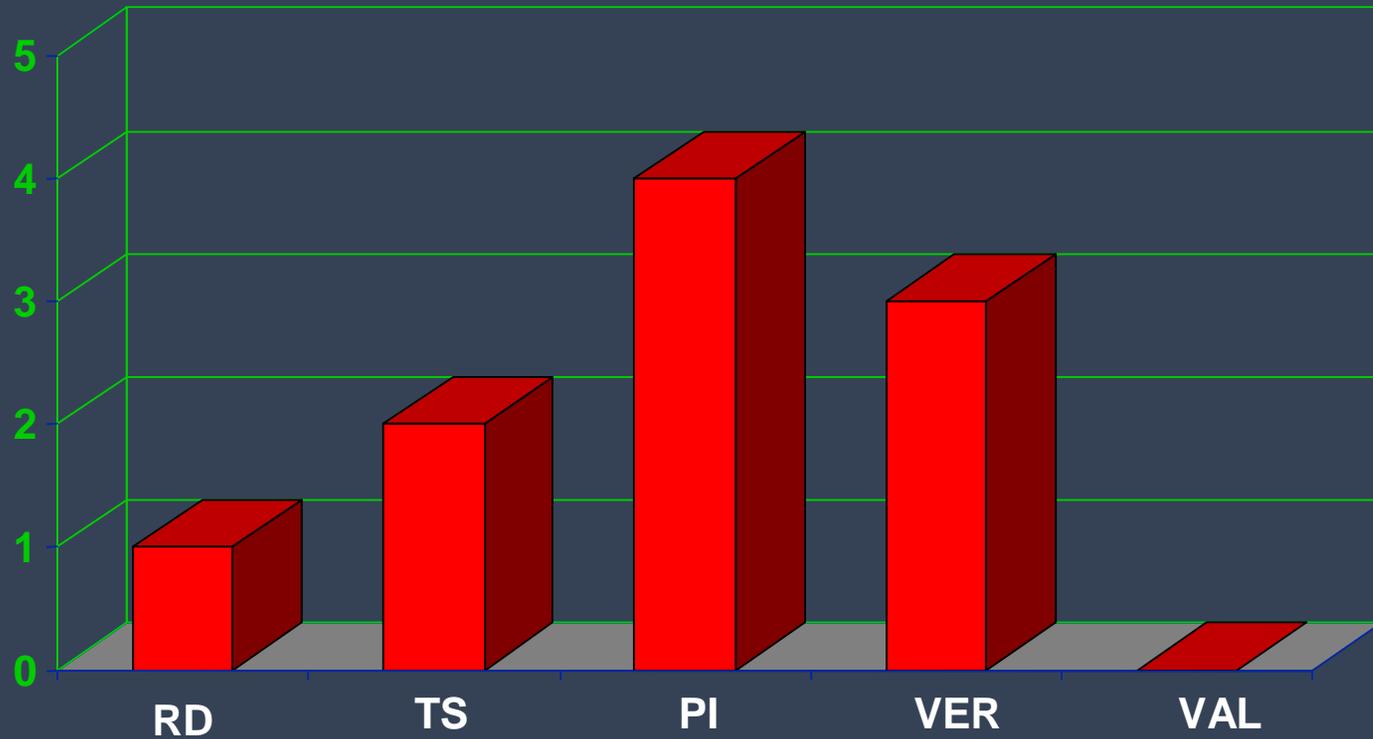
# Capability Levels

- Optimizing
- Quantitatively Managed
- Defined
- Managed
- Performed
- Incomplete





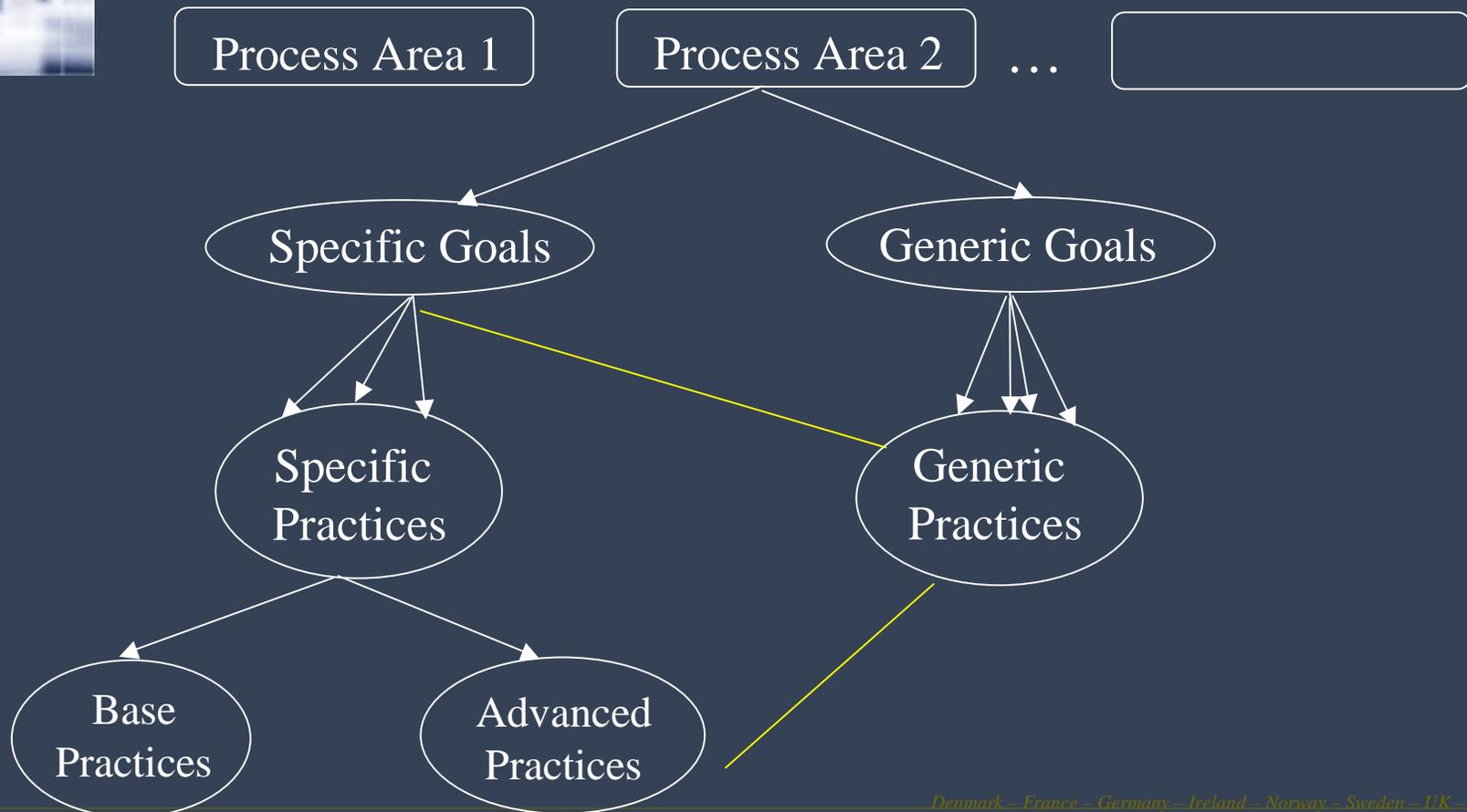
# Process Areas of varying Capabilities



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# Structure of the Continuous Representation



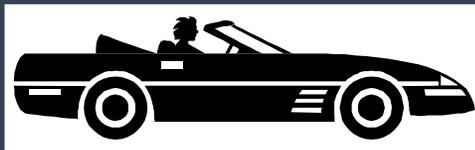
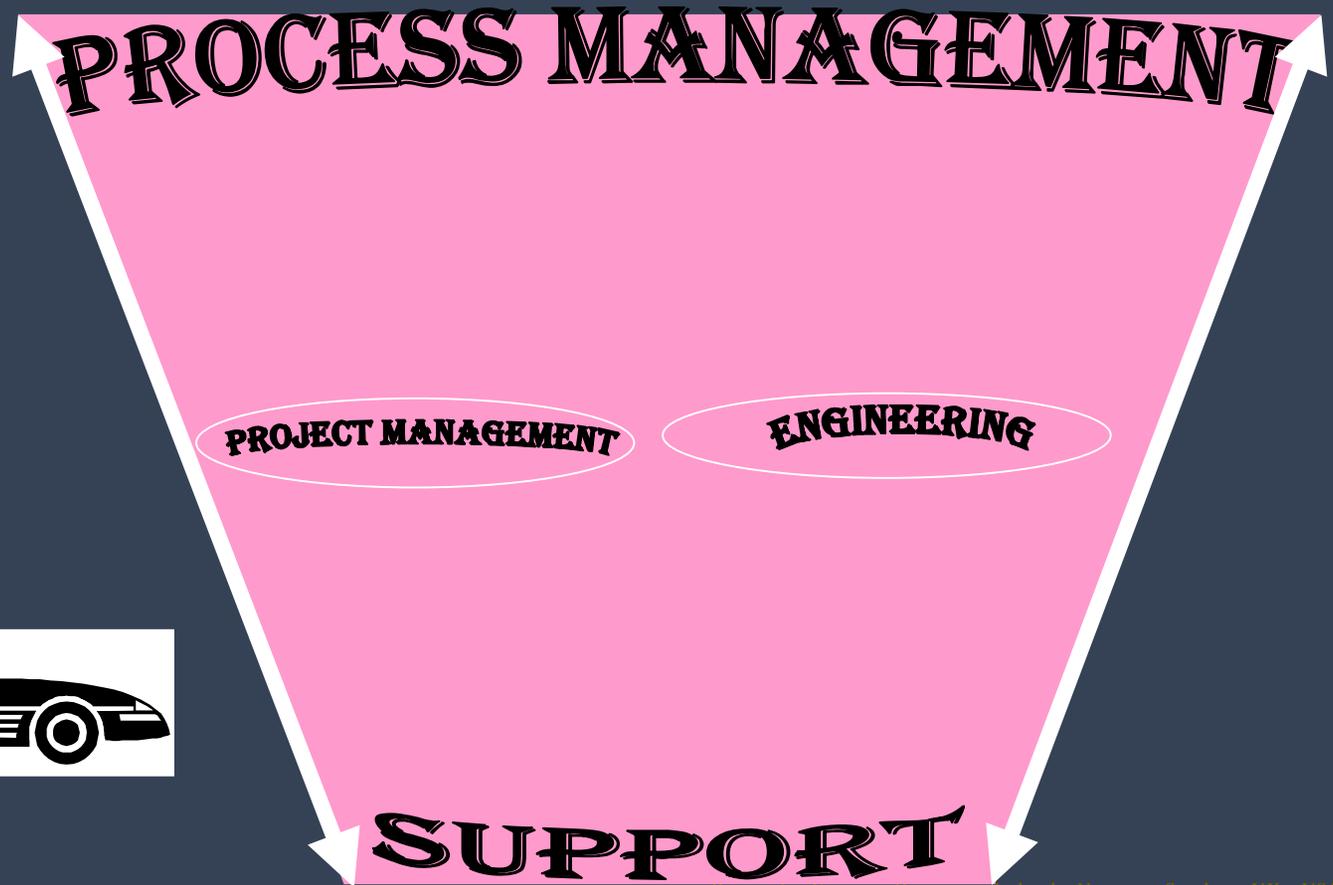


<b>Process Areas</b>	<b>Project Planning</b>	<b>Requirements Management</b>	<b>Measurement and Analysis</b>	<b>Organizational Process Focus</b>
	<b>Project Monitoring and Control</b>	<b>Requirements Development</b>	<b>Product and Process Quality Assurance</b>	<b>Organizational Process Definition</b>
	<b>Supplier Agreement Management</b>	<b>Technical Solution</b>	<b>Configuration Management</b>	<b>Organizational Training</b>
	<b>Integrated Project Management</b>	<b>Product Integration</b>	<b>Decision Analysis and Resolution</b>	<b>Organizational Process Performance</b>
	<b>Risk Management</b>	<b>Verification</b>	<b>Causal Analysis and Resolution</b>	<b>Organizational Innovation and Deployment</b>
	<b>Quantitative Project Management</b>	<b>Validation</b>		
<b>Category</b>	<b>Project Management</b>	<b>Engineering</b>	<b>Support</b>	<b>Process Management</b>

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# Process Categories



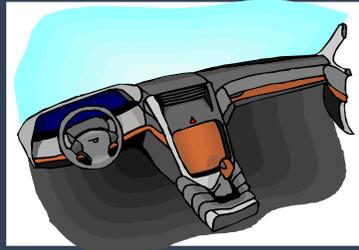
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# Process Categories

*Project Management*



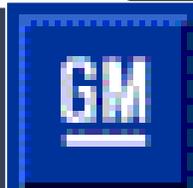
*Process Management*



*Engineering*



*Support*



**DAIMLERCHRYSLER**

# Model Elements



## ■ Required

- Specific Goals
- Generic Goals



## ■ Expected

- Specific Practices
- Generic Practices
- Advanced Practices



## ■ Informative

- Subpractices
- Typical Work Products
- Generic Practice Elaborations
- Discipline Amplifications





## Basic Structure of a PA

- Purpose
- Introductory Notes
- Related Process Areas
- Specific and Generic Goals
  - Name
  - Sentence
- Goal to Practice Mapping
- Specific Practices by Specific Goals
  - Discipline specific amplifications
- Generic Practices by Generic Goals
  - Generic practice elaborations





# Numbering of Practices

Belongs to goal x

SP<sub>x.y-z</sub>

Capability Level z

Sequence number y

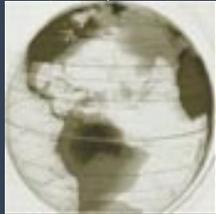
- In the engineering PAs
  - Replacement SPs  
2 SPs with the same **sequence number** - look at the **capability level**
  - Additional SPs  
SPs that only exist at a particular **capability level** and above



# Break



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# Moving to CMMI-SE/SW

## Module 4

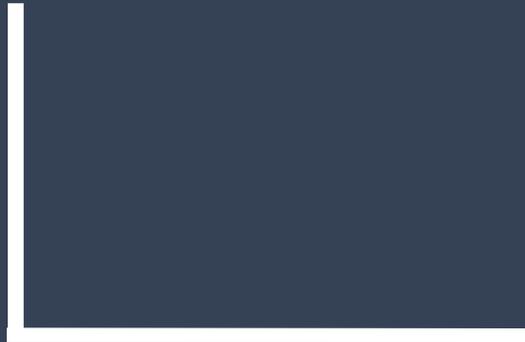
## The Generic Components



# Continuous Representation

- An organization's process maturity may be represented by a set of points in two dimensions.
  - the *process dimension*
    - “What” you do
  - the *capability dimension*
    - “How well” you do it

C  
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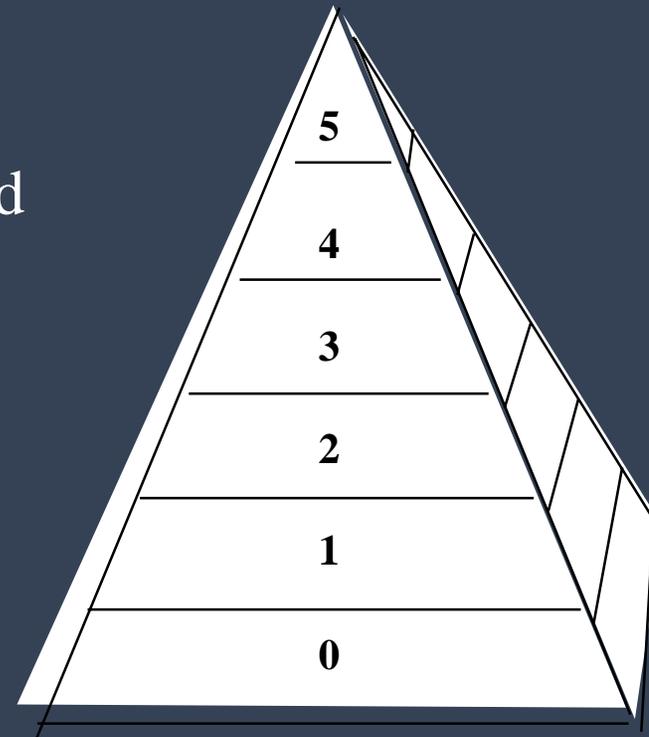


Process



# Capability Levels

- Optimizing
- Quantitatively Managed
- Defined
- Managed
- Performed
- Incomplete

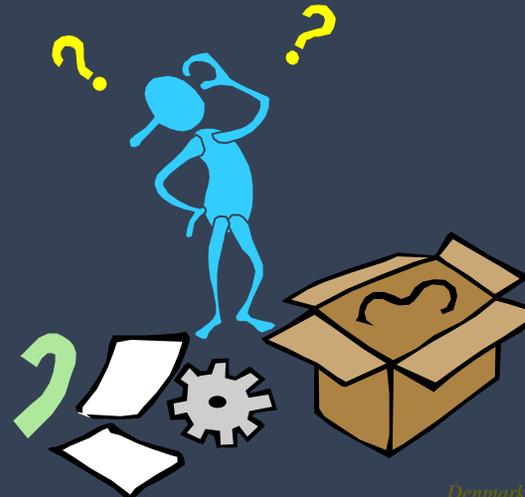




# Capability Level 0

Incomplete

- Practices are not performed or partially performed
- The Specific Goals of the Process Area are not satisfied.





# Capability Level 1

Performed

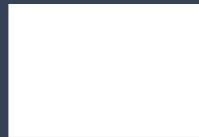
- Satisfies all the goals of the Process Area
- Supports and enables the work needed





# Performed Capability

- GG1
  - Achieve specific goals
  
- GP1.1
  - Identify work scope
  
- GP1.2
  - Perform base practices





# Capability Level 2

## Managed

- A performed practice that is:
  - planned and executed
  - in accordance with policies
  - by skilled people
  - with adequate resources
  - producing controlled outputs
  - involves stakeholders
  - is reviewed and evaluated
  - for conformance to requirements

# Managed Capability (1/2)



- **GG2**

- Institutionalize a Managed Process

- **GP2.1**

- Establish an Organizational Policy

- **GP2.2**

- Plan the Process

- **GP2.3**

- Provide Resources

- **GP2.4**

- Assign Responsibility



# Managed Capability (2/2)



- GP2.5

- Train People



- GP2.6

- Manage Configurations



- GP2.7

- Identify and Involve Relevant Stakeholders



- GP2.8

- Monitor and Control the Process



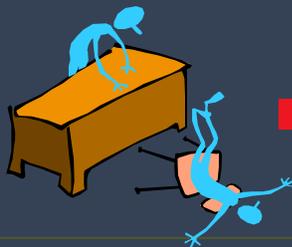
- GP2.9

- Objectively Evaluate Adherence



- GP2.10

- Review status with Higher-Level Management





# Capability Level 3

## Defined

- A Managed Process that is:
  - tailored from the organization's set of standard processes
  - according to the organization's tailoring guidelines
  - has a maintained process description
  - contributes to the organization's process assets



# Defined Capability

## ■ GG3

- Institutionalize a Defined Process



## ■ GP3.1

- Establish a Defined Process



## ■ GP3.2

- Collect Improvement Information



# Capability Level 4

## Quantitatively Managed

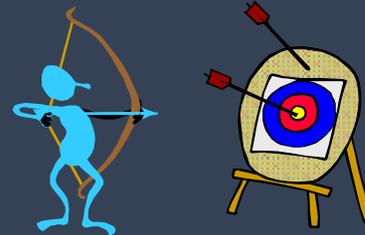
- A Defined Process that is:
  - controlled using statistical and other quantitative techniques



# Quantitatively Managed Capability

## ■ GG4

- Institutionalize a quantitatively managed process



## ■ GP4.1

- Establish quality objectives

## ■ GP4.2

- Stabilize subprocess performance





# Capability Level 5

## Optimizing

- A quantitatively managed process that is:
  - changed and adapted to meet
  - relevant current and projected business objectives



# Optimizing Capability

- GG5

- Institutionalize an Optimizing Process



- GP5.1

- Ensure Continuous process improvement

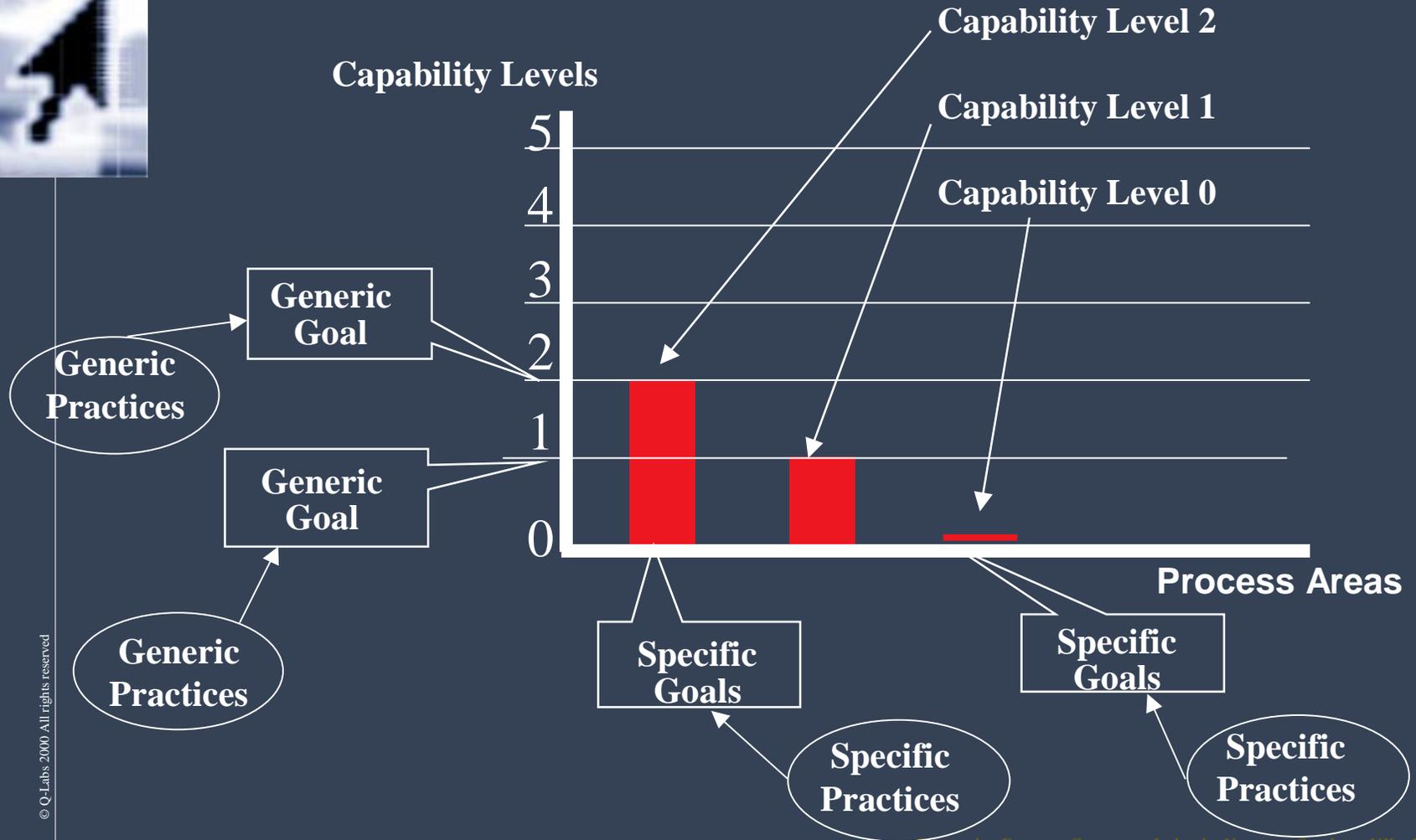
- GP5.2

- Correct Common Causes of Problems





# Structure of the CMMI



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# Summary

Capability Level	Goals	Number of	
		Goals	Practices
0 Incomplete		0	0
1 Performed		1	2
2 Managed		1	10
3 Defined	1	2	
4 Quantitatively Managed		1	2
5 Optimizing		1	2



# Break



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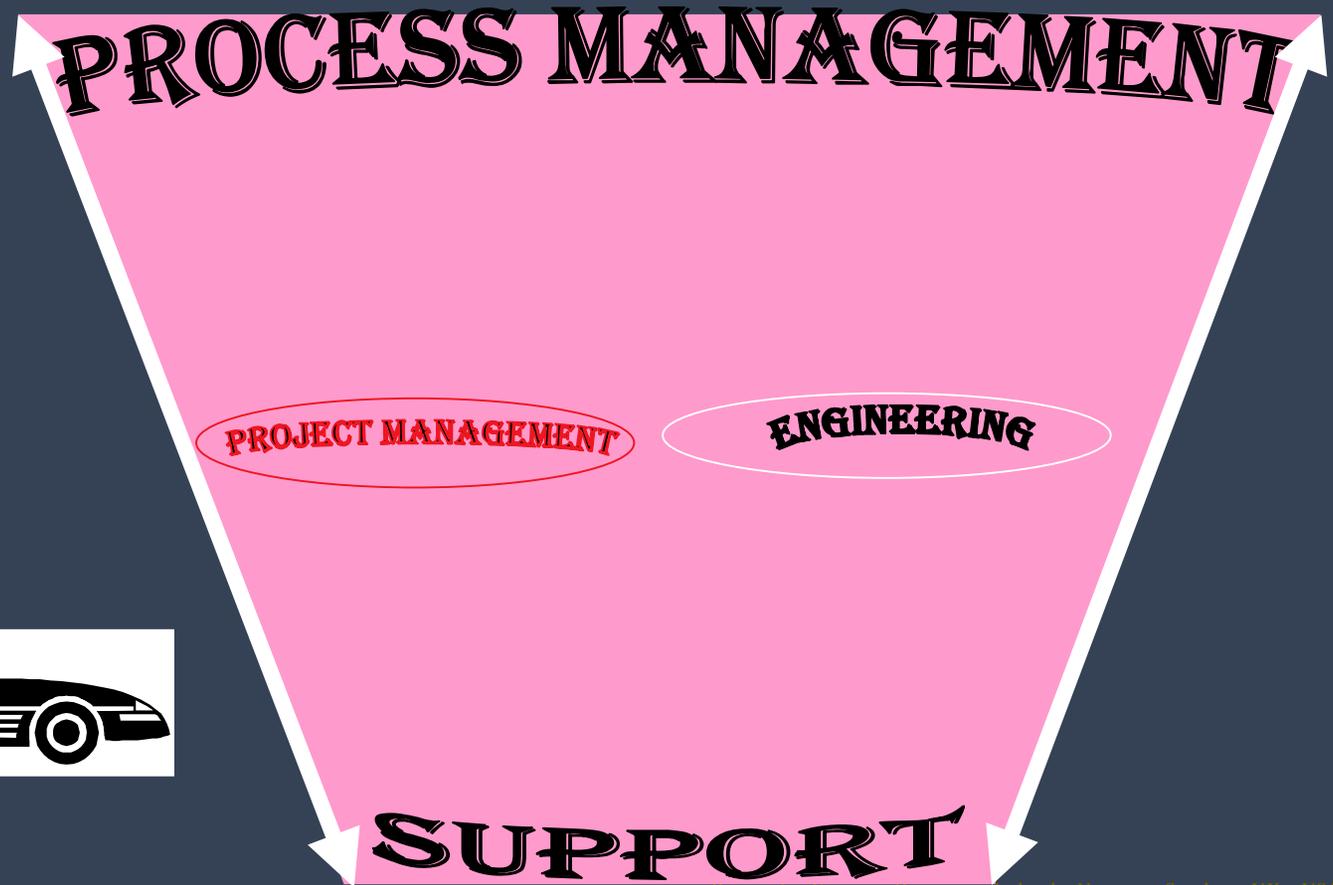
# Moving to CMMI-SE/SW

## Module 5

### Process Category: Project Management



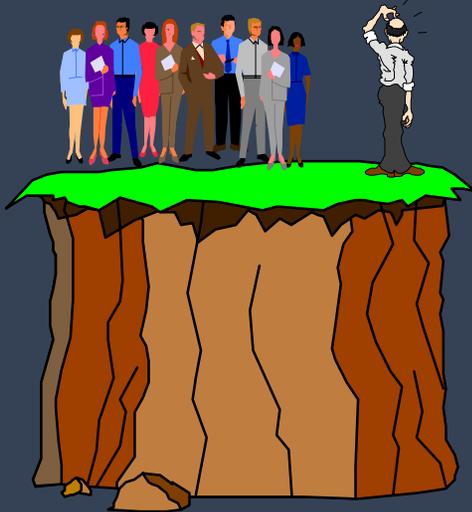
# Process Categories



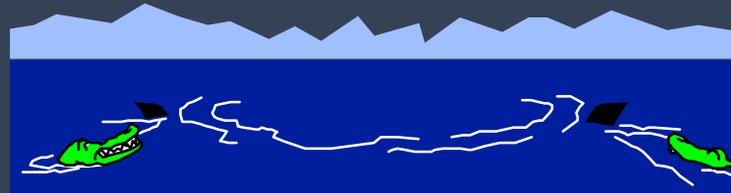
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# Project Management



Planning,  
Monitoring,  
Controlling  
the project



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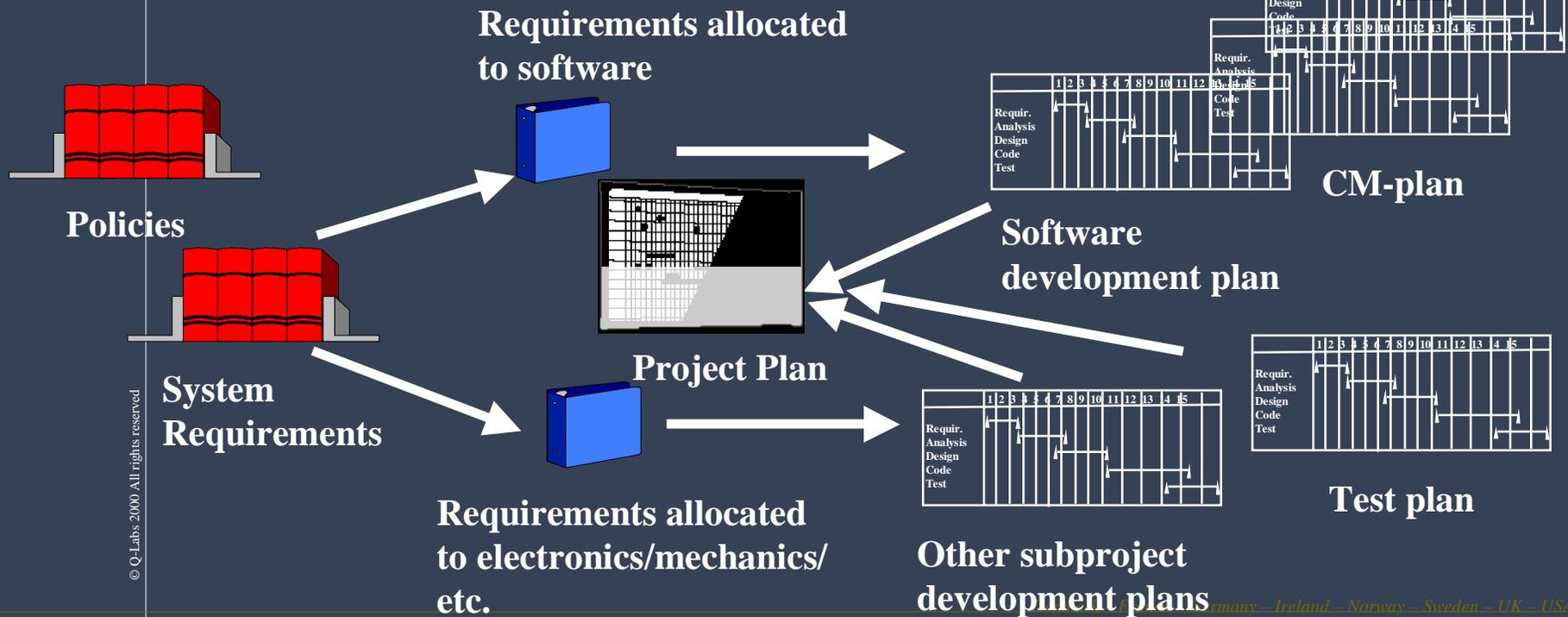
# Project Management Process Areas

- Project Planning
- Project Monitoring and Control
- Supplier Agreement Management
- Integrated Project Management
- Risk Management
- Quantitative Project Management



# Project Planning

Establish and maintain plans that define Project Activities

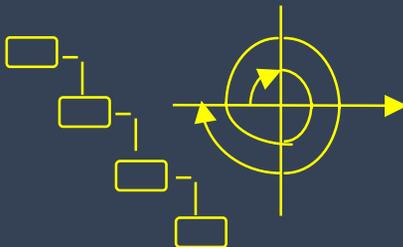
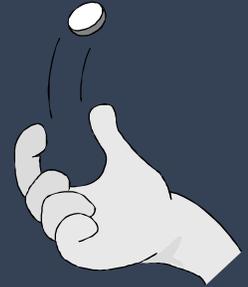


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# Project Planning Goals

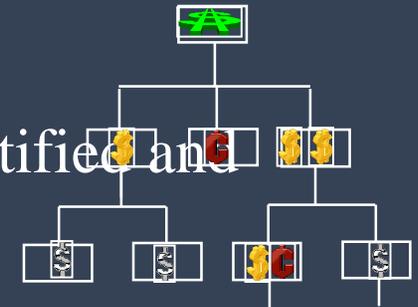
- SG1 Establish estimates
- SG2 Develop a project plan
- SG3 Obtain commitment to the plan





# Project Planning Details

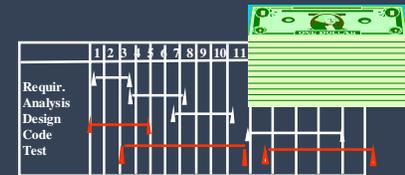
- Use of project planning parameters and work breakdown structure (WBS) when planning the project
- Stakeholders are identified and their involvement is planned
- Knowledge and skills needed are identified and planned for
- Administration of project “data”, (documents produced during the project) is planned and managed
- Explicit commitment process





# Project Planning Summary

- Identification of
  - project activities
  - project risks
- Estimation of
  - project effort, costs, resources
- Definition of measures for
  - project progress and performance
- Establishment of
  - project and subordinate plans
  - schedules
- Obtainment of commitment
- Coordination of stakeholders





# Project Monitoring and Control

Provide understanding into the project's progress so that appropriate corrective actions can be taken when the project's performance deviates significantly from the plan





# Project Monitoring and Control Goals

SG1 Monitor project against plans

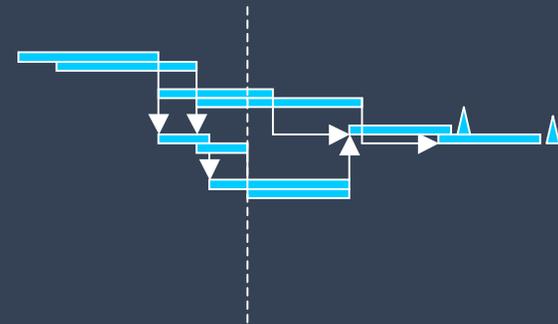
SG2 Manage corrective actions to closure





# Project Monitoring and Control Details

- All planning items are monitored
  - planning parameters
  - stakeholder involvement
  - risks
  - progress
  - .....





# Project Monitoring and Control Summary

## ■ Monitoring

- project planning parameters
- commitments and project risks
- data management and stakeholder interaction



## ■ Reviewing

- project and product progress



## ■ Correcting issues that could hinder project objectives from being met



# Supplier Agreement Management

Manage the acquisition of products and services from suppliers external to the project for which there exists a formal agreement





# Supplier Agreement Management Goals

SG1 Establish supplier agreement

SG2 Satisfy supplier agreement





# Supplier Agreement Management Details

- Formal agreement may be contract, license or memorandum of agreement
- Covers both products and services delivered to the customer
- Can also be used for products/services not delivered to the customer
- Suppliers can be both internal and external to the organization
- Does not cover situations where supplier is part of a project (e.g. integrated product teams)





# Supplier Agreement Management Summary

- Establish requirements
- Select supplier or acquire off-the-shelf
- Establish and maintain agreements
- Conduct reviews and monitor performance
- accept and transition products



# Integrated Project Management

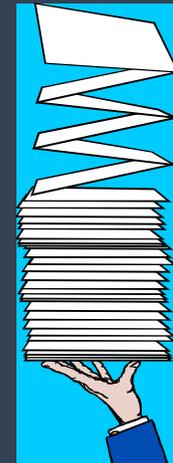
Establish and manage the project and the involvement of relevant stakeholders according to an integrated and defined process that is tailored from the organisation's set of standard processes.





# Integrated Project Management Goals

- SG1 Use the project's defined process
- SG2 Coordinate and collaborate with relevant stakeholders





# Integrated Project Management Details

- Project uses a defined process tailored from the set of standard processes
- The project plan integrates subordinate plans e.g.
  - component realization
  - quality assurance
  - verification and validation, integration
  - configuration management
- Covers the coordination of stakeholder efforts





# Integrated Project Management Summary

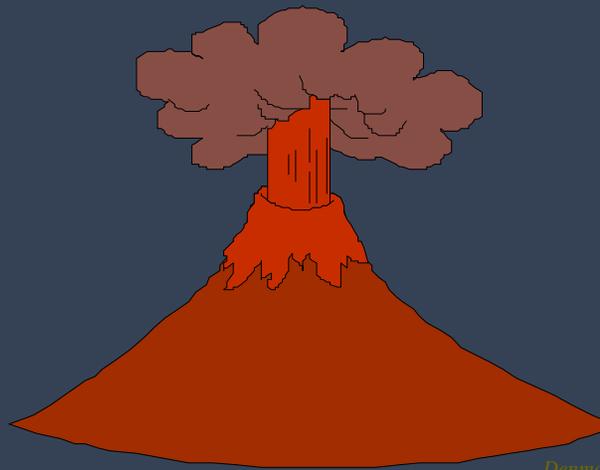
- Tailoring the organization's set of standard processes
- Producing the project's defined process
- Managing the project using integrated plans
- Using and contributing to the organizations process assets
- involving and coordinating relevant stakeholders





# Risk Management

Identify potential problems before they occur, so that risk handling activities may be planned and invoked as needed across the life cycle to mitigate adverse impacts on achieving objectives.





# Risk Management Goals

- SG1 Prepare for risk management
- SG2 Identify and analyze risk
- SG3 Mitigate risk





# Risk Management Details

- Risk Management covers
  - risk identification
  - risk analysis
  - risk quantification
  - risk prioritization
  - risk mitigation
  - risk contingency planning





# Risk Management Summary

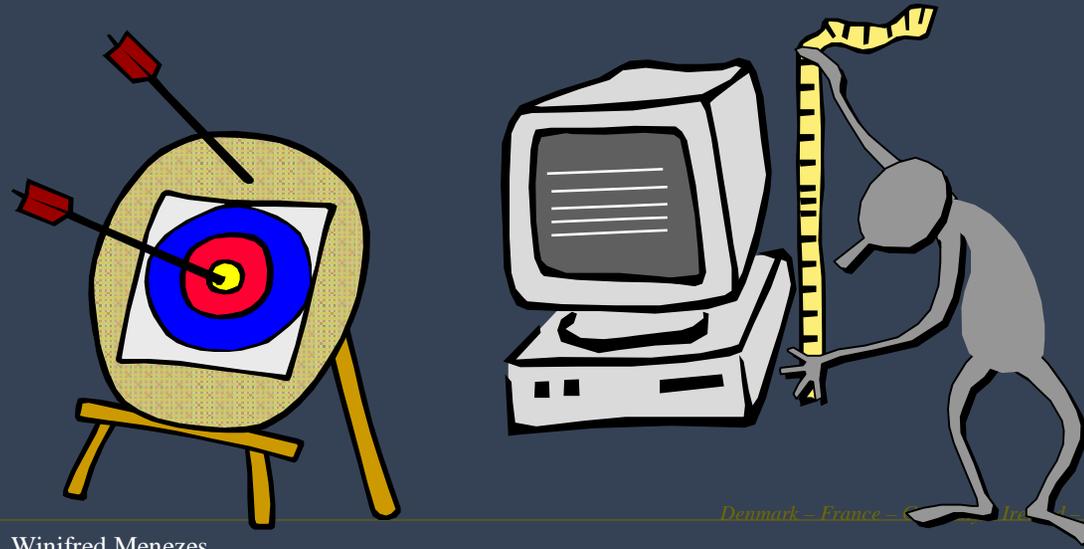
- Determine risk source and category
- identify risks
- analyze each risk
- develop mitigation plans for high priority risks
- monitor status
- implement mitigation plans





# Quantitative Project Management

Quantitatively manage the project's defined process to achieve the project's established quality and process performance requirements and objectives.





# Quantitative Project Management Goals



SG1 Quantitatively manage the project

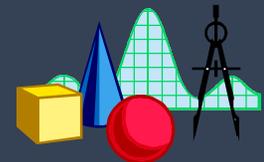
SG2 Statistically manage subprocess performance





## Quantitative Project Management Details

- Closely coupled to “Organizational Process Performance” (OPP)
- Covers quantitative and statistical control of selected subprocesses
- Uses standard process measures to monitor subprocess stability in the project
- Provides information back to OPP



# Quantitative Project Management Summary



- Establish and maintain project's quality and process performance objectives
- Identify subprocesses based on stability and capability data
- Select subprocesses to be statistically managed
- Select measures and analytical techniques
- Determine whether objectives can be met
- Take corrective action when needed
- Record management data





# Moving to CMMI-SE/SW

## Module 6

## Process Category: Engineering

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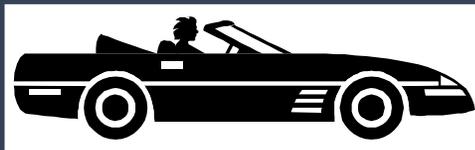
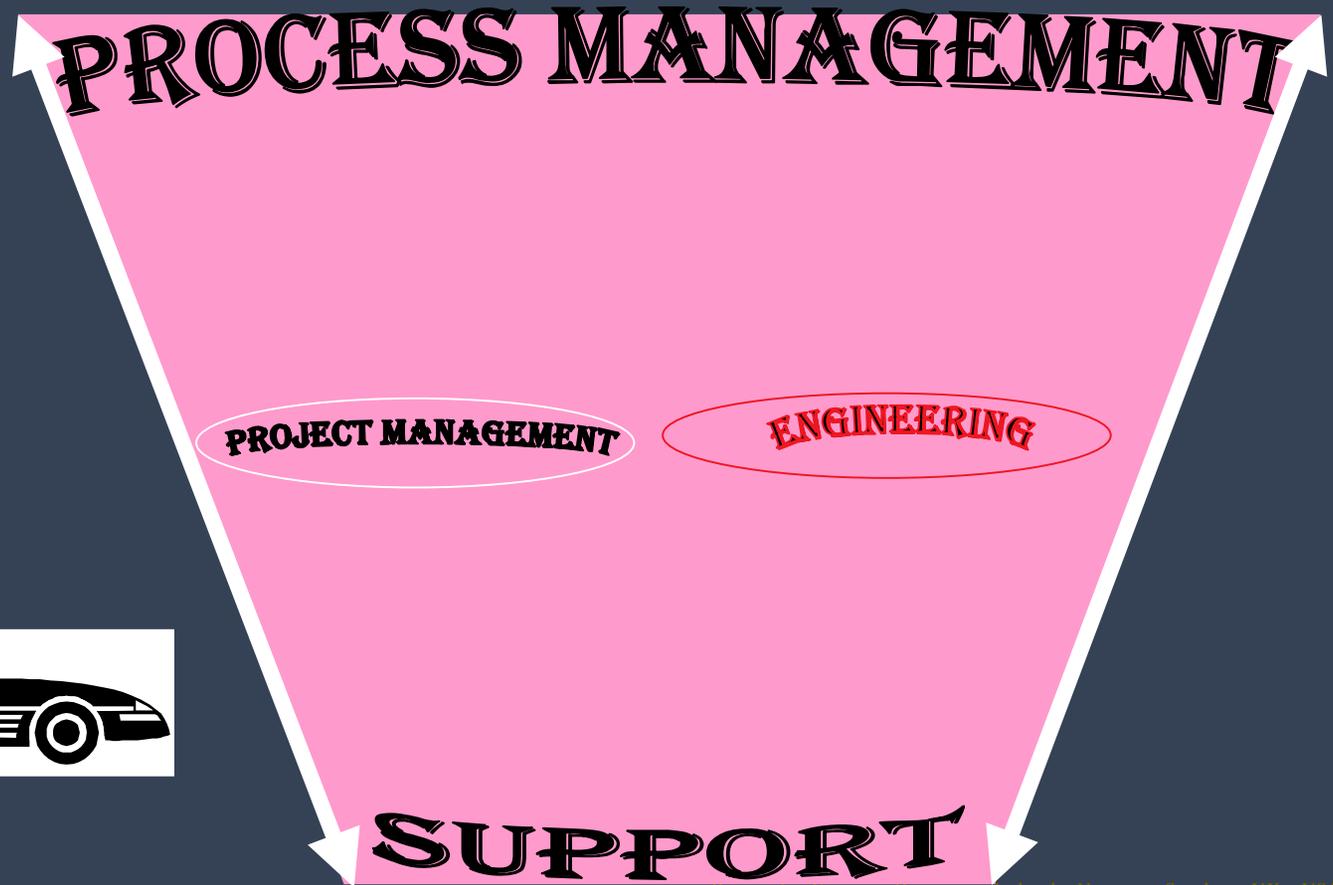
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# Process Categories

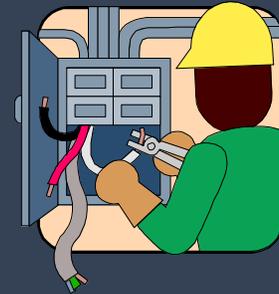


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# Engineering





# Engineering Process Areas

- Requirements Management
- Requirements Development
- Technical Solution
- Product Integration
- Verification
- Validation





# Requirements Development

Produce and analyze customer, product and product component requirements.





# Requirements Development Goals

- SG1 Develop customer requirements
- SG2 Develop product requirements
- SG3 Analyze and validate requirements





# Requirements Development Details

- Requirements development starts by gathering/eliciting stakeholder needs
- Stakeholder needs are transformed to customer requirements, which are broken down to product and product component requirements (including derived and interface requirements)
- Operational concepts and scenarios are developed
- Requirements are validated





# Requirements Development Summary

- Collect and coordinate stakeholder needs
- Develop life cycle requirements for the product
- Establish customer requirements
- Establish product and product component requirements





# Technical Solution

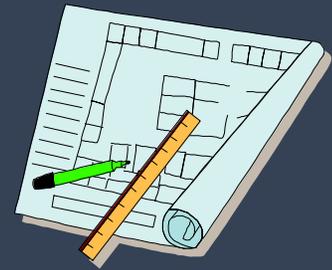
Develop, design and implement solutions to requirements. Solutions, designs and implementations encompass products, product components, and product related processes either singly or in combinations as appropriate.





# Technical Solution Goals

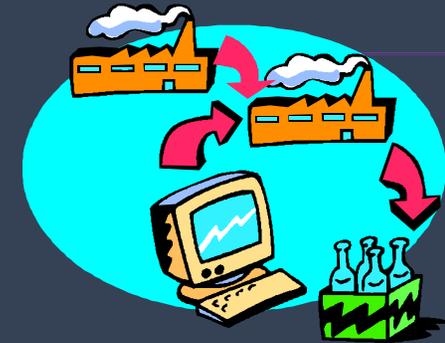
- SG1 Select product component solutions
- SG2 Develop the design
- SG3 Implement the product design





# Technical Solution Details

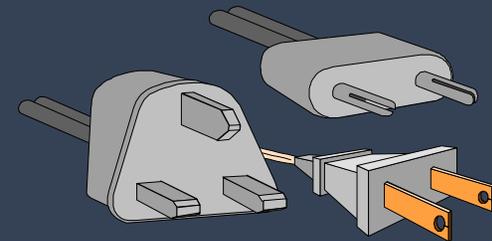
- Applies to development of
  - product
  - product components
  - services
  - product related components
- Alternative solutions evaluated and the best solution chosen
- Complete design (including interface descriptions) documented in a technical data package
- Make, buy or reuse analysis





# Technical Solution Summary

- Evaluate and select solutions
- Develop detailed designs
- Implement the designs





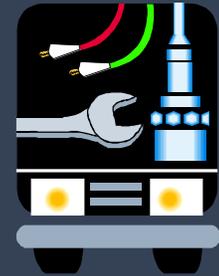
# Product Integration

Assemble the product from the product components, ensure the product as integrated functions properly, deliver the product.





# Product Integration Goal



- SG1 Prepare for product integration
- SG2 Ensure interface compatibility
- SG3 Assemble product components and deliver the product





# Product Integration Details



- Progressive assembly of product components
- Integration strategy identified early in the project
- Identification of the integration environment
- Interfaces managed to ensure completeness and compatibility
- Components inspected upon receipt and “checked out” after integration
- Packing, delivery and installation covered



# Product Integration Summary

- Develop an integration strategy and plans
- Establish an integration environment
- Ensure compatibility and manage interfaces
- Integrate components
- Package and deliver components





# Verification

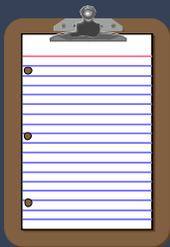
Assure that selected work products meet their specified requirements.





# Verification Goals

- SG1 Prepare for verification
- SG2 Perform peer reviews
- SG3 Verify selected work projects





# Verification Details

- Ensures requirements are met at each stage of the development process
- Verification strategy identifies verification environment and work products to be verified
- Accomplished through use of:
  - testing
  - peer reviews (inspections, walkthroughs, etc.)





# Verification Summary

- Develop a verification strategy and plans
- Establish the verification environment
- Prepare for and perform peer reviews
- Verify selected work products
- Analyze verification data
- Take corrective action if necessary





# Validation

Demonstrate that a product or product component fulfills its intended use when placed in its intended environment.

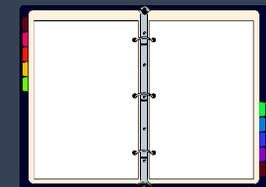
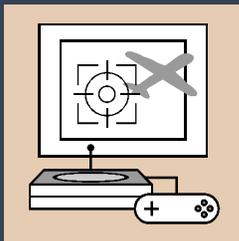




# Validation Goals

SG1 Prepare for validation

SG2 Validate product or product components





# Validation Details

- Key phrases performs its **intended functions in its intended environment**
- Validation activities and environment may be similar to verification





# Validation Summary

- Determine a validation strategy
- Define detailed validation strategy
- Perform validation
- Capture and analyze results



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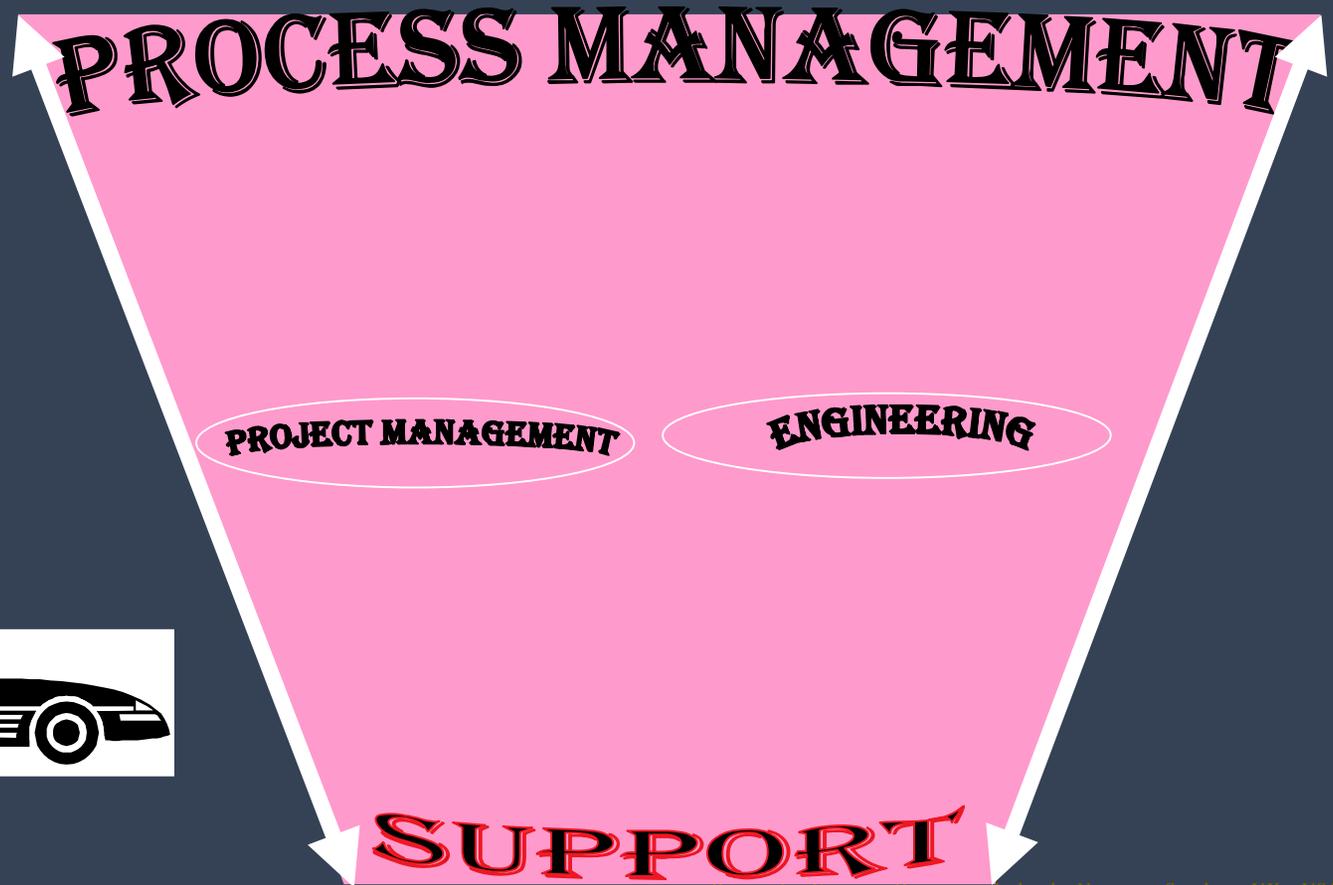
# Moving to CMMI-SE/SW

## Module 7

### Process Category: Support



# Process Categories

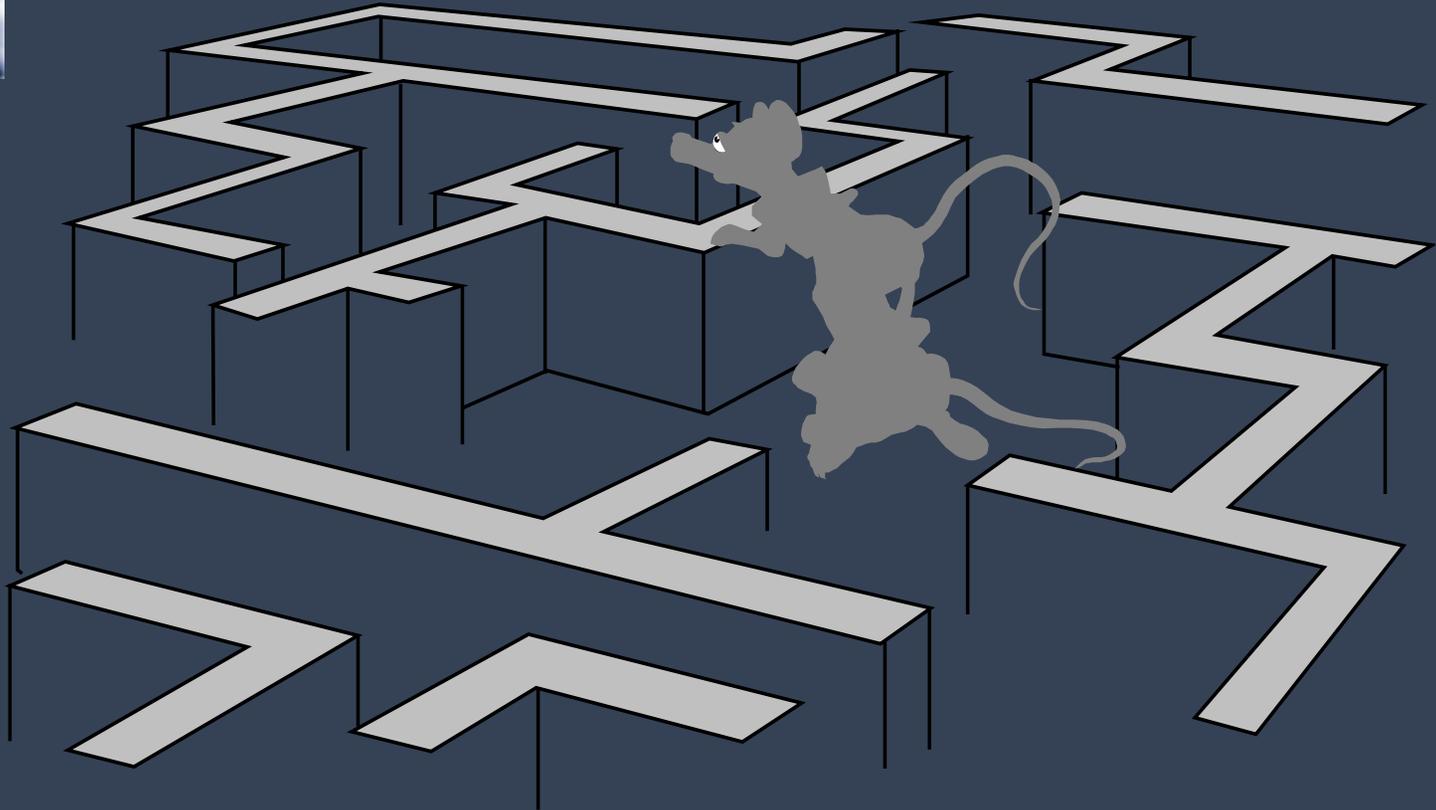


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# SUPPORT

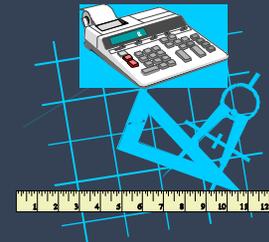


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# Support Process Areas

- Configuration Management
- Process & Product Quality Assurance
- Measurement & Analysis
- Decision Analysis & Resolution
- Causal Analysis & Resolution





# Configuration Management

Establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits





# Configuration Management Goals Establish Baselines

- SG1 Establish baselines
- SG2 Track and control changes
- SG3 Establish integrity





# Configuration Management Details

- Work products placed under CM
  - items delivered to the customer
  - designated internal work products
  - acquired products, tools, reuse libraries
  - standards, procedures
- Changes to configuration items are controlled
- Integrity of baselines maintained





# Configuration Management Summary

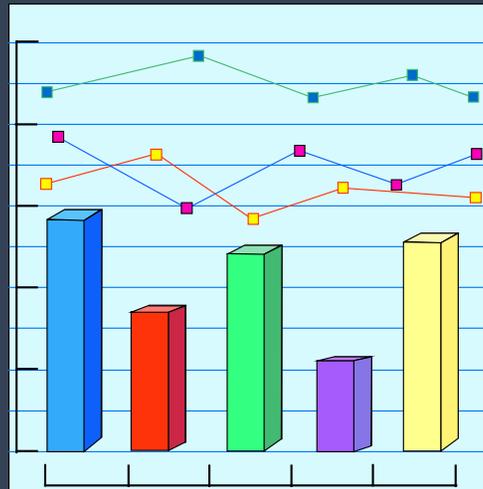
- Identify configuration items
- Control changes
- Make information on configuration status available
- Perform configuration audits





# Process & Product Quality Assurance

Provide staff and management with objective insight into the processes and associated work products





# Process & Product Quality Assurance Goals

- SG1 Objectively evaluate processes and work products
  
- SG2 Provide objective insight





# Process & Product Quality Assurance Details

- Objective evaluation of products, processes and non-project activities (e.g. training)
- Independent reporting channel to appropriate level of management
- Non-compliance resolved preferably within the project (escalation if resolution not possible)
- PPQA ensures process adherence, VER ensures requirements have been met





# Process and Product Quality Assurance Summary

- Review work products to ensure they are appropriate and usable
- Objectively review work products, activities and services
- Ensure non-compliance issues are addressed
- Provide feedback to developers
- Provide management with quality status
- Support the delivery of quality products and services





# Measurement and Analysis

Develop and sustain a measurement capability that is used to support management information needs.





# Measurement and Analysis Goals

SG1 Align measurement and analysis activities

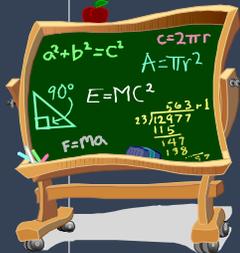
SG2 Provide measurement results





# Measurement and Analysis Details

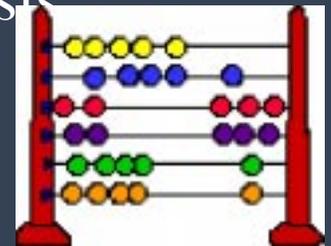
- Describes the introduction of a measurement program within an organization
- Starting point is business objectives and information needed to make decisions
- Measurements evolve from basic project management measures, to organizational measures, to statistical control of selected subprocesses





# Measurement and Analysis Summary

- Establish measurement objectives
- Define measures and procedures for data collection, storage and analysis
- Collect and analyze measurement data
- Store and manage data
- Report results of measurement and analysis





# Decision Analysis and Resolution

Make decisions using a structured approach that evaluates identified alternatives against established criteria.





# Decision Analysis and Resolution Goals

SG1 Evaluate alternatives



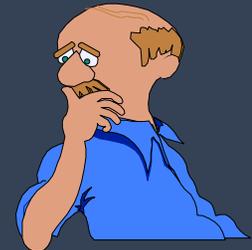


## Decision Analysis and Resolution Details

- Formal decision making process when deciding on issues that significantly impact the project
- Identify, document and analyze alternatives
- Use decision making models (from OR) to make decisions
- Document rationale for decision



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# Decision Analysis and Resolution Summary

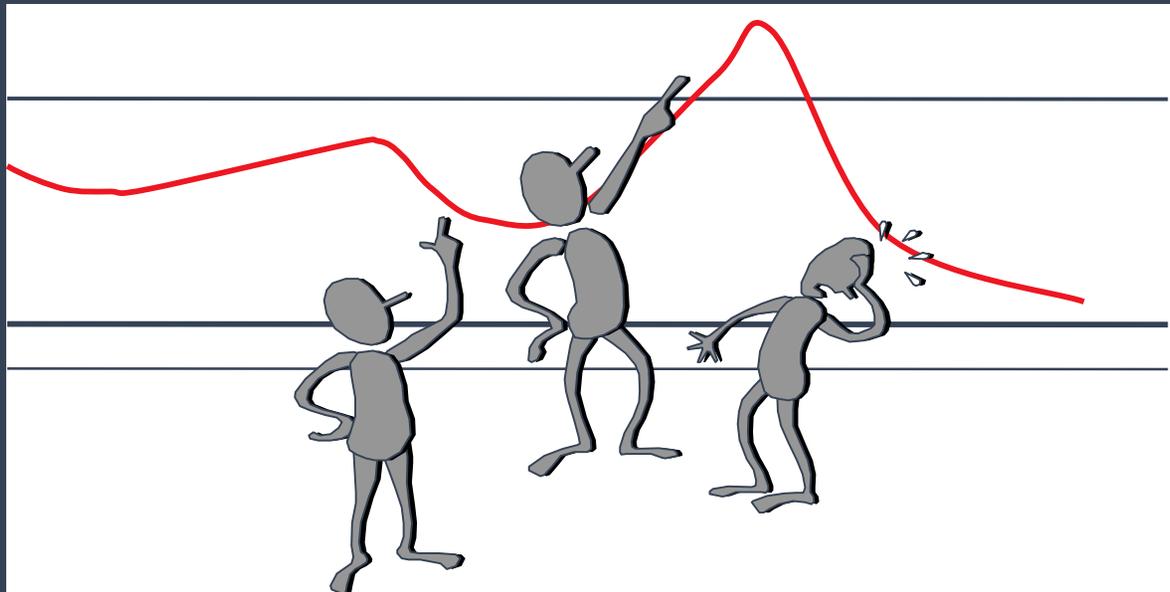
- Establish guidelines to determine which issues will need a formal decision process
- Select methods for decision making
- Develop appropriate criteria
- Make decisions





# Causal Analysis and Resolution

Identify causes of defects and other problems and take action to prevent them from occurring in the future



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# Causal Analysis Resolution Goals

SG1 Determine causes of defects

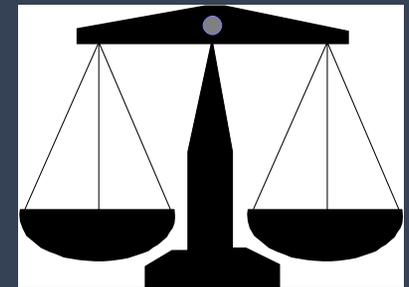
SG2 Address causes of defects





# Causal Analysis and Resolution Details

- Defect prevention through root cause analysis
- Performed on defects as well as non-defect related problems (e.g cycle time)
- Practices based on the existence of a measurement program





# Causal Analysis and Resolution Summary

- Identify and analyze causes of defects
- Take specific actions to remove causes of defects



# Moving to CMMI-SE/SW

## Module 8

### Process Category: Process Management

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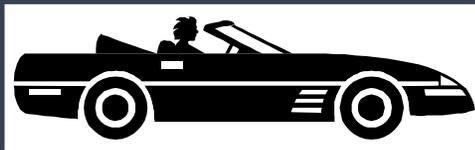
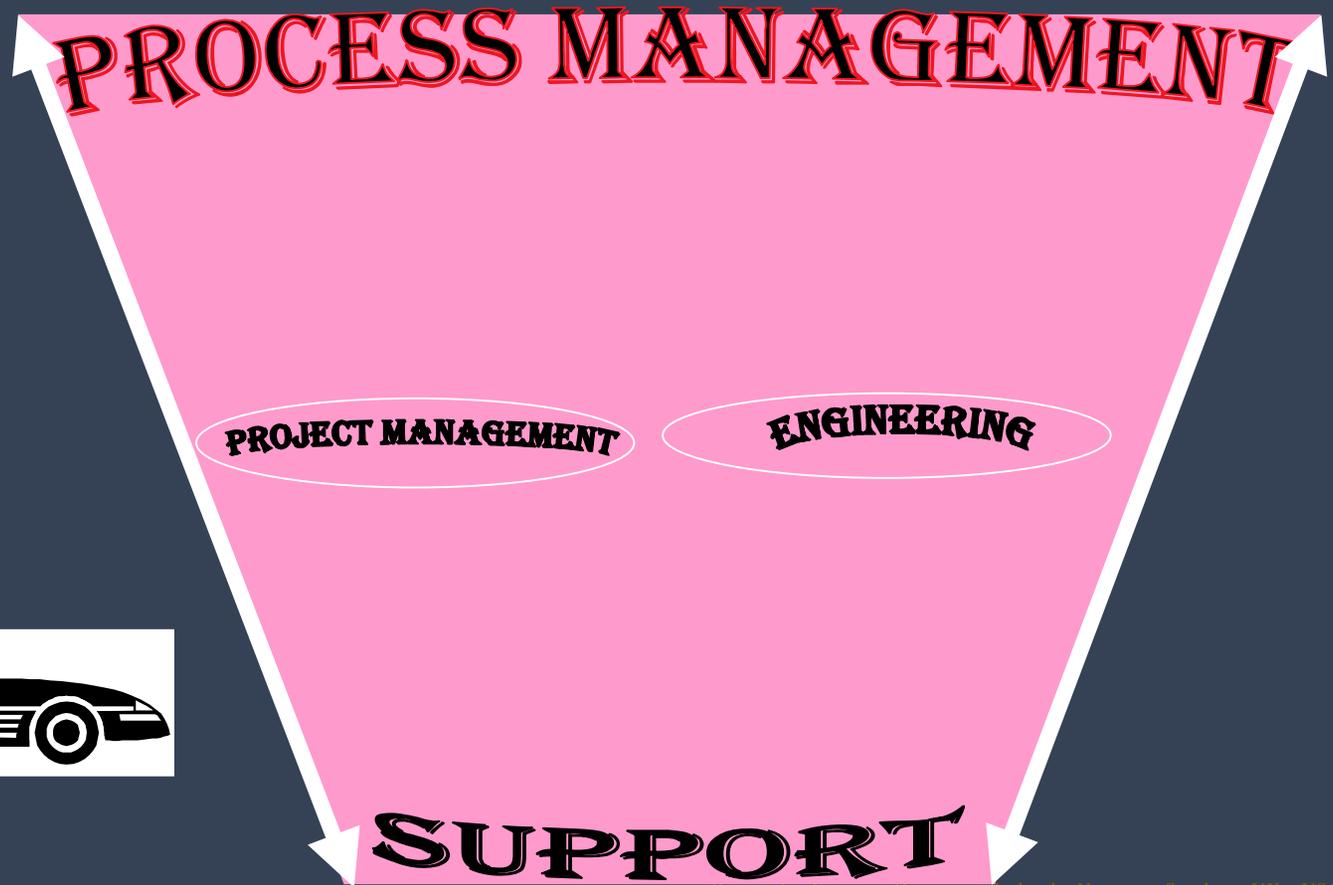
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3 January 2001

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# Process Categories



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# PROCESS MANAGEMENT





# Process Management Process Areas

- Organizational Process Focus
- Organizational Process Definition
- Organizational Training
- Organizational Process Performance
- Organizational Innovation and Deployment



# Organizational Process Focus

Establish and maintain an understanding of the organization's processes and process assets, and identify, plan and implement the organization's process improvement activities





# Organizational Process Focus Goals

SG1 Determine process improvement opportunities

SG2 Plan and implement process improvement activities





# Organizational Process Focus Details

- Focus on organization's set of standard processes and the processes derived for use within a project
- Process assets: anything useful related to describing, improving or deploying the process
- Focus is on improving the processes





# Organizational Process Focus Summary

- Appraise organization's and project's processes
- Establish action plans to improve processes
- Coordinate process improvement activities





# Organizational Process Definition

Establish and maintain a usable set of organizational process assets.

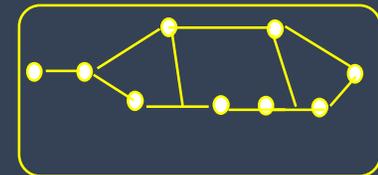




# Organizational Process Definition Goals

SG1 Create organizational process assets

SG2 Make supporting process assets available





# Organizational Process Definition Details

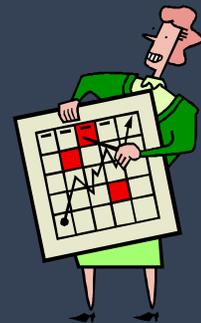
- Establishment of Process Assets
  - set of standard processes
  - tailoring guidelines
  - process library (useful artifacts)
  - measurement repository





# Organizational Process Definition Summary

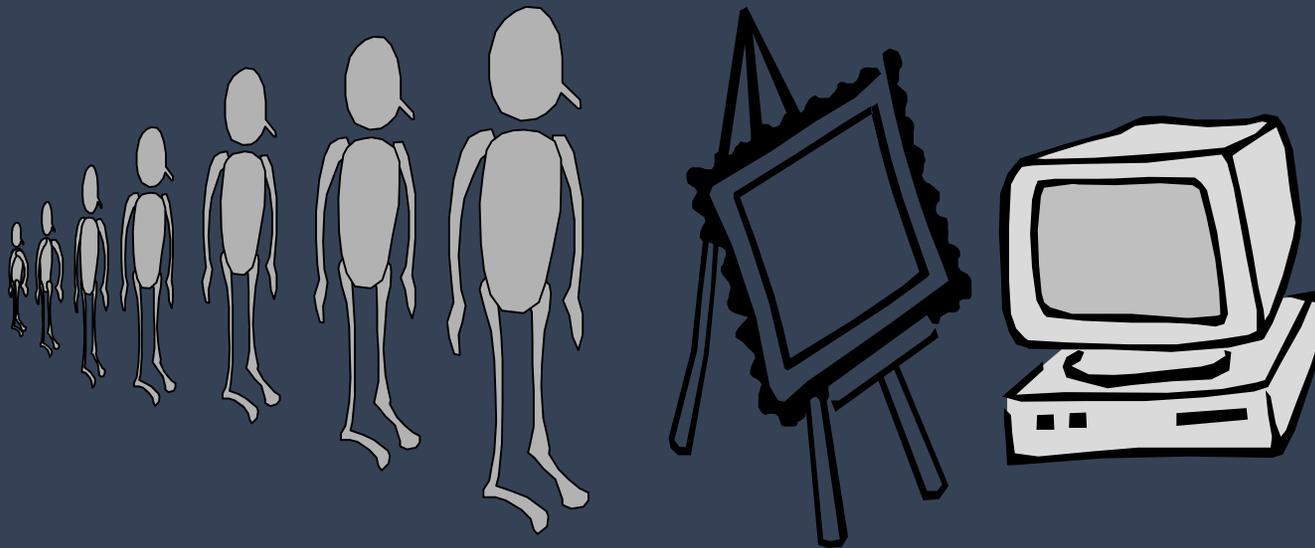
- Establish and maintain:
  - organization's set of standard processes
  - description of life-cycle models
  - tailoring guidelines
  - organization's measurement repository
  - organization's asset library





# Organizational Training

Develop the skills and knowledge of people so they can perform their roles effectively and efficiently.



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# Organizational Training Goals

SG1 Identify training needs and make training available

SG2 Provide necessary training





# Organizational Training Details

- Skills and knowledge can be
  - technical
  - organizational
  - contextual
- Covers the training necessary to
  - support the organization's business objectives
  - fulfill the tactical needs common across projects or support groups
- Can be
  - classroom training
  - self-guided training
  - on-the-job training
  - etc





# Organizational Training Summary

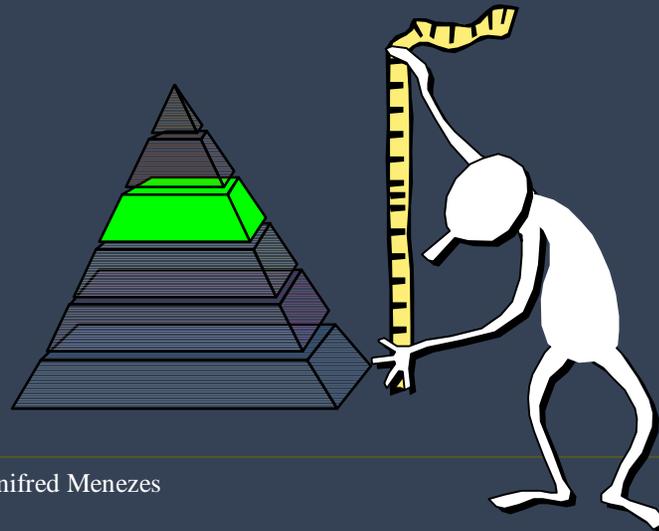
- Identify training needed by the organization
- Obtain and provide training





# Organizational Process Performance

Establish and maintain a quantitative understanding of the performance of an organization's set of standard processes and provide the process performance data, baselines, and models to quantitatively managing the organization's projects.





# Organizational Process Performance Goals

SG1 Establish performance baselines and models





# Organizational Process Performance Details

- Baselines and models that characterize the capability of the organization's subprocesses are established and maintained
- Sets the stage for Quantitative Project Management





# Organizational Process Performance Summary

- Define measures that characterize the organization's process performance
- Collect process performance data
- Use data to:
  - quantify the organization's set of standard processes
  - establish process performance objectives, baselines and models for the organization



# Organizational Innovation and Deployment



- Select and deploy incremental and innovative improvements that measurably improve the organization's processes and technologies. The improvements support the organization's quality and process performance objectives as derived from the organization's business objectives

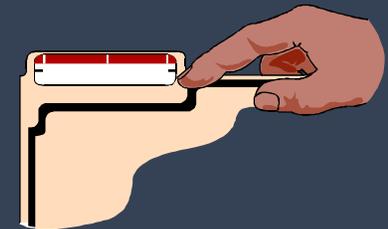




# Organizational Innovation and Deployment Goals

SG1 Select improvements

SG2 Deploy improvements





# Organizational Innovation and Deployment Details

- Covers both evolutionary and revolutionary process improvements
- Improvement ideas are evaluated and prioritized
- Prioritized improvements are piloted
- Results of pilots are evaluated
- Successful pilots lead to improvements deployed across the organization





# Organizational Innovation Deployment Summary

- Collect and analyze innovation, technology improvement proposals
- pilot and select improvements for deployment
- plan and manage the deployment of improvements
- measure the effects of deployed process and technology improvements





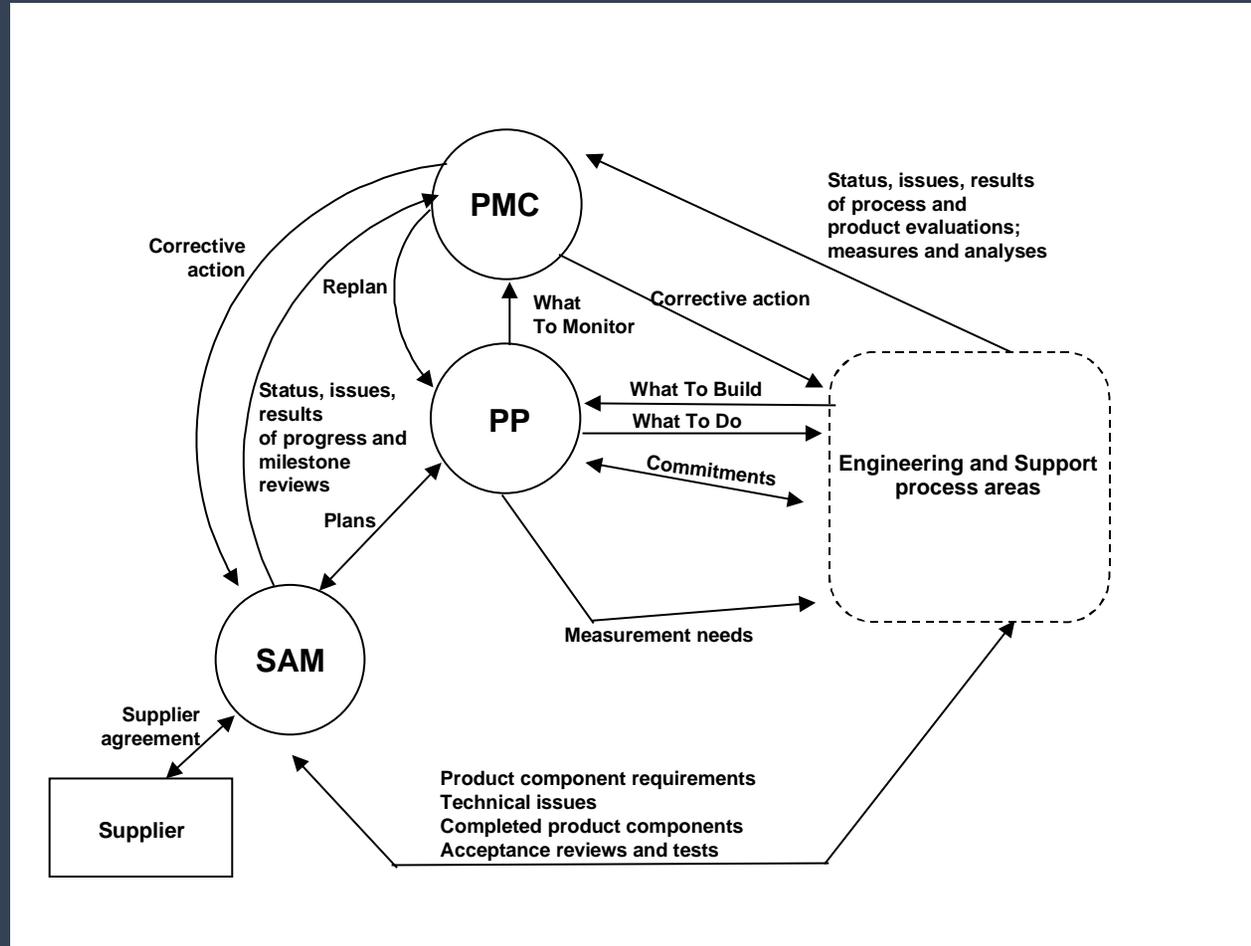
# Moving to CMMI-SE/SW

## Module 9

### Relationship Between Process Areas



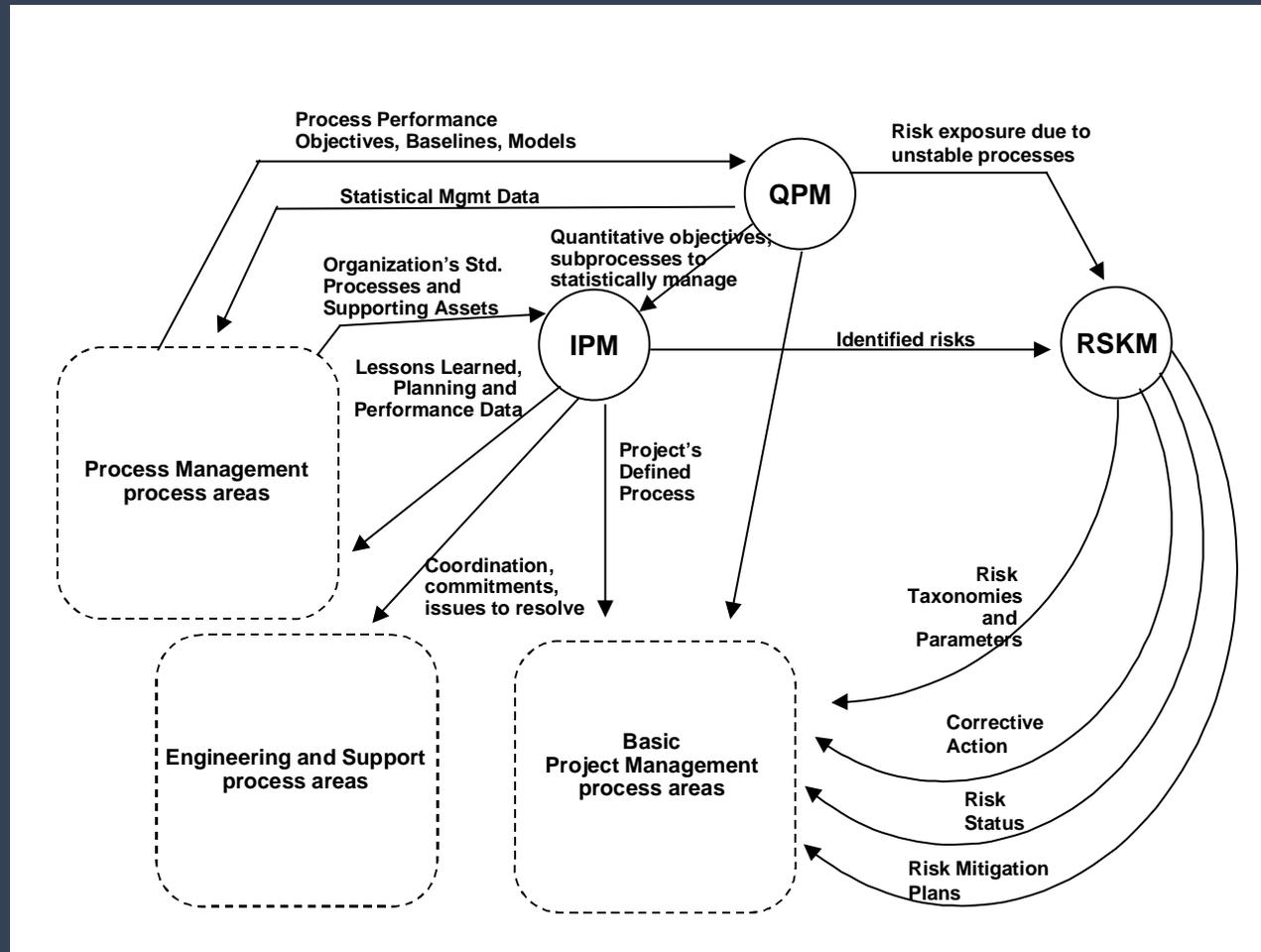
# Basic Project Management



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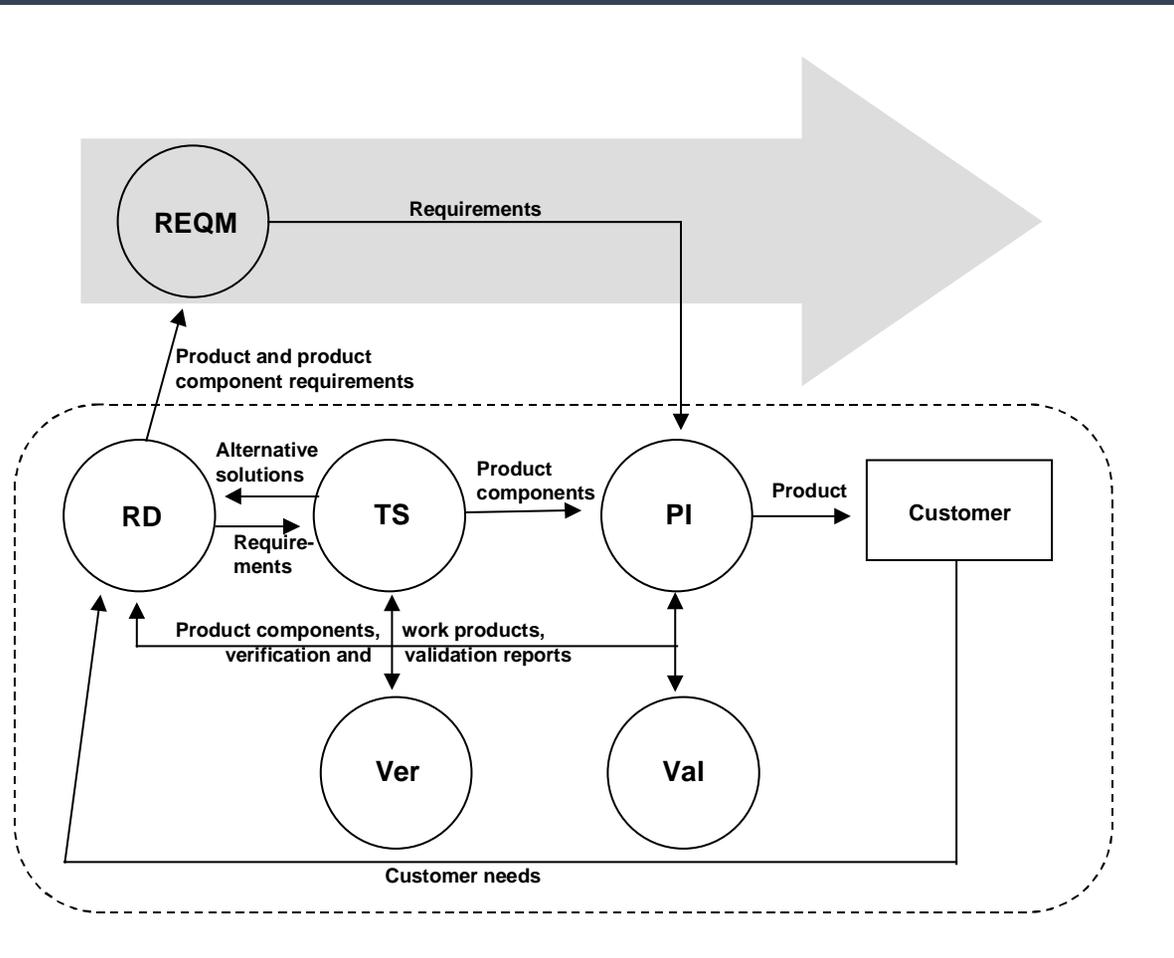


# Advanced Project Management



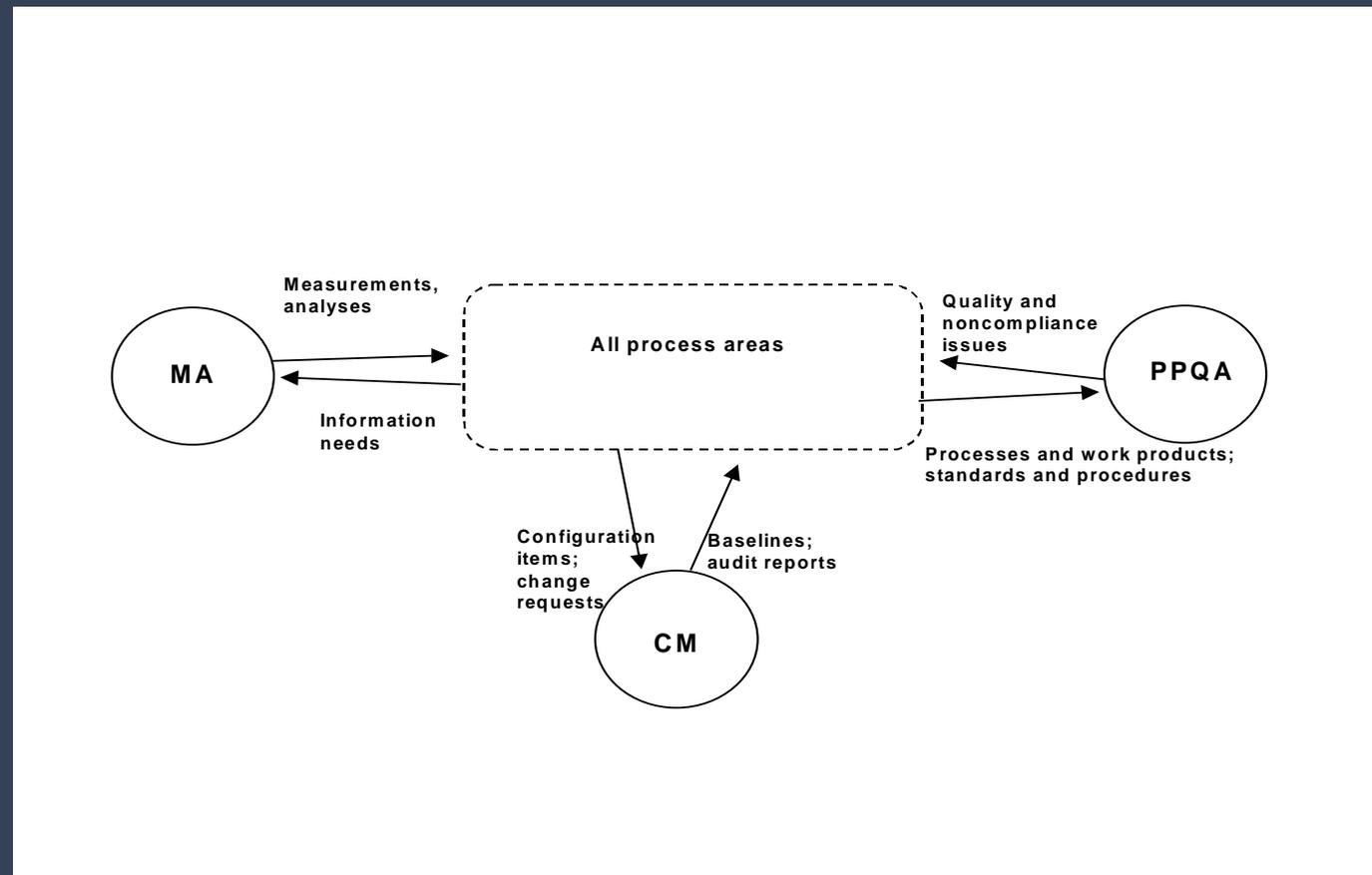


# Engineering



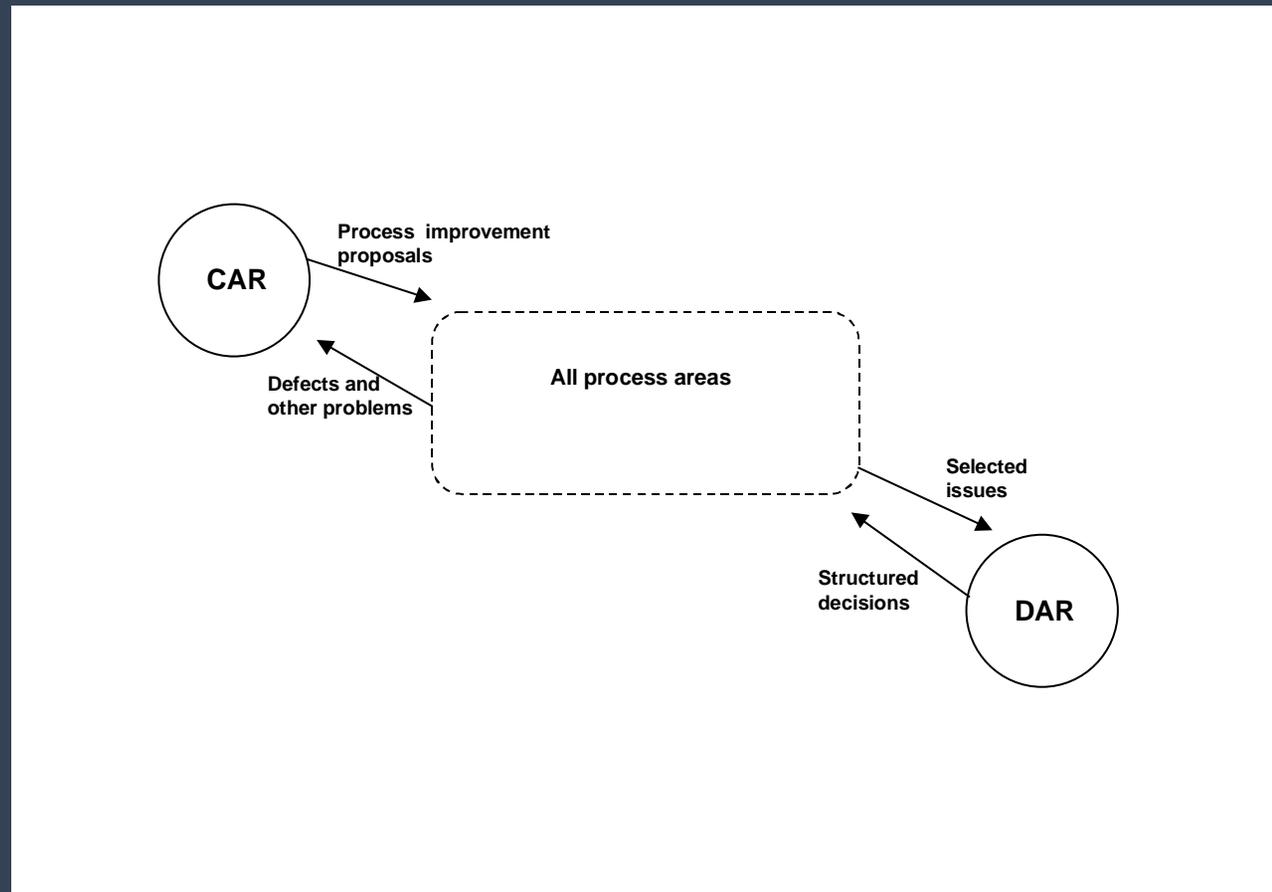


# Basic Support Process Areas



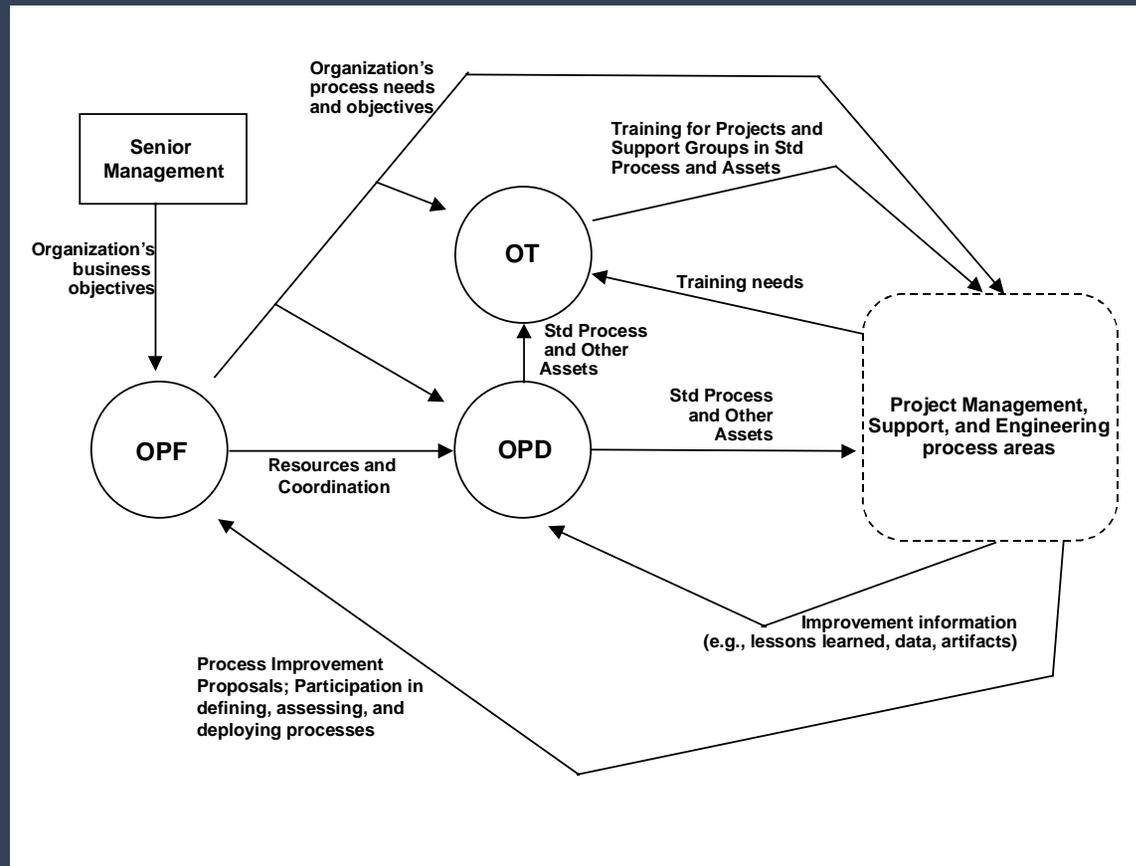


# Advanced Support Process Areas



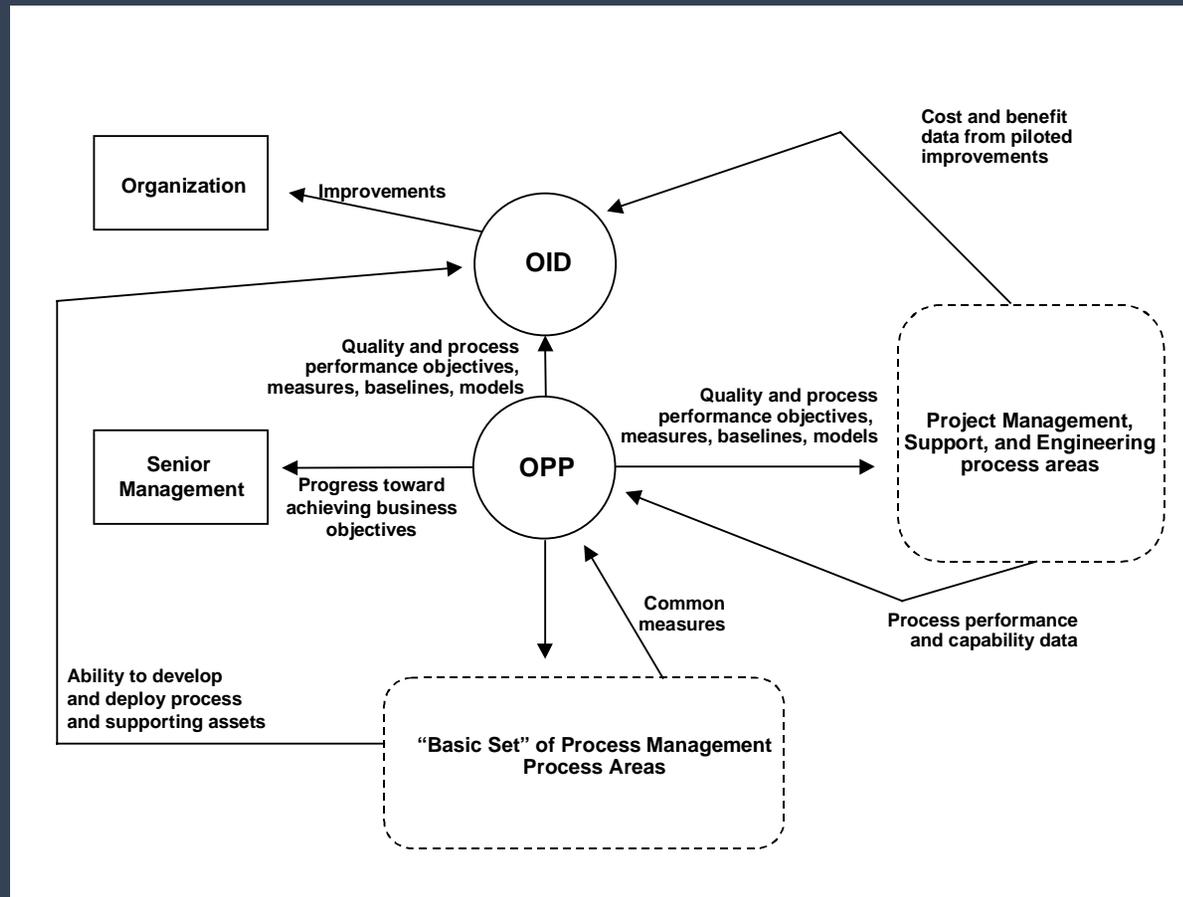


# Basic Process Management PAs





# Advanced Process Management PAs





# Moving to CMMI-SE/SW

## Module 10

### Using the CMMI

Q Template 60

Approved  
win

Date  
3 January 2001

Revision  
A

Doc. number  
MD/QLS 01:0002/9



# Improvements and Assessments

## Improvements

Choose disciplines

Choose representation

Choose process areas

## Three types of assessments

Type A

Type B

Type C



# Improvements Choose disciplines

CMMI - SW

CMMI - SE

CMMI - SE / SW

CMMI - SE / SW / IPPD

CMMI - SE/IPPD

CMMI - SW/IPPD

CMMI - SE / SW / A

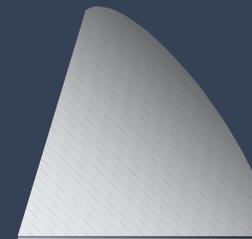
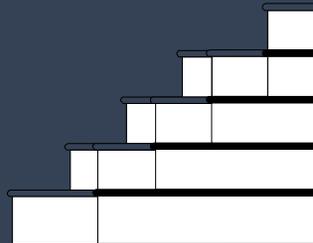
CMMI - SE / SW / IPPD / A

SW-CMM/SE-CMM/..



# Improvements Choose representations

■ Advantages? Disadvantages?





# Improvements Choose Process Areas

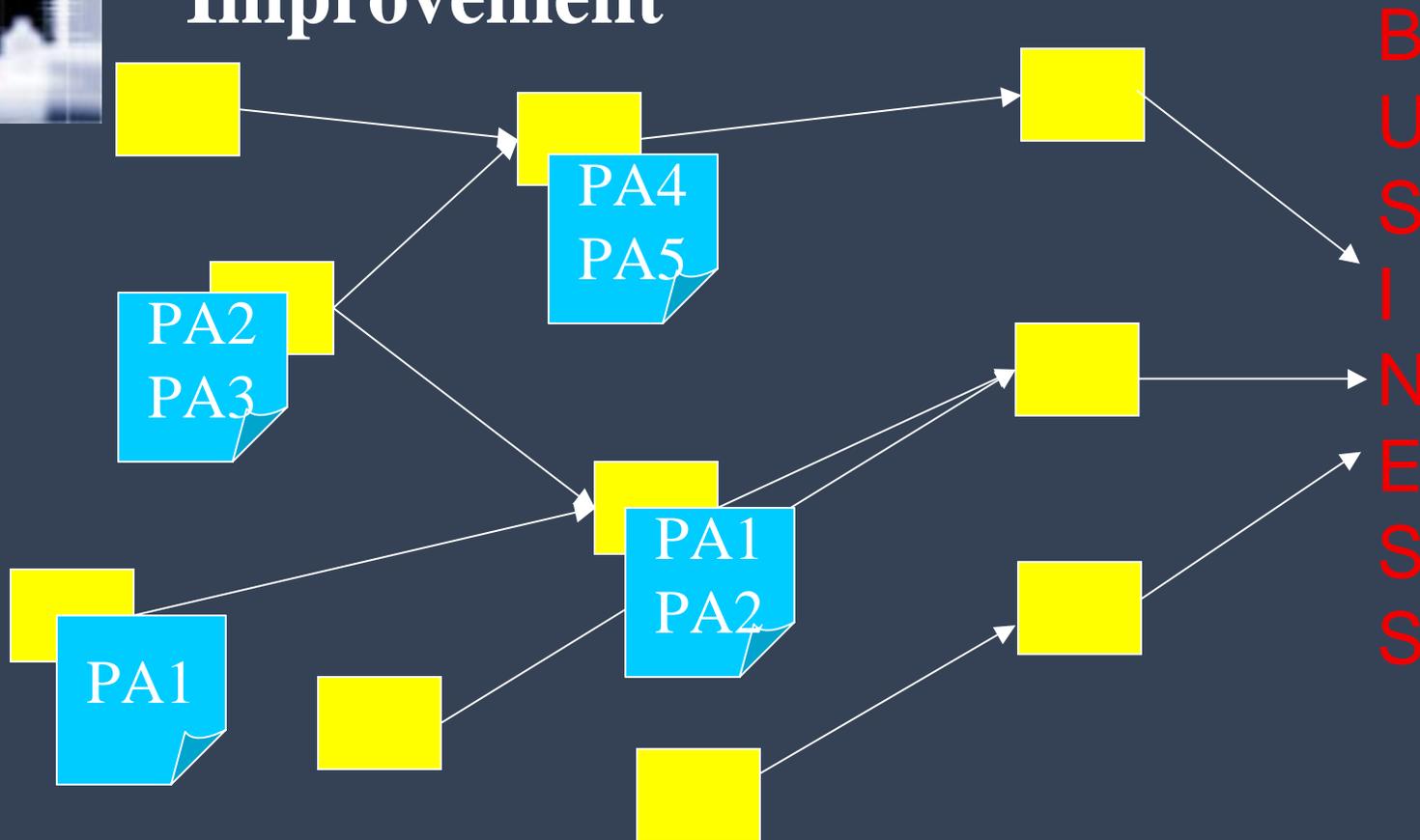
Maturity  
Level

5		CAR		OID
4			QPM	OPP
3	RD, TS, PI, VER, VAL	DAR	IPM, RSKM	OPF, OPD OT
2	REQM	CM, M&A PPQA	PP, PMC SAM	
	Engineering	Support	Project Management	Process Management

Process Categories



# Coupling Business Goals to Improvement





# Assessments Type A

- **Characteristics**
  - Comprehensive, formal
- **Advantages**
  - Robust method, consistent, repeatable results, objective view
- **Team leader qualifications**
  - Experienced
- **Team size**
  - 4-10 + lead assessor
- **Effort/person**

80 - 120 hours

SCAMPI



# Assessments Type B

- **Characteristics**
  - Initial assessment, Partial assessment, Self assessment
- **Advantages**
  - Less comprehensive, Less expensive
- **Team leader qualifications**
  - Moderately experienced
- **Team size**
  - 1- 6 + lead assessor
- **Effort/person**
  - 40 - 80 hours



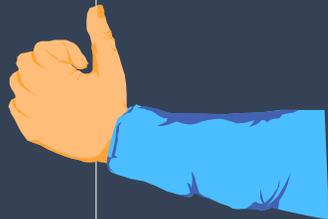
# Assessments Type C

- **Characteristics**
  - Quick look at specific areas
- **Advantages**
  - Little training needed
- **Team leader qualifications**
  - Moderate + novice
- **Team size**
  - 1-2 + lead assessor
- **Effort/person**
  - 10 - 20 hours



## Rating Rules General

- Process areas outside the assessment scope are “not applicable”
- Process areas are “not rated” if there is insufficient data coverage
- Goal satisfaction is rated
- For each goal: “Do the weaknesses in aggregate have a significant negative impact on the goal?”
  - No -> goal satisfied
  - Yes -> goal not satisfied





# Rating Rules

## Continuous representation



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- A process area is given a Capability Rating equivalent to the highest level and all levels below for which the SGs and GGs are satisfied.
- For each PA, rate satisfaction of the CLs.
  - CL1 -> satisfaction of all SGs for that PA
  - CL2 -> satisfaction of GG1 + GG2 (+ SG satisfaction for eng. PAs with CL2 SPs)
  - CL3 -> satisfaction of GG1 + GG2 + GG3 (+ SG satisfaction for eng. PAs with CL2 & CL3 SPs)
  - CL4 -> satisfaction of GG1+ GG2 + GG3 + GG4
  - CL5 -> satisfaction of GG1 + GG2 + GG3 + GG4 + GG5

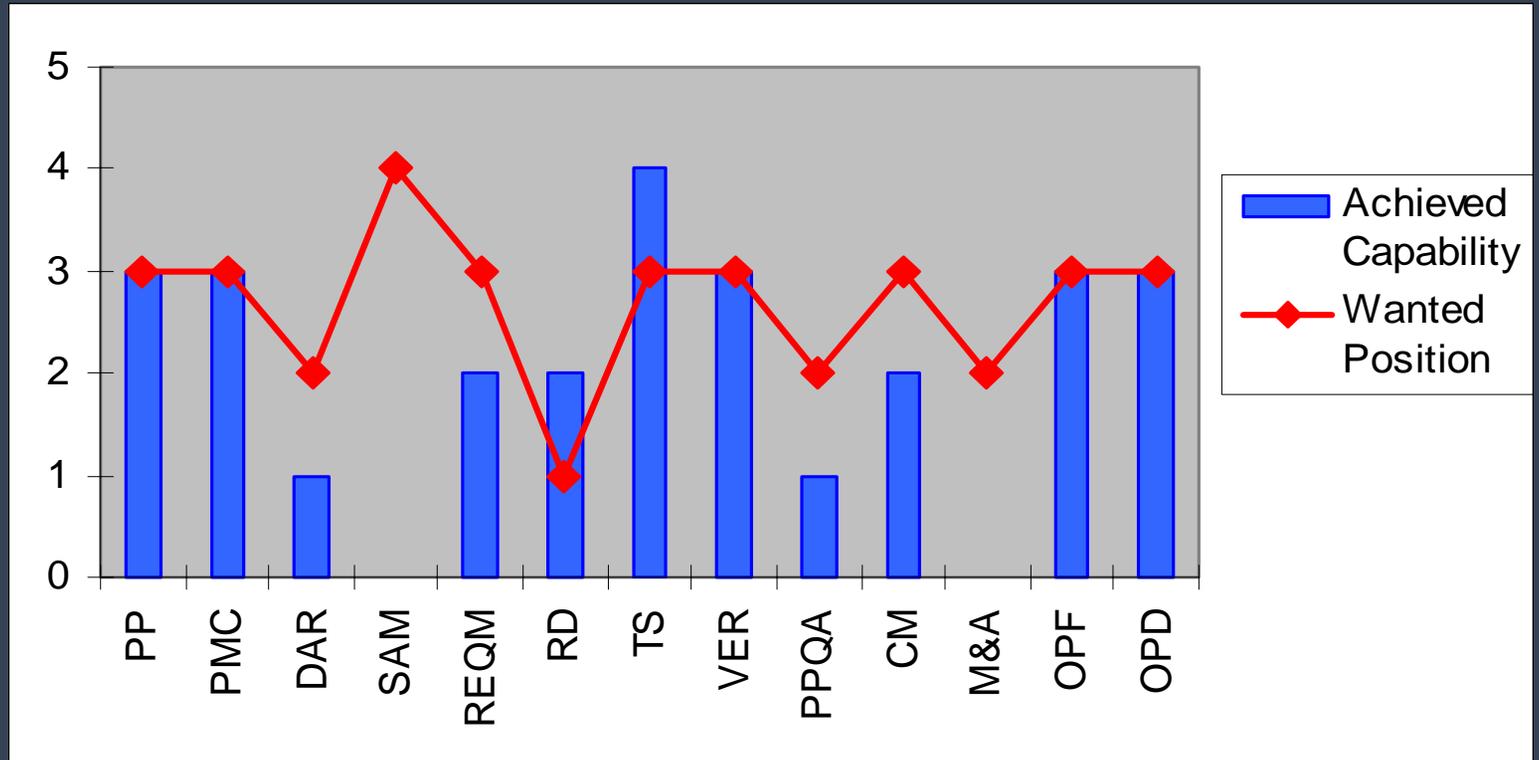
# Goal Fulfillment Table

PA	Capability Level 1				Capability Level 2				Capability Level 3			
	SG1	SG2	SG3	GG1	SG1-2	SG2-2	SG3-2	GG2	SG1-3	SG2-3	SG3-3	GG3
PP	S	S	S	S	-	-	-	S	-	-	-	N
PMC	S	S	-	S	-	-	-	S	-	-	-	N
REQM	S	-	-	S	S	-	-	S	-	-	-	N
RD	S	S	S	S	S	-	S	N	-	-	NR	NR
TS	S	S	S	S	S	-	-	N	-	NR	-	NR
VER	S	S	S	S	S	S	S	N	NR	-	-	NR
CM	S	S	N	N	-	-	-	NR	-	-	-	NR
PPQA	N	S	-	N	-	-	-	NR	-	-	-	NR
MA	S	S	-	S	-	-	-	S	-	-	-	N
OPF	S	N	-	N	-	-	-	NR	-	-	-	NR
OPD	N	N	-	N	-	-	-	NR	-	-	-	NR

**S = Satisfied, N = Not Satisfied, NR = Not Rated, - = Not Applicable**



# Capability Level Overview





## Key figures from some pilots

What	A	B	C*
Assessment team	1+6	1+5	1+2
Effort/person (hrs)	131	68	~25
Weeks (on-site)	2	1	~ 4
No. of PAs	11	11	1-7
No. of Participants	64	32	5-6
=> hrs/PA	12 hrs	6 hrs	5 hrs

\* 4 mini-assessments (figures show average per assessment)



## CMMI continuous compared to SW-CMM

- “The continuous model moves away from level pressure”
- “Splitting SPE (from SW-CMM) into 5 separate PAs is good”
- “The model covers a broader scope and more depth”
- “DAR is one of the improvements in the CMMI”
- “The whole product life cycle is covered better in the CMMI even at lower capability levels”

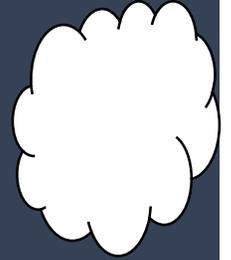


## Issues and concerns

- When does a project start?
- Assessors need to:
  - move from staged thinking
  - understand non-software disciplines
- The psychological impact of level 0 can be demoralizing to the organization
- It is not easy to decide:
  - Which process areas to focus on (for assessment and improvement)
  - What the desired capabilities for each process area are



## Anonymous voices Assessment team



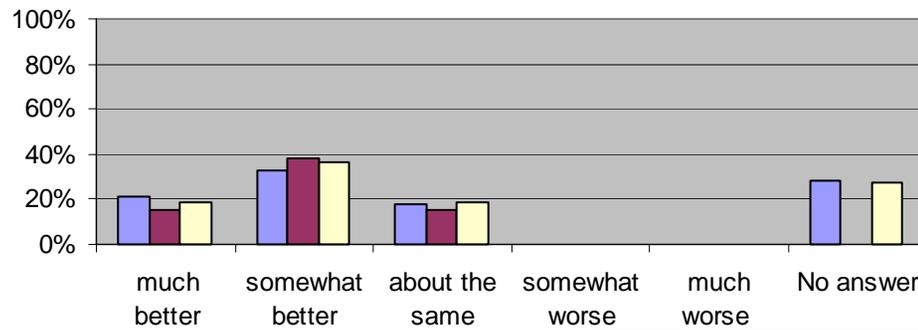
- The CMMI is easier to use in prioritizing and addressing improvements based on business goals
- The possibility of focusing on separate PAs is useful
- Because selection of the PAs to assess was based upon needs, follow-up and improvement will be more effective
- The model is well suited to organizations that have both HW & SW development as well as product management / business management



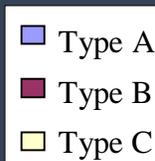
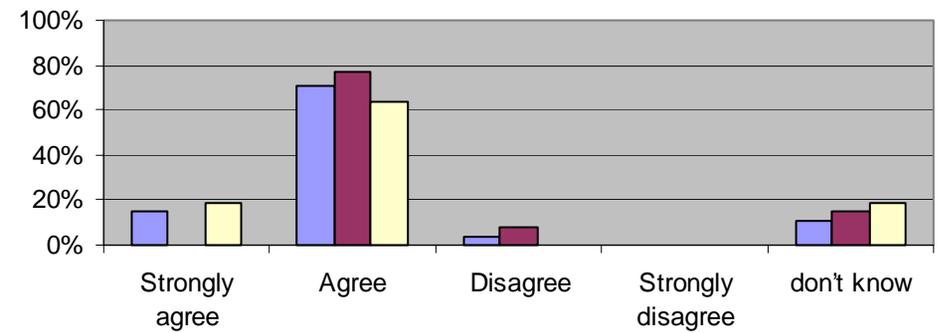
# Anonymous voices Assessment Participants



**Accuracy compared to other assessments in organization**



**CMMI provides real direction for long term process improvement**





# Questions



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# Wrap up and Evaluations





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