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DEFINING THE FUTURE

# Measurement Strategies in the CMMI

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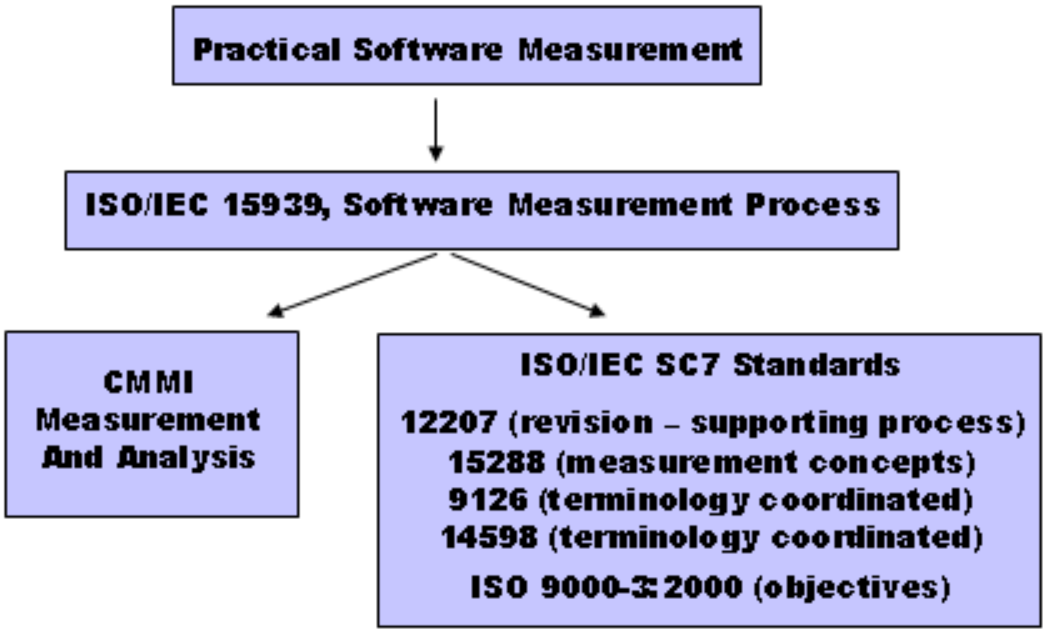
# Background

- **Software measurement remains a challenge for many projects and organizations**
- **It is difficult to select a set of measures that are easy to define and collect, yet offer real insight into progress, process, and quality**
- **This presentation will discuss strategies for starting and enhancing a CMMI-compliant measurement system**

# Measurement and Analysis Process Area

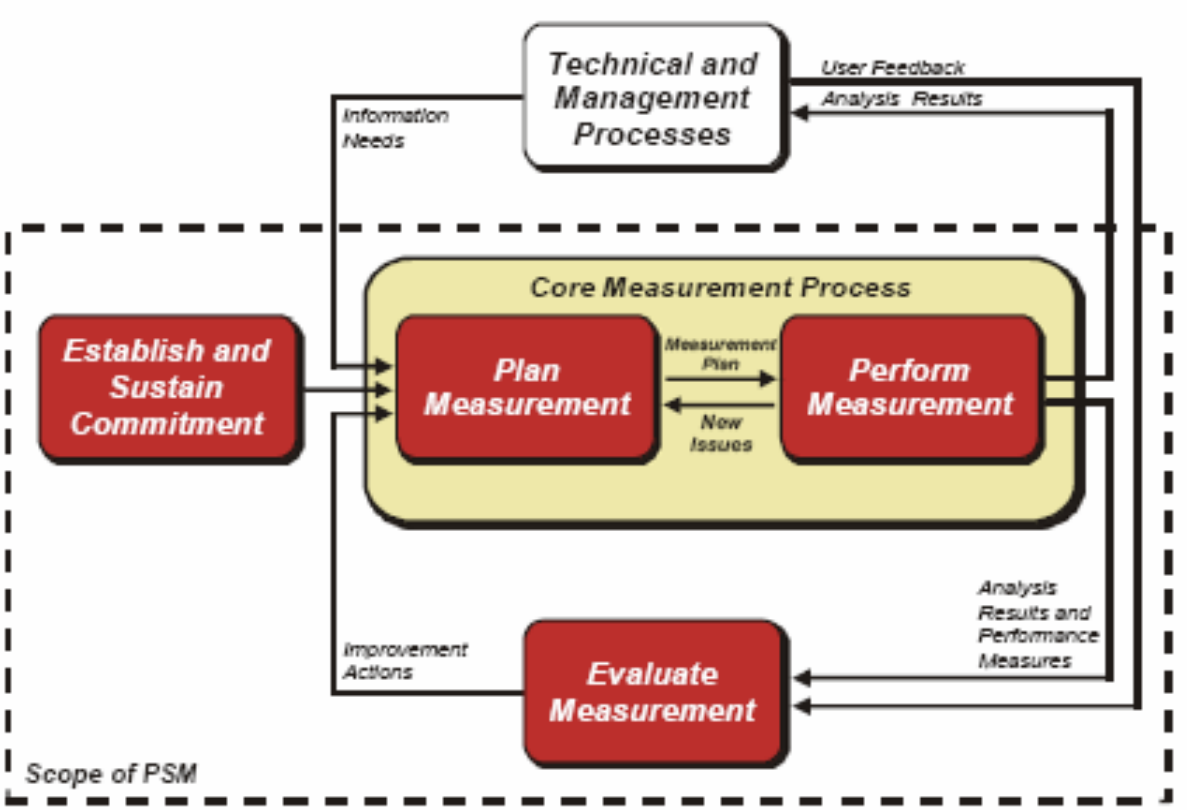
- **Purpose**
  - Develop and sustain a measurement capability that is used to support management information needs
- **Involves specifying:**
  - Information needs and measurement objectives
  - Measures
  - Data collection and storage mechanisms
  - Analysis techniques
  - Reporting and feedback mechanisms
- **Written to conform to ISO/IEC 15939, Software Engineering – Software Measurement Process**




*Rick Hefner, "Measurement Strategies in the CMMI", 24 April 2007*

# Measurement Principles

- **Measurement is a consistent but flexible process that must be tailored to the unique information needs and characteristics of the project or organization**
- **Decision makers must understand what is being measured and trust the information**
- **Measurement must be used to be meaningful**




*Reference: http://www.psmsc.com*

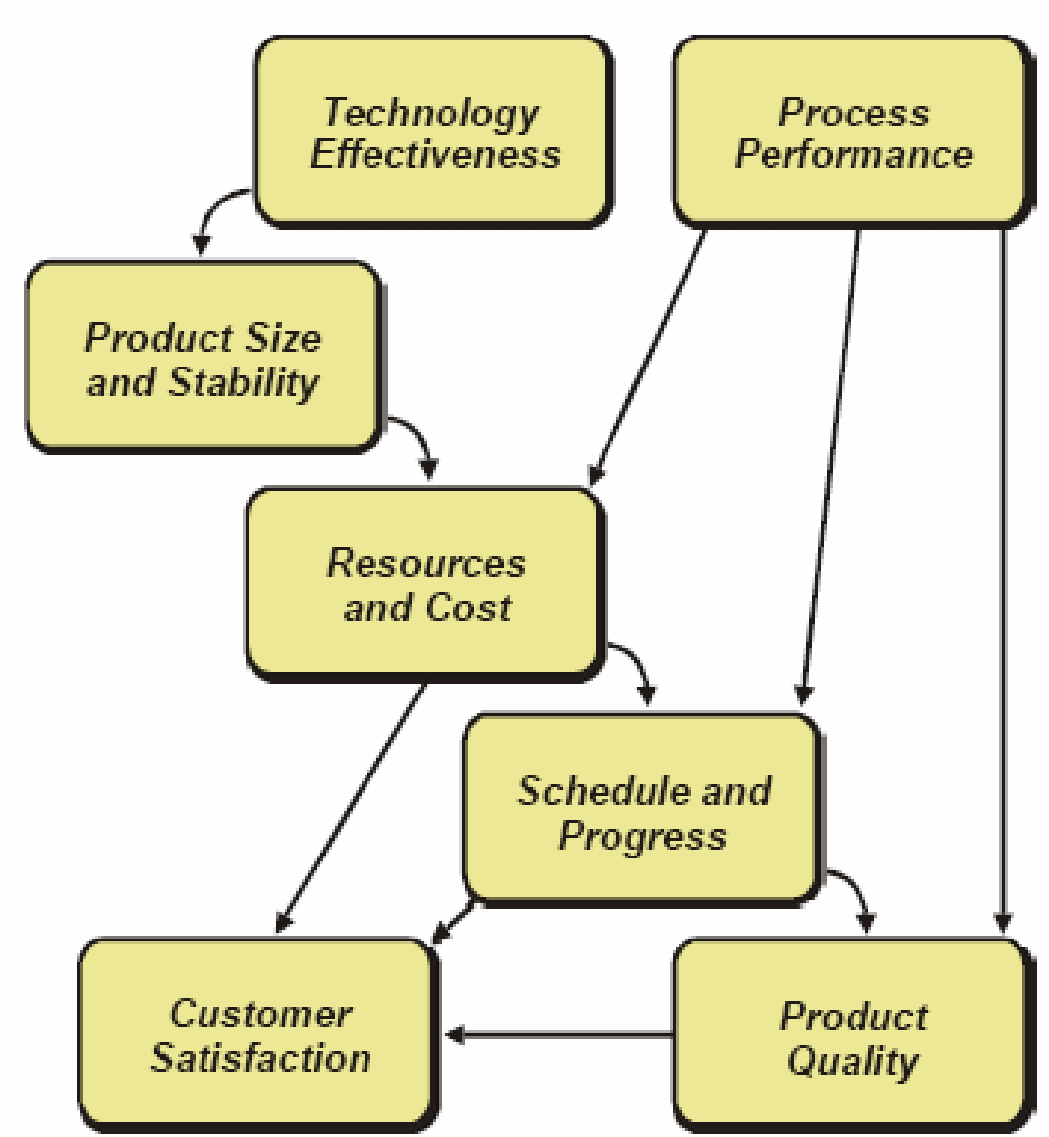
*Rick Hefner, "Measurement Strategies in the CMMI", 24 April 2007*

# Multi-Level Measurement Requirements

- **Different types of information are needed at different levels of the infrastructure**


*Rick Hefner, "Measurement Strategies in the CMMI", 24 April 2007*

# Analysis Model

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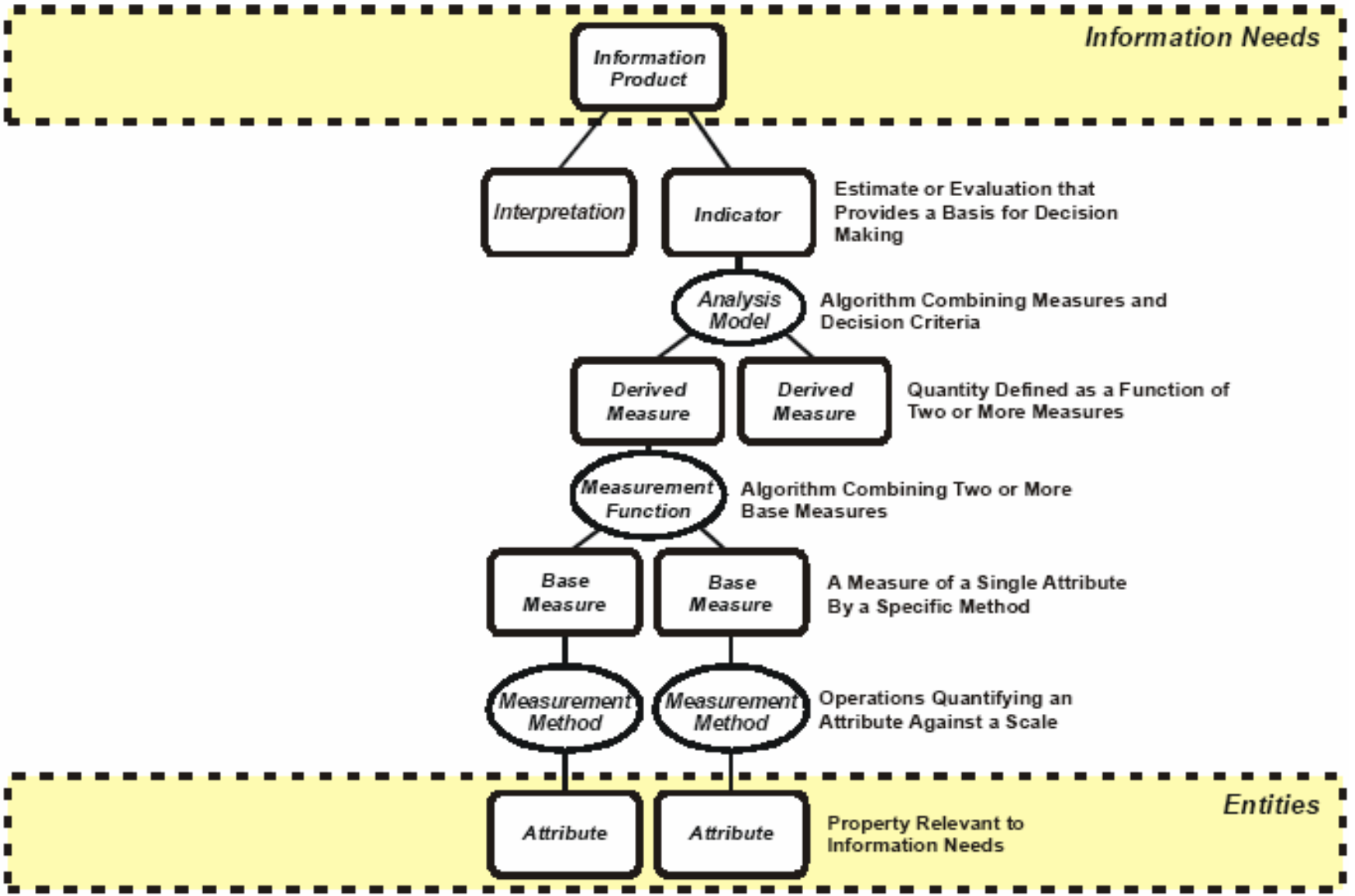
# ISO/IEC 15939, Software Engineering - Software Measurement Process

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# Measurement and Analysis – Goal 1

| Goal/Practices | Notes | Typical Evidence |
|---|---|---|
| **SG 1 Align Measurement and Analysis Activities**<br>Measurement objectives and activities are aligned with identified information needs and objectives. | Focus is on alignment with objectives, not just specifying a set of metrics | |
| **SP 1.1 Establish Measurement Objectives**<br>Establish and maintain measurement objectives that are derived from identified information needs and objectives. | See following slide | Information needs<br>Measurement objectives |
| **SP 1.2 Specify Measures**<br>Specify measures to address the measurement objectives. | | List of metrics, operational definitions |
| **SP 1.3 Specify Data Collection and Storage Procedures**<br>Specify how measurement data will be obtained and stored. | | Collection and storage procedures |
| **SP 1.4 Specify Analysis Procedures**<br>Specify how measurement data will be analyzed and reported. | | Analysis procedures |

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# Information Needs & Measurement Objectives

- **Information needs** set requirements for determining the needed metrics
- **Measurement objectives** set requirements for determining the needed metrics collection, storage, analysis, and reporting mechanisms

**Information Needs**

What types of information are needed by the project?

- **Progress**
- **Quality**
- **Information needed by the organization**
- **Information needed by the customer**

**Measurement Objectives**

What objectives influence how the measures are collected, analyzed, stored, reported?

- **Accuracy**
- **Timeliness**
- **Security**

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# Measurement and Analysis – Goal 2

| Goal/Practices | Notes | Typical Evidence |
|---|---|---|
| **SG 2 Provide Measurement Results**<br>Measurement results that address identified information needs and objectives are provided. | Following defined procedures | |
| **SP 2.1 Collect Measurement Data**<br>Obtain specified measurement data. | | Measurement collection records |
| **SP 2.2 Analyze Measurement Data**<br>Analyze and interpret measurement data. | Evidence should explicitly show interpretations | Analysis results<br>Interpretations |
| **SP 2.3 Store Data and Results**<br>Manage and store measurement data, measurement specifications, and analysis results. | | Data storage records |
| **SP 2.4 Communicate Results**<br>Report results of measurement and analysis activities to all relevant stakeholders. | | Metrics reports/ briefings |

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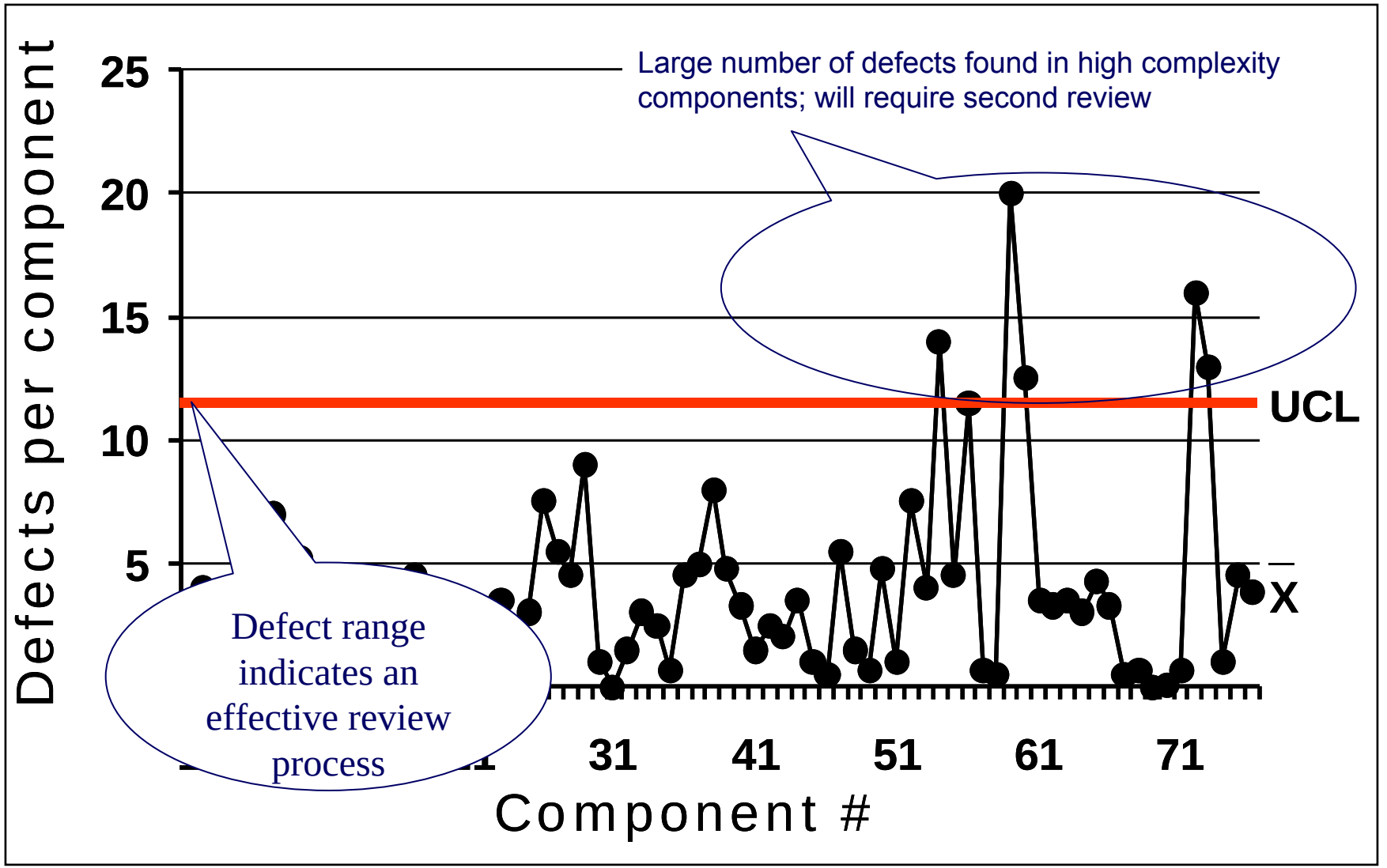
# What Does the Data Mean?



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# Management Styles in the CMMI

**Project**

**Quantitative management**

**Proactive management**

**Reactive mgmt. (plan, track, and correct)**

| Level | Process Areas |
|---|---|
| 5 Optimizing | Causal Analysis and Resolution<br>Organizational Innovation and Deployment |
| 4 Quantitatively Managed | Quantitative Project Management<br>Organizational Process Performance |
| 3 Defined | Requirements Development<br>Technical Solution<br>Product Integration<br>Verification<br>Validation<br>Organizational Process Focus<br>Organizational Process Definition<br>Organizational Training<br>Risk Management<br>Integrated Project Management (for IPPD*)<br>Integrated Teaming*<br>Integrated Supplier Management**<br>Decision Analysis and Resolution<br>Organizational Environment for Integration* |
| 2 Managed | Requirements Management<br>Project Planning<br>Project Monitoring and Control<br>Supplier Agreement Management<br>Measurement and Analysis<br>Process and Product Quality Assurance<br>Configuration Management |
| 1 Performed | |

**Organizational**

**Quantitative improvement**

**Qualitative improvement**

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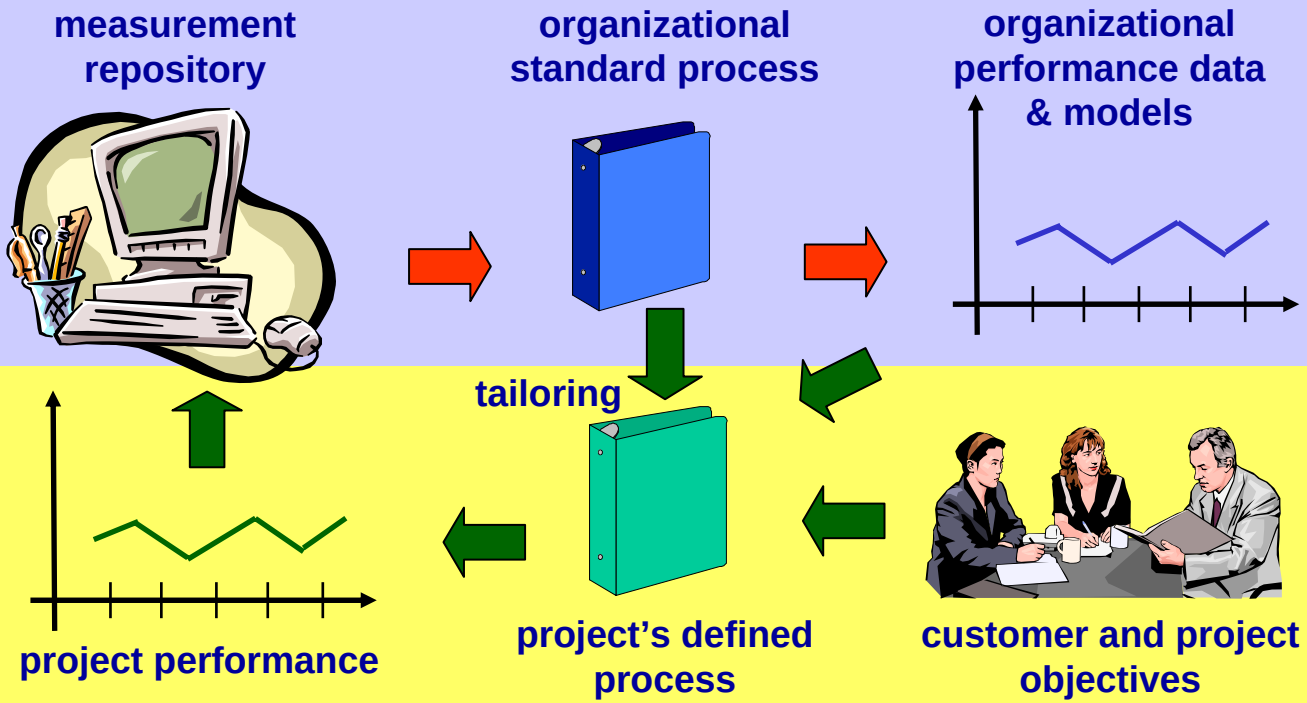
# Measurement at CMMI Level 4

- **Organizational Process Performance**
  - Establishes a quantitative understanding of the performance of the organization's set of standard processes
  - Provides process performance data, baselines, and models to quantitatively manage the organization's projects

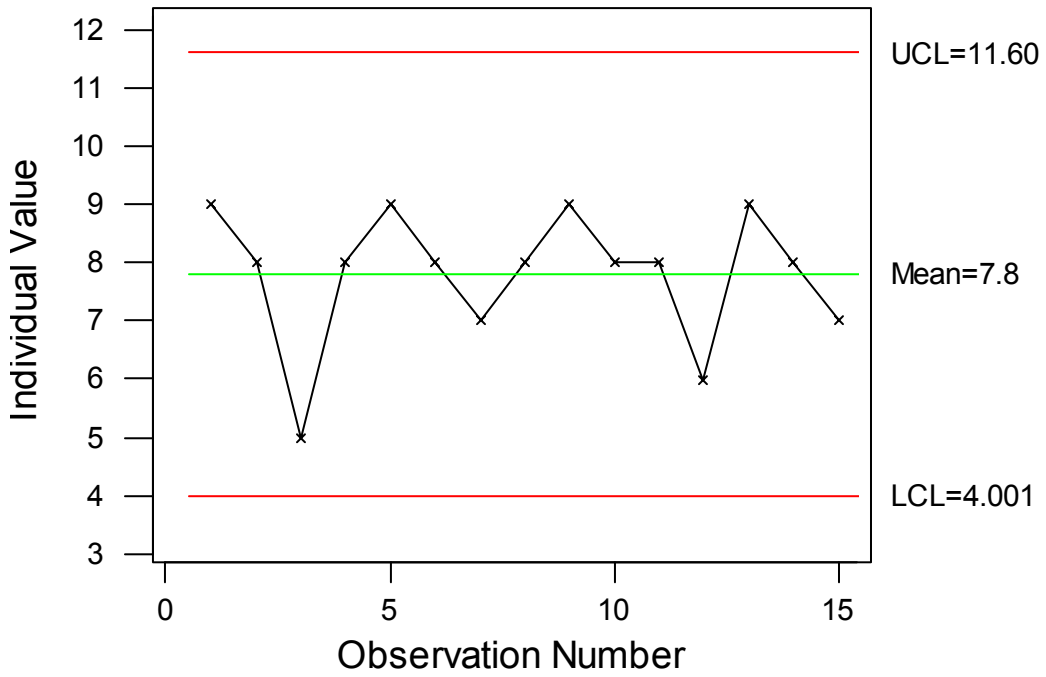



- **Quantitative Project Management**
  - Quantitatively manage the project's defined process to achieve the project's established quality and process-performance objectives.

*Exercise*

# What is Quantitative Management?

- **Suppose your project conducted several peer reviews of similar code, and analyzed the results**
  - Mean = 7.8 defects/KSLOC
  - +3σ = 11.60 defects/KSLOC
  - -3σ = 4.001 defects/KSLOC




- **What would you expect the next peer review to produce in terms of defects/ KSLOC?**
- **What would you think if a review resulted in 10 defects/KSLOC?**
- **3 defects/KSLOC?**

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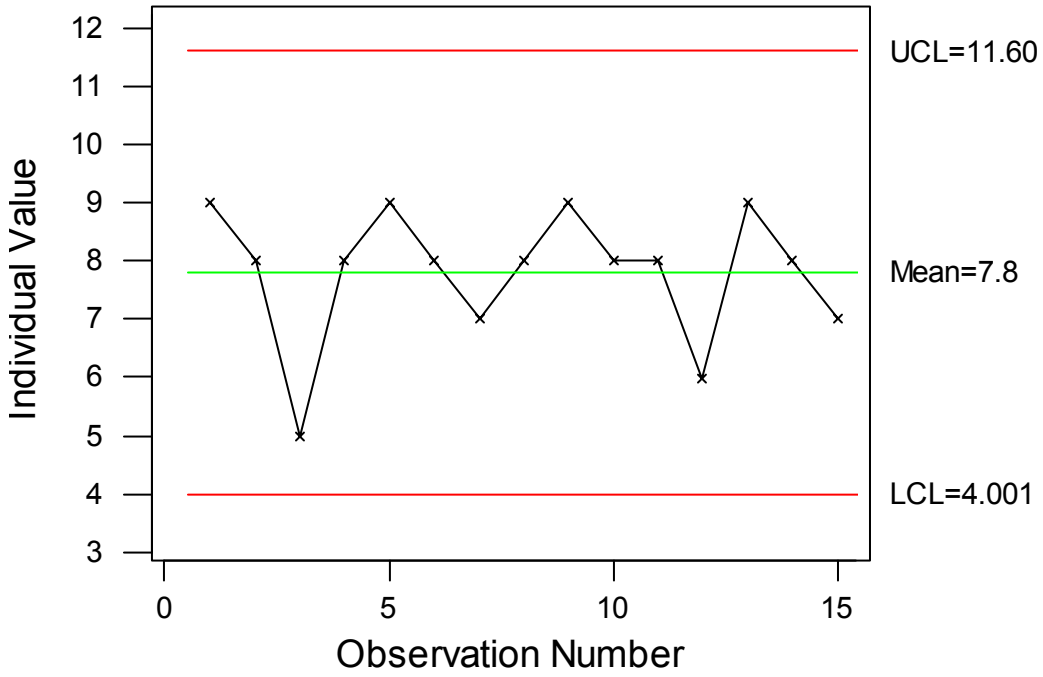
*Exercise*

# What is Required for Quantitative Management?

- **What is needed to develop the statistical characterization of a process?**




- **The process has to be stable (predictable)**
  - Process must be consistently performed
  - Complex processes may need to be stratified (separated into simpler processes)
- **There has to be enough data points to statistically characterize the process**
  - Processes must occur frequently within a similar context (project or organization)

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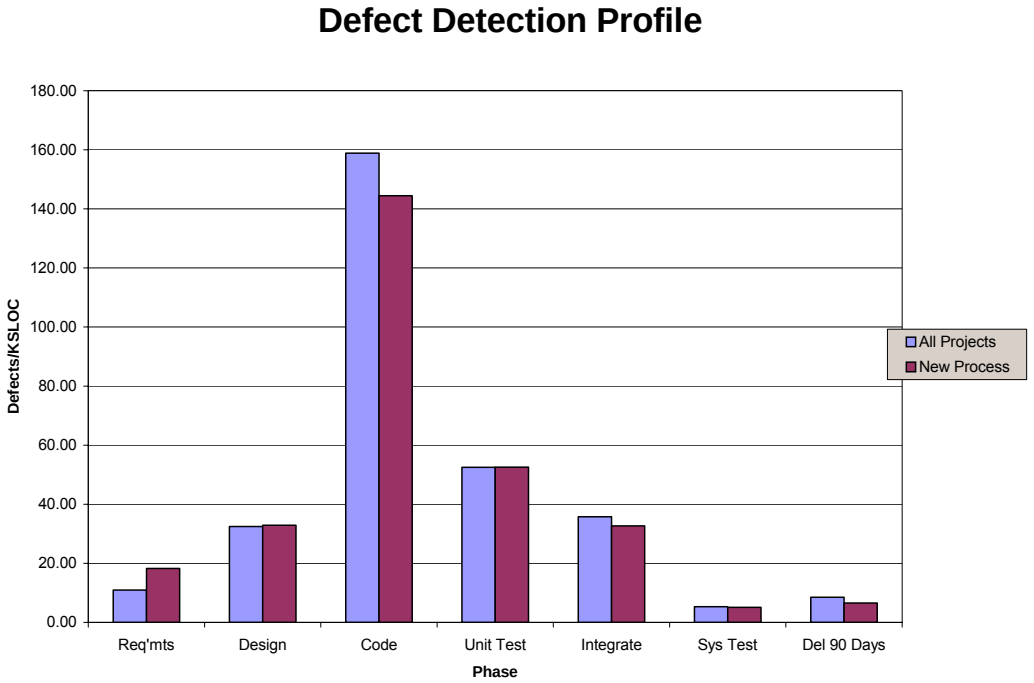
# Typical Choices in Industry

- **Most customers care about:**
  - Delivered defects
  - Cost and schedule
- **So organizations try to predict:**
  - Defects found throughout the lifecycle
  - Effectiveness of peer reviews, testing
  - Cost achieved/actual (Cost Performance Index – CPI)
  - Schedule achieved/actual (Schedule Performance Index – SPI)




**Process performance**

- **Process measures** (e.g., effectiveness, efficiency, speed)
- **Product measures** (e.g., quality, defect density).

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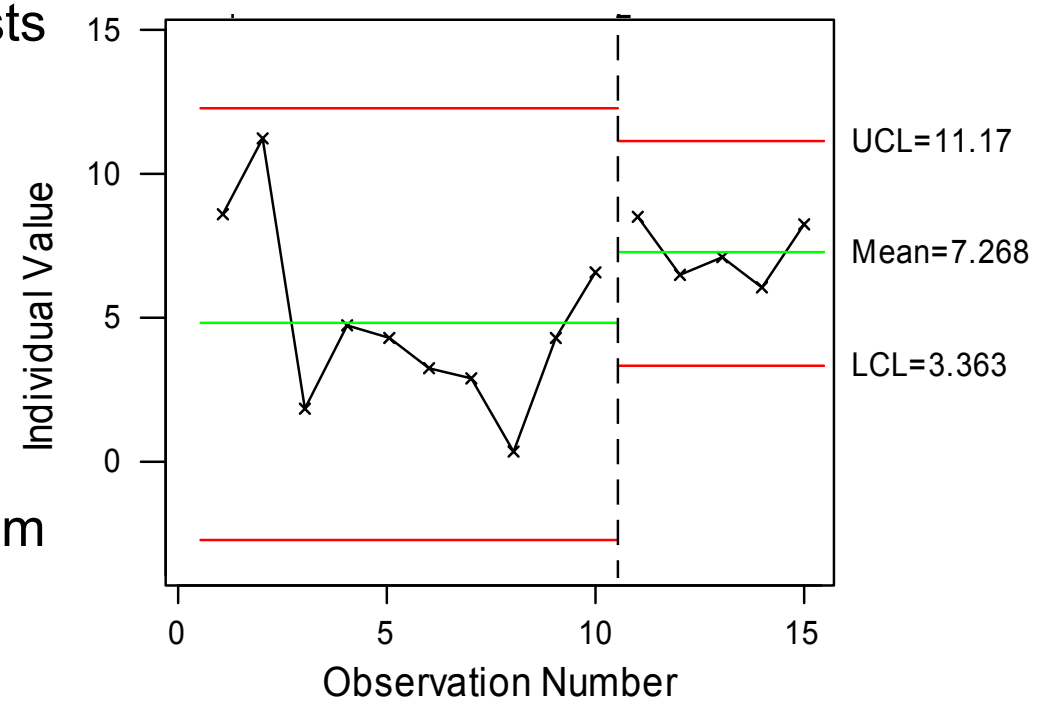
# Measurement at CMMI Level 5

- **Organizational Innovation & Deployment**
  - Set quantitative improvement goals (e.g., reduce variation by X%, reduce mean by Y%)
  - Seek innovative improvements - cause a shift in process capability
  - Analyze potential improvements to estimate costs and impacts (benefits)
  - Pilot improvements to ensure success
  - Measure the impact of improvements quantitatively (variation and mean)

- **Causal Analysis & Resolution**
  - Identify and analyze causes of defects and other problems
  - Take specific actions to remove the causes - prevent the occurrence of those types of defects and problems in the future

# Peer Reviews – Improving the Process

- **Reduce the variation**
  - Train people on the process
  - Create procedures/checklists
  - Strengthen process audits
- **Increase the effectiveness (increase the mean)**
  - Train people
  - Create checklists
  - Reduce waste and re-work
  - Replicate best practices from other projects

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# Lessons Learned

- **To establish (revitalize) a measurement system, start by identifying all the stakeholders and what information they need to make decisions**
  - Look for common needs, which drive common metrics that can be used by many stakeholders
  - There is no “magic” set of metrics that works for every project or every organization
- **It takes several months, if not years, to develop an effective measurement system**
  - Initially, focus is on ensuring data is provided
  - Next, focus in on data definition problems
  - Finally, focus on effective use of the data
  - Concentrate on developing a data-driven culture
- **When moving to Levels 4 and 5, expect a period of trial-and-error to discover the metrics you need**
  - Focus on management by variation (e.g., Six Sigma)