



# Overview of CMMI® for Development v.1.2

- Corrado Gajetti
- Motorola Software Group  
Torino Software Center
- Process & Quality Department

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## Purpose

- The purpose of this module is to familiarize with important concepts in CMMI

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## Topics

### Representations

### Overview of CMMI Model Components

### Process Areas

## CMMI Terminology

- *Software process capability* describes the range of expected results that can be achieved by following a software process.
  - One means of predicting the most likely outcomes to be expected from the next software project the organization undertakes.
- *Software process maturity* is the extent to which a specific process is explicitly:
  - defined, managed, measured, controlled, and effective.
- *Software process performance* represents the actual results achieved by following a software process.

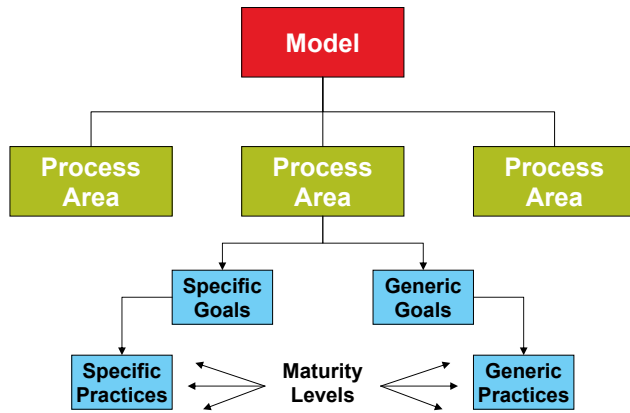
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# Structure of the CMMI



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# Goals and Practices

- Each **Process Area** is made up of **Goals**
- Each **Goal** is made up of **Practices**
- **Goals/Practices** are **Specific** or **Generic**
  - Specific means for one PA only
  - Generic means across all PAs
  - Generic goals/practices have Elaborations which instantiate them for each PA
- **Some practices have Amplifications** which show applicability to different domains:
  - Hardware Engineering
  - Systems Engineering
  - Software Engineering

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# CMMI Model Representations

There are two types of representations in CMMI models:

- staged
- continuous

Both representations provide ways of implementing process improvement to achieve **business goals**.

Both representations provide essentially the same content and use the same model components but are organized in different ways.

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# Staged vs. Continuous Representations

## Staged Representation: PAs by Maturity Level

Level	Focus	Process Areas	Quality Productivity
5 Optimizing	Continuous Process Improvement	Organizational Innovation and Deployment Causal Analysis and Resolution	↑ Quality Productivity  ↓ Risk Rework
4 Quantitatively Managed	Quantitative Management	Organizational Process Performance Quantitative Project Management	
3 Defined	Process Standardization	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition +IPPD Organizational Training Integrated Project Management +IPPD Risk Management Decision Analysis and Resolution	
2 Managed	Basic Project Management	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management	
1 Initial			

## Continuous Representation: PAs by Categories

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

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## Staged vs. Continuous Representations

### Staged

- Levels made up of sets of process areas (broad)
- 5 Levels (1-5)
- Levels indicate organizational maturity

### Continuous

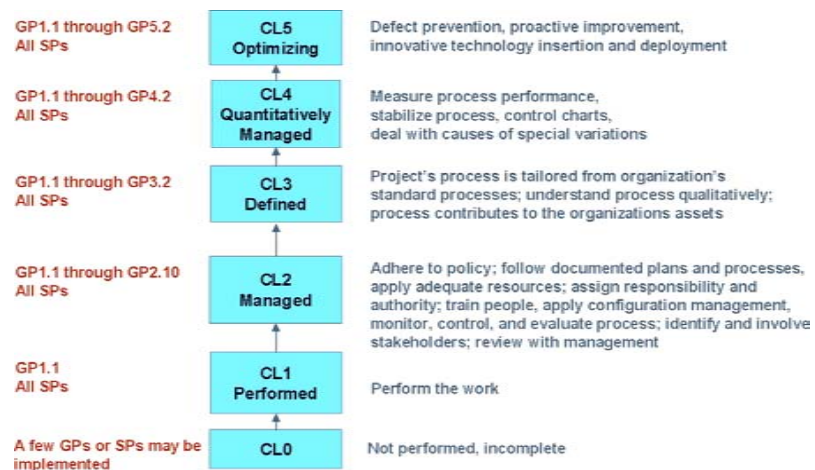
- Levels defined for each process area
- 6 levels (0-5)
- Levels indicate process capability

## Continuous: Capability Levels

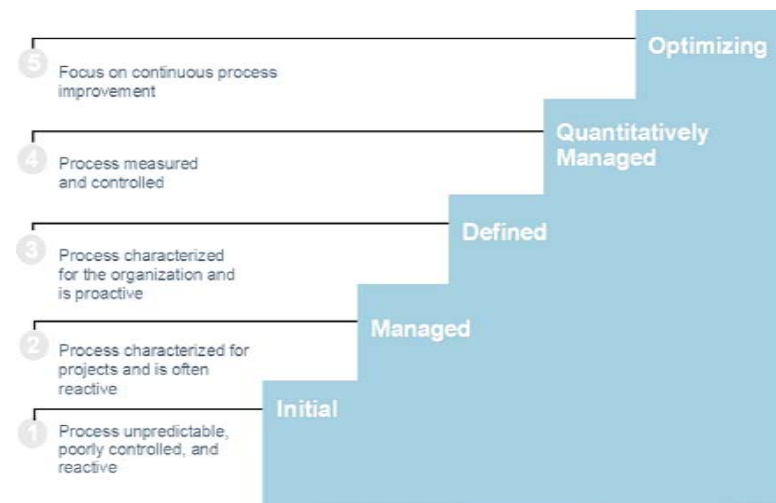
- A capability level consists of a generic goal and its related generic practices that can improve the organization's processes associated with a process area. Capability levels provide a scale for measuring your processes against each process area in a CMMI model. There are six capability levels.
- Each level is a layer in the foundation for continuous process improvement
- Capability levels are cumulative (i.e., a higher capability level includes the practices of the lower levels).

5	Optimizing
4	Quantitatively Managed
3	Defined
2	Managed
1	Performed
0	Incomplete

## Achieving Capability Levels for a Process Area



## Staged: Maturity Levels



## Achieving Maturity Levels -1

### To achieve a maturity level

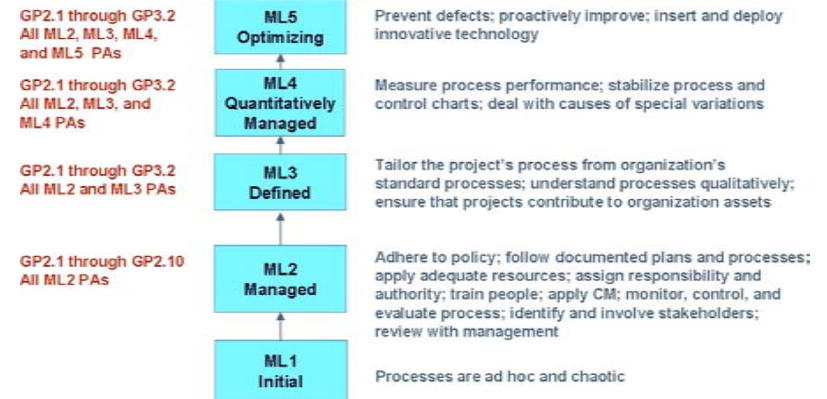
- All process areas at that level and all levels below it must be satisfied or determined to be not applicable.

### And to achieve a maturity level 3 or higher

- The generic goal 3 for each applicable maturity level 2 PA must also be rated satisfied for maturity level 3 or higher

**Note: A process area is satisfied if and only if all of the process area's relevant specific and generic goals are rated as satisfied.**

## Achieving Maturity Levels -2



## Topics

Process Improvement Concepts and CMMI Model

Representations

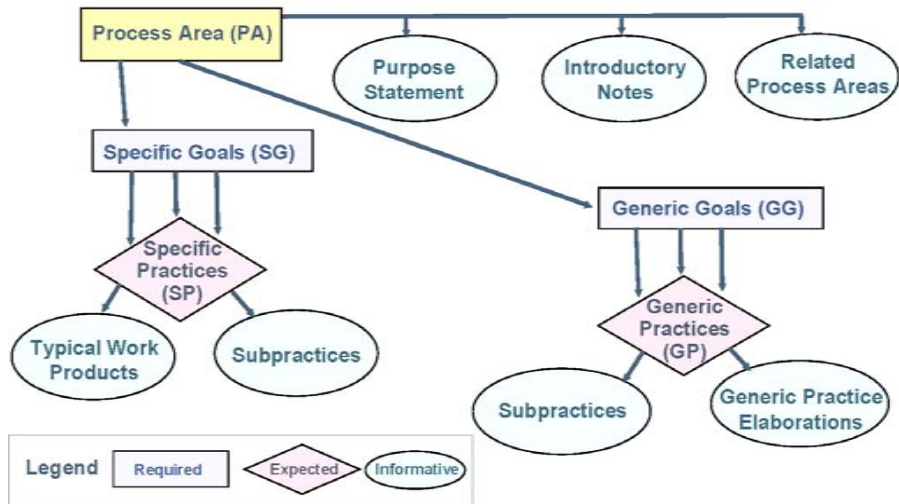
Overview of CMMI Model Components

Process Areas

## Process Area

- **Cluster of related practices in an area that, when implemented collectively, satisfy a set of goals considered important for making improvement in that area. All CMMI process areas are common to both continuous and staged representations.**
- **They are organized by**
  - maturity level in the staged representation
  - category (i.e., Process Management, Project Management, Support, and Engineering) in the continuous representation.
- **There are 22 process areas.**

## Process Area Components



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## Topics

Process Improvement Concepts and CMMI Model Representations

Overview of CMMI Model Components

Process Areas

Overview

Selected PAs

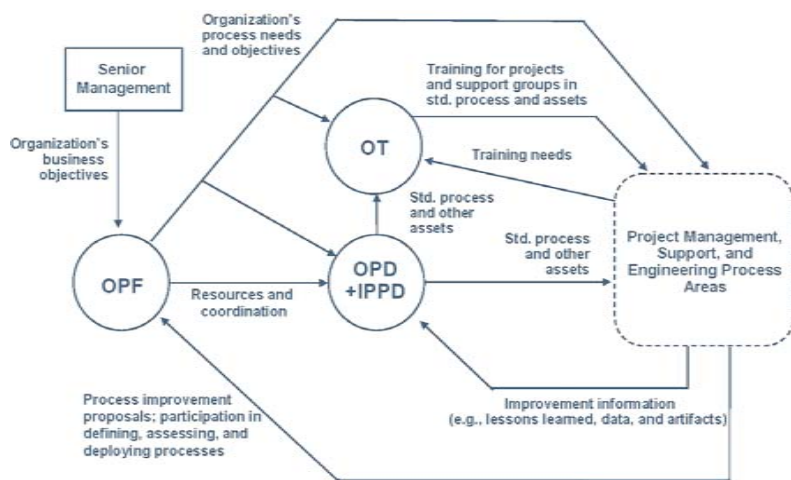
Configuration Management

Engineering PAs

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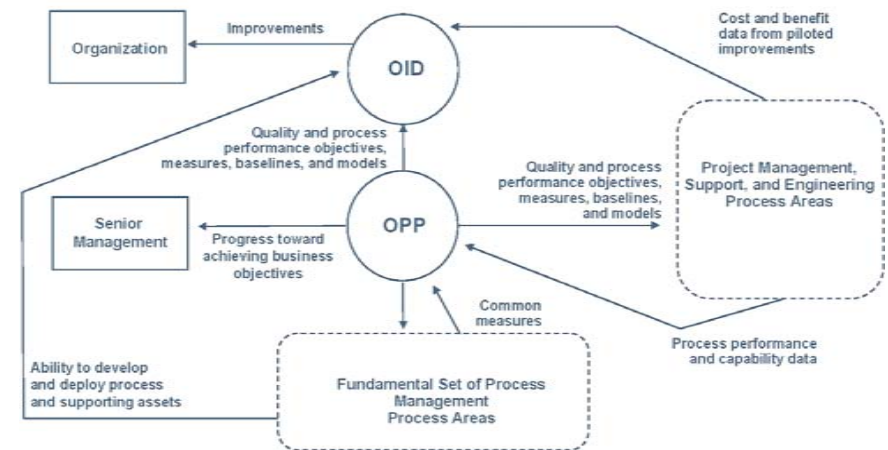
## Basic Process Management PAs



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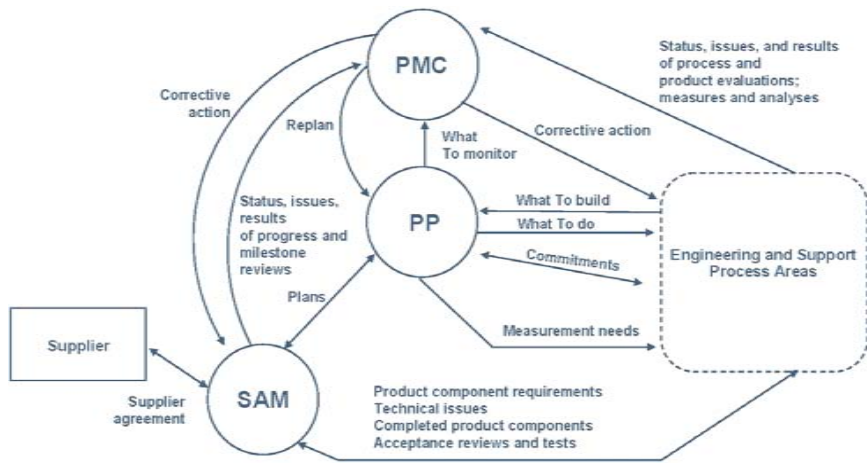
## Advanced Process Management PAs



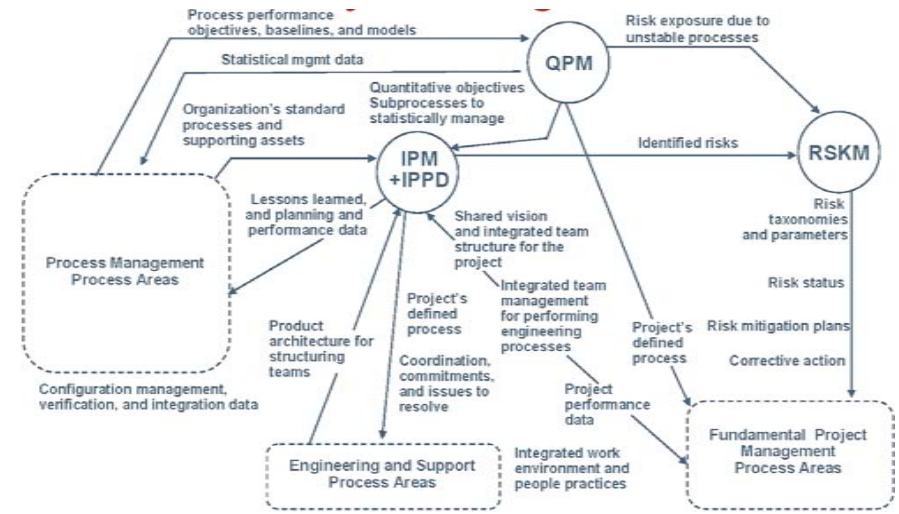
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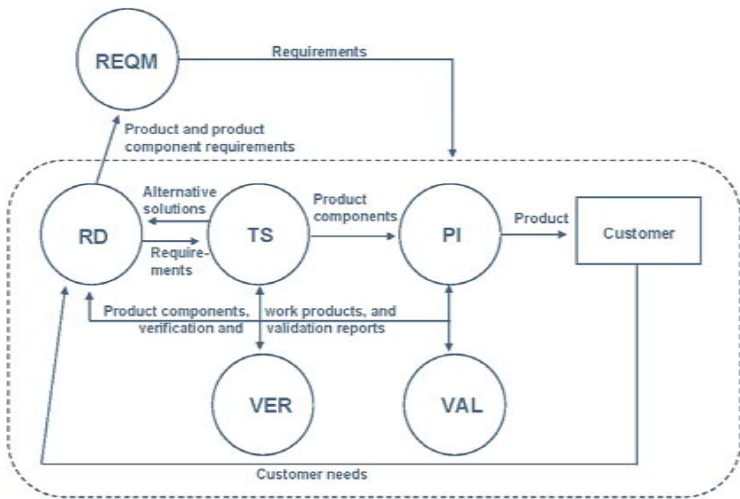
# Basic Project Management PAs



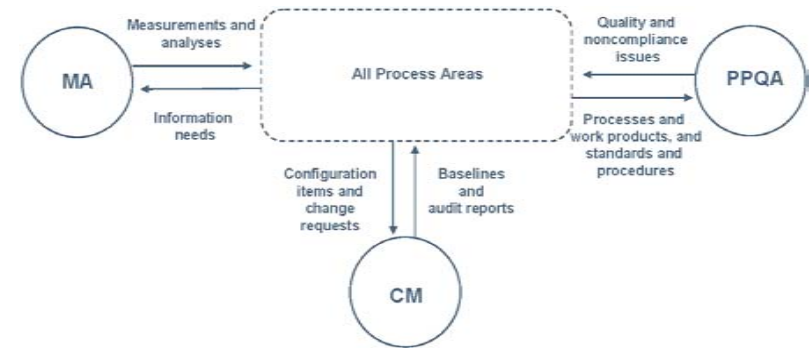
# Advanced Project Management PAs



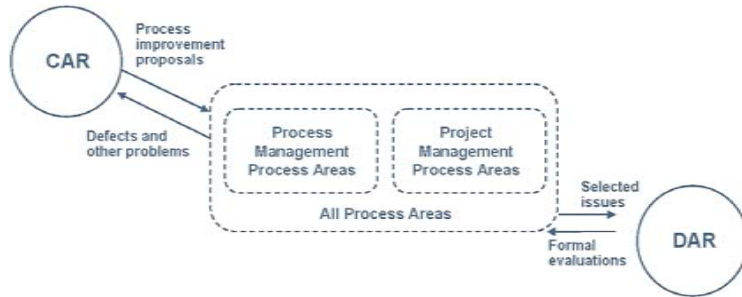
# Engineering PAs



# Basic Support PAs



## Advanced Support PAs



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## For More Information About CMMI

- Go to the following CMMI websites:
  - <http://www.sei.cmu.edu/cmmi/>
  - <http://www.sei.cmu.edu/cmmi/results.html>
  - <http://seir.sei.cmu.edu/seir/>
  - <https://bscw.sei.cmu.edu/pub/bscw.cgi/0/79783>
  - <http://www.ndia.org> (CMMI Technology Conferences)
  - <http://seir.sei.cmu.edu/pars> (publicly released SCAMP<sup>SM</sup> summaries)

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## Software Engineering A Business Case



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## Outline

- Presentation of Motorola Software Group
- Introduction to the use of a Process, its benefit, some examples
- Elements of Quality Assurance
- Elements of Defect Prevention

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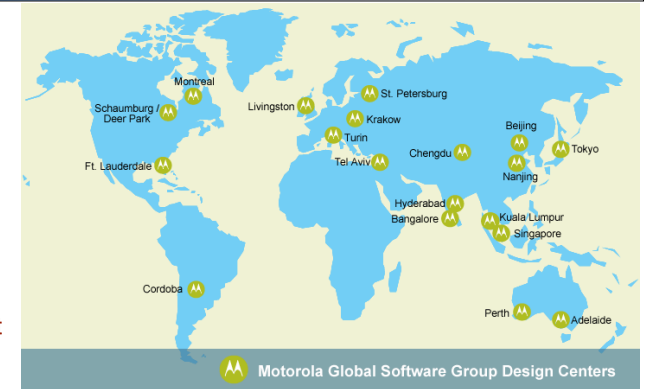
# Presentation of Motorola Software Group



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## Motorola Software Group, Torino Software Center

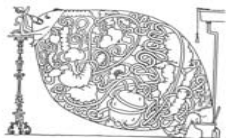
- With over 6,000 engineers in 19 design centers across the world, the Motorola Software Group (MSG) provides key research and development of production-level software to support product development for Motorola businesses.
- MSG was the world's first commercial software organization assessed at SEI CMM level 5, and continues to support that excellence with over 95% of its engineers being classified at SW-CMM® or CMMI® 5.
- MSG is the provider of custom software products, component system solutions and platforms for Motorola business partners and their customers.



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# Introduction to the use of a Process, its benefit, some examples



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## Requirements of a Process

- Assure high quality software is developed
  - Minimize development cycle time
  - Maximize engineering productivity
  - Allow for learning from project experience

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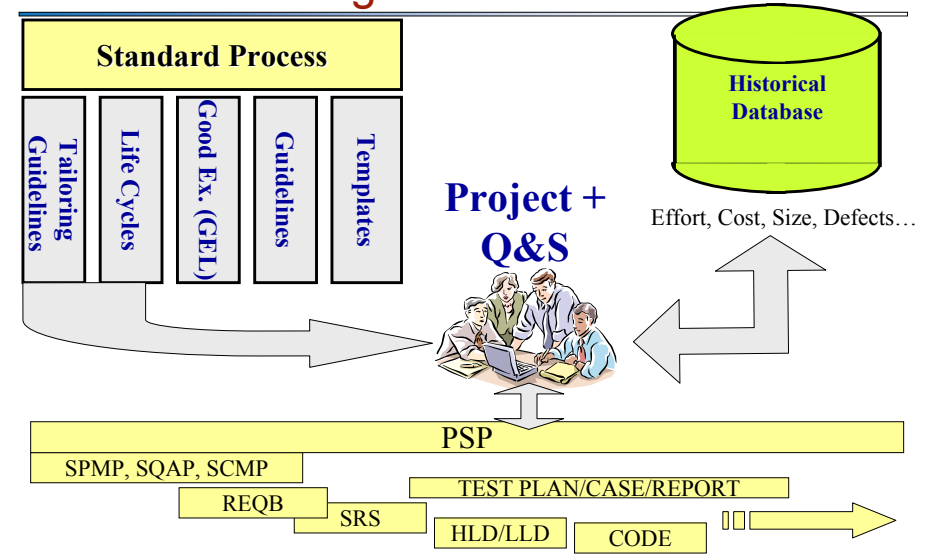
## Factors contributing to projects success



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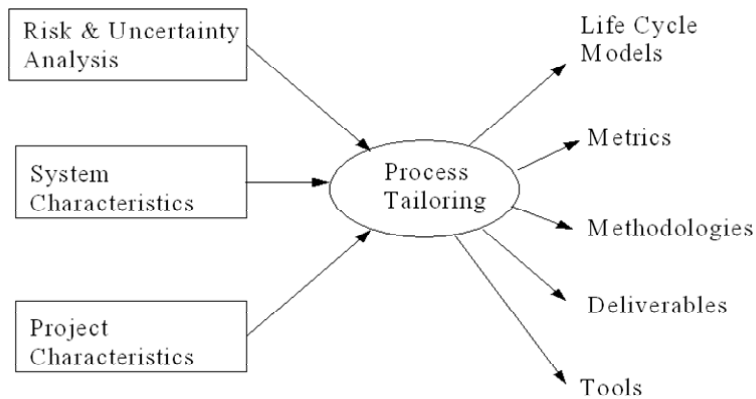
## Process Tailoring



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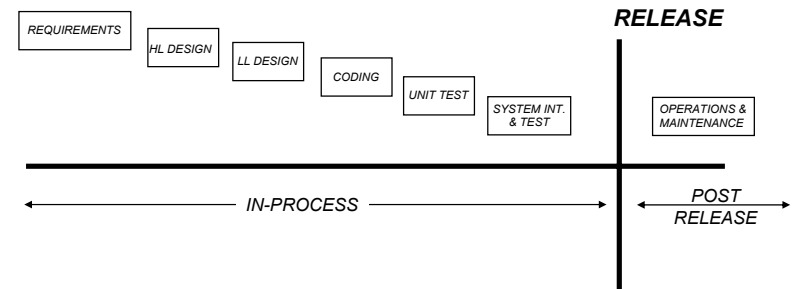
## Process Tailoring



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## Example of Software Development



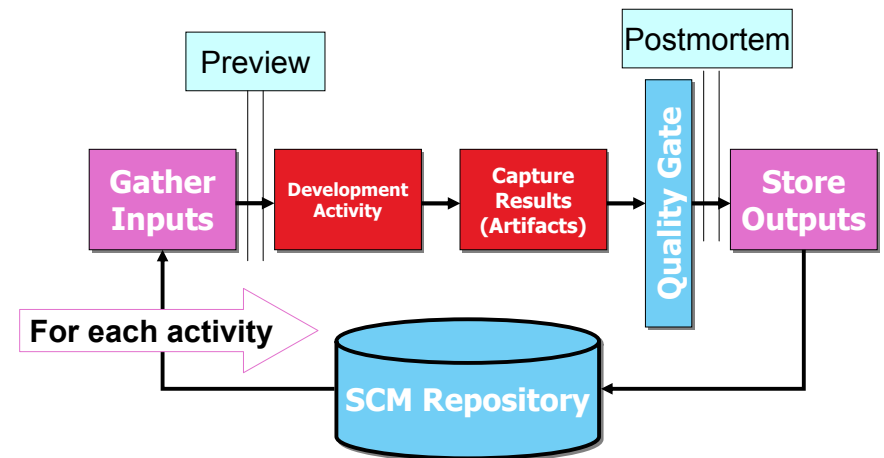
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## Motorola Key Principles: the “Inviolates”

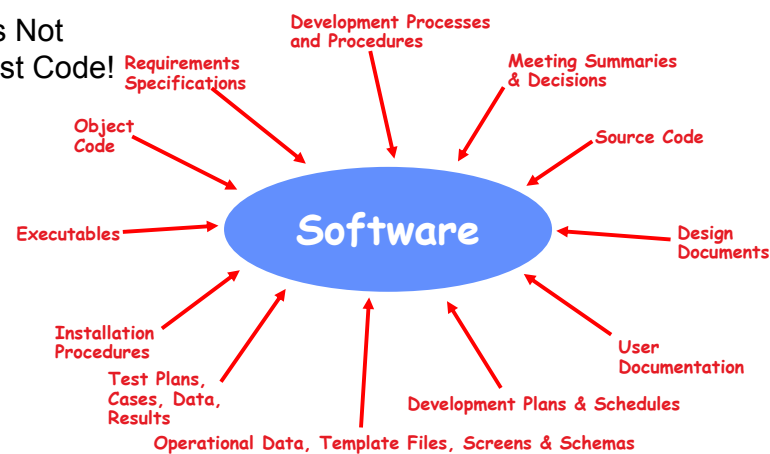
- 1. Project Planning & Tracking
- 2. [Process Framework](#)
- 3. Previews and Post Mortems
- 4. [Records and Metrics](#)
- 5. [Quality Control \(Review & Test\)](#)
- 6. [Configuration Management](#)

## Process Framework and Preview & PostMortem

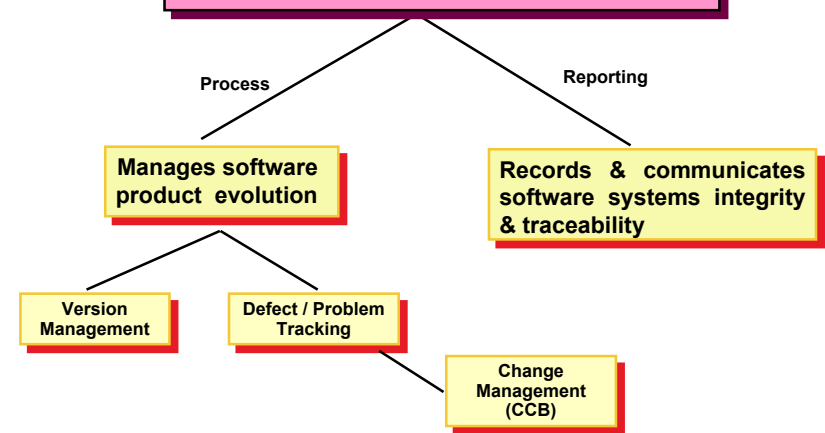


## Configuration Assets

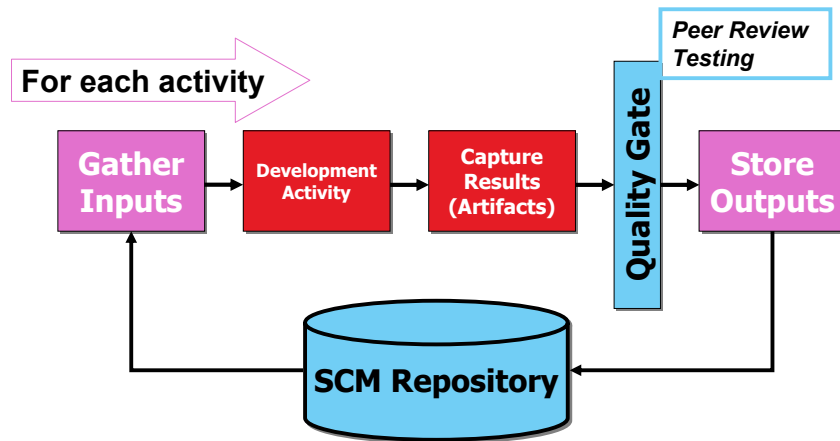
It's Not Just Code!



## Software Configuration Management



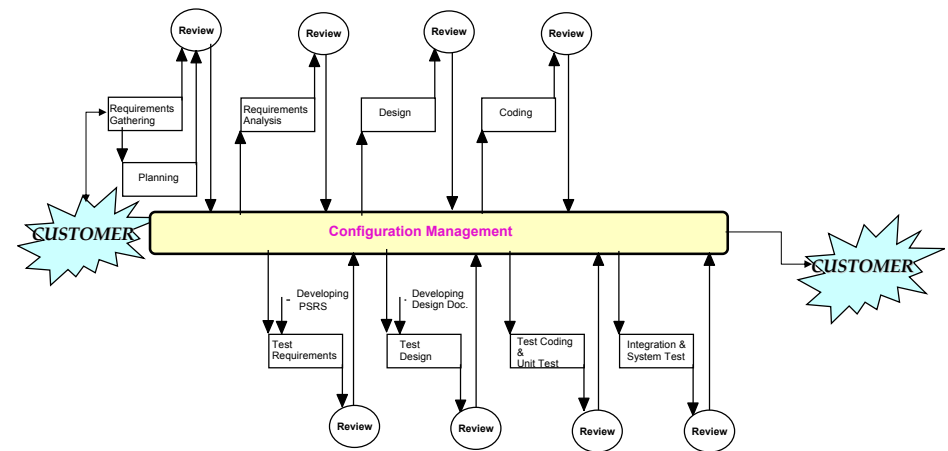
## When CM?



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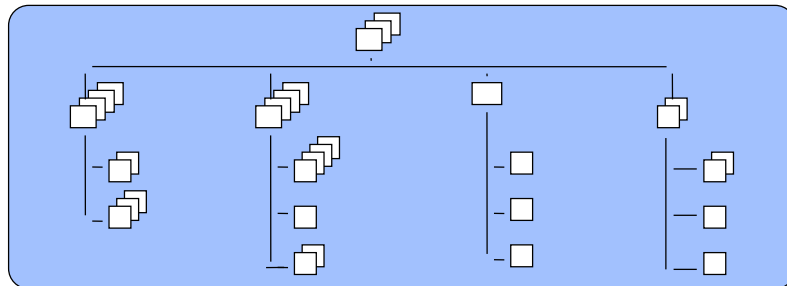
## CM & the Development Life Cycle



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## Version Control of Complex Objects



- Each configuration item has (potentially) many versions.
- Composite configuration items have versions consisting of combinations of elementary configuration items.
- Many of the configuration items can be undergoing change simultaneously.
- There may be a complex set of dependencies between versions.

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## Parallel Development

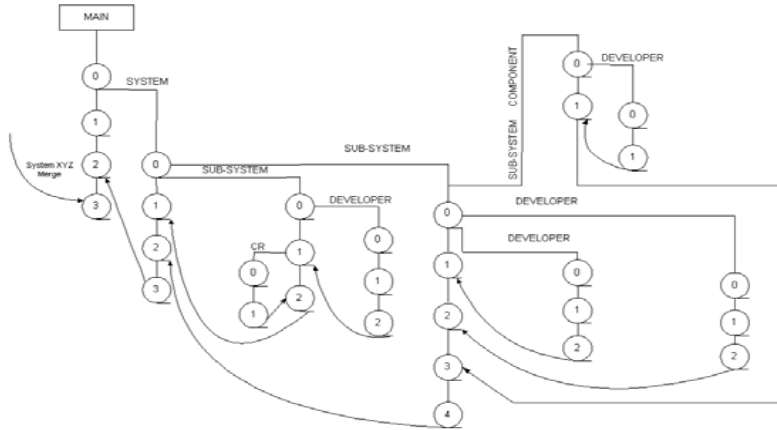
Parallel development allows different developers the ability to modify the same source files at the same time

- **Development line**
  - Main
  - System
  - Sub-System
  - Sub-System Component
  - Developer
  - Change Request
- A development line is named “Branch”
- Naming is based on “path” of branch

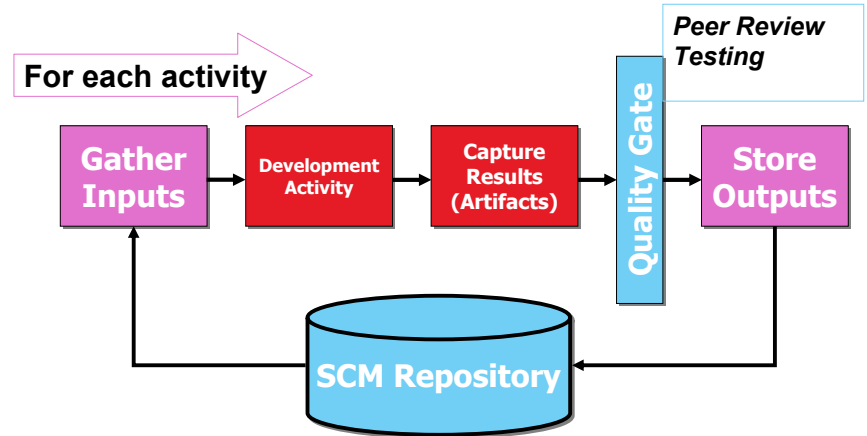
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# Parallel Development



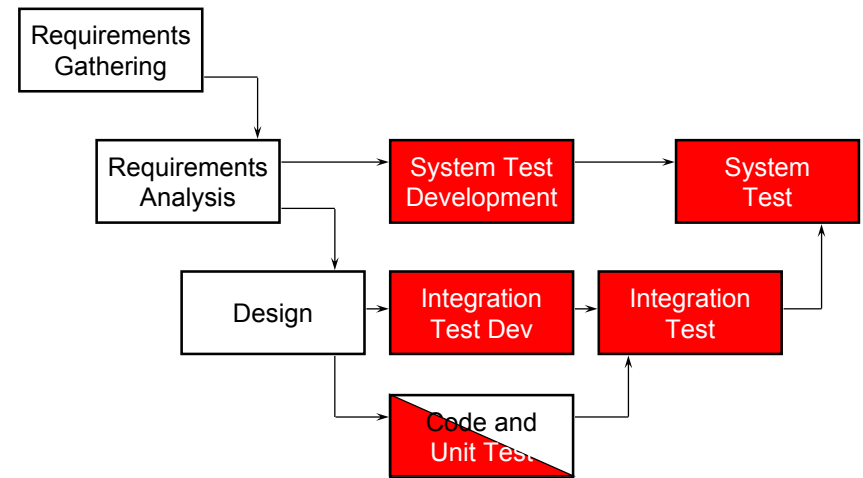
# Quality Control



# What is Verification and Validation?

- Walkthroughs
- Formal Technical Reviews (FTR)
  - ✓ Inspections
  - ✓ Reviews
- Testing:
  - ✓ Unit
  - ✓ Integration
  - ✓ System
  - ✓ Performance
  - ✓ Regression
  - ✓ Acceptance

# V Model Life-Cycle: Testing

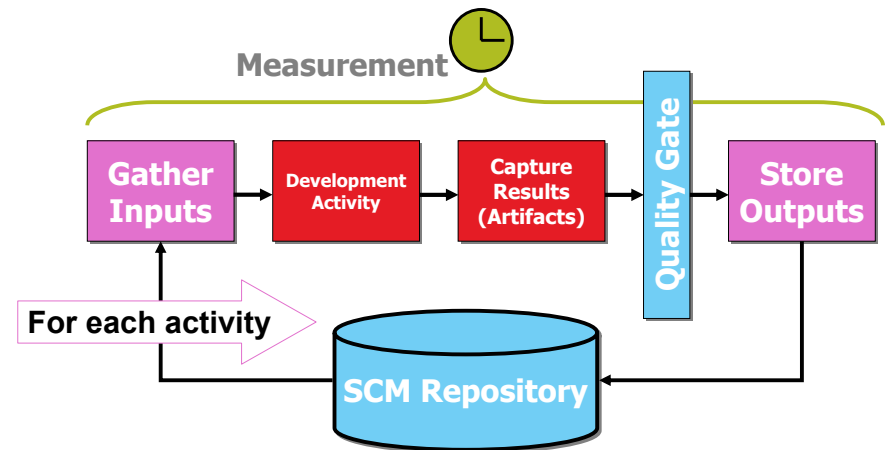


## Why is it Important?

- A POOR testing program can cause mission failure.
- A GOOD testing program is a major project cost.
- A GOOD testing program will help significantly as you define your early requirements and design work.
- A GOOD testing program forces you to face and deal with problems as the work is done, and when the cost of rework and fixes is much lower.
- A GOOD testing program can't totally make up for a poor software project, but it does help prevent many ills and will at least let you know you are in trouble early.

Source: Little Book of Testing Vol. I & II, June 1998  
Software Project Managers Network

## Records and Metrics



## Benefits of Software Metrics

- Evaluating the past
  - By helping us in assessing our past performance objectively
- Monitoring the present
  - By providing better visibility
  - By enabling better communication
  - By helping in better resource management
- Predicting the future
  - Based on historic data
  - By helping us in setting realistic goals

## Motorola Software Group Metrics Program

- A metrics program is in place to control the process performance of the software projects quantitatively.
  - Process performance is measured.
  - Measurements are reported and analyzed at any level
  - Preventive, Corrective and Improvement Actions are taken accordingly
- The Organization collects performance data, sets baselines and establishes goals.



## Examples of Motorola Metrics

### ➤ Product Metrics

➤ to identify the basic quality of a software product.

#### ➤ e.g. Post Release Defects

➤ Product performance

➤ Memory usage



### ➤ Process Metrics

➤ to identify basic quality of a process and its QA

➤ e.g. Productivity

➤ Cost of Quality

## Examples of Motorola Metrics

### ➤ Problem and Maintenance Metrics

➤ e.g. Number of New Open Problems

➤ Age of Open Problems,

Age of Closed Problems

Cost to Fix Problems

➤ **Estimation Accuracy Metrics to determine the viability of estimates.**

➤ e.g. Estimation Accuracy

## Elements of Quality Assurance



## Factors Affecting Quality

- Major factors that help in delivering defect-free software and continuous improvement include:
  - having a clear understanding of the requirements,
  - composing the right process for the project and applying the process correctly,
  - applying effective testing techniques,
  - rigorous use of configuration control,
  - proper product development (architecture, design, coding) phases,
  - metrics analysis to control and manage the project.

## Quality Assurance Team -Support

- The Quality Assurance Team ensure standard processes implementation by performing support and audit to projects and areas affected by CMM.
- Guidance, verification and validation on project planning and tailoring
- Support in establishing Customer quality requirements
- Participation in organizational meetings and reviews, project previews and post-mortems.
- Participation in V&V activities (e.g.: Peer Reviews)
- Support in Metrics collection and Analysis
- Assess Total Customer Satisfaction

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## Quality Assurance Team - Audits

- **Project Audit**
  - An audit of a project determines compliance to the standard software process, requirements, and project plans
- **Functional Configuration Audit**
  - an activity to validate a product's conformance to its requirements
- **Physical Configuration Audit**
  - an activity to validate a product's conformance to its design

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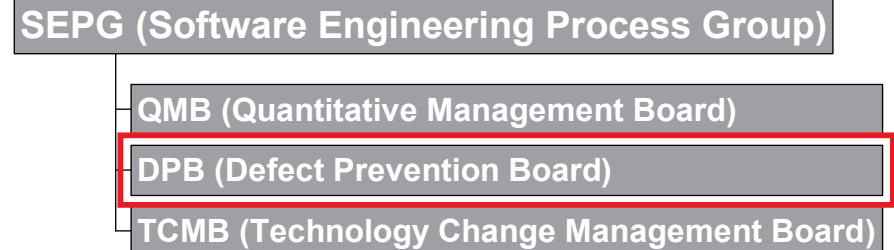


## Elements of Defect Prevention



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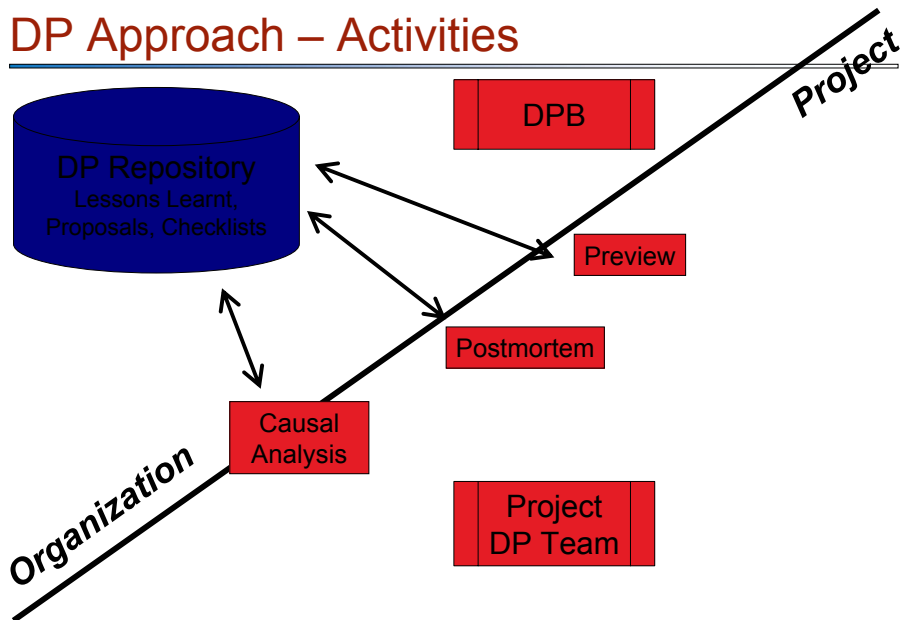
## DP Approach – SPI Support Organization



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## DP Approach – Activities



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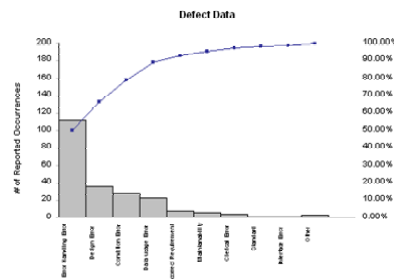
## DP Activities – Causal Analysis

- Causal Analysis (CA) is an important part of Defect Prevention, it is the process used to identify the Root Cause of problems and developing methods to prevent them from being reintroduced.
- For post-release defects CA includes analysis of cause of missing those defects before release.
- To be most effective, CA should be done at the earliest possible time with respect to when the problem was found, for the following reasons:
  - The closer the examination is to the source of the problem, the better the author will recall the problem and surrounding factors.
  - The sooner the sources of problems are identified the sooner a solution may be implemented to prevent further occurrences that may result from the same source.

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## DP Activities: Pareto Chart



### ■ Pareto Chart Analysis

- Pareto chart is a simple tool that helps to focus efforts on the problems offering the greatest potential for improvement by showing their relative frequency or size in a descending bar graph.
- A Pareto chart gives a graphical way of showing the "vital few" problems that need to be worked on.
- It is based on the 20% - 80% rule

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## DP Activities: Ishikawa ("Fishbone") Diagram



- Fishbone diagrams are a graphical technique, which assist in determining the Root Cause of issues. The spines of the diagram act as pointers to the cause of the issues, represented as the backbone of the diagram
- Fishbone diagrams can be of use when attempting to find the Root Cause of any issue.

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