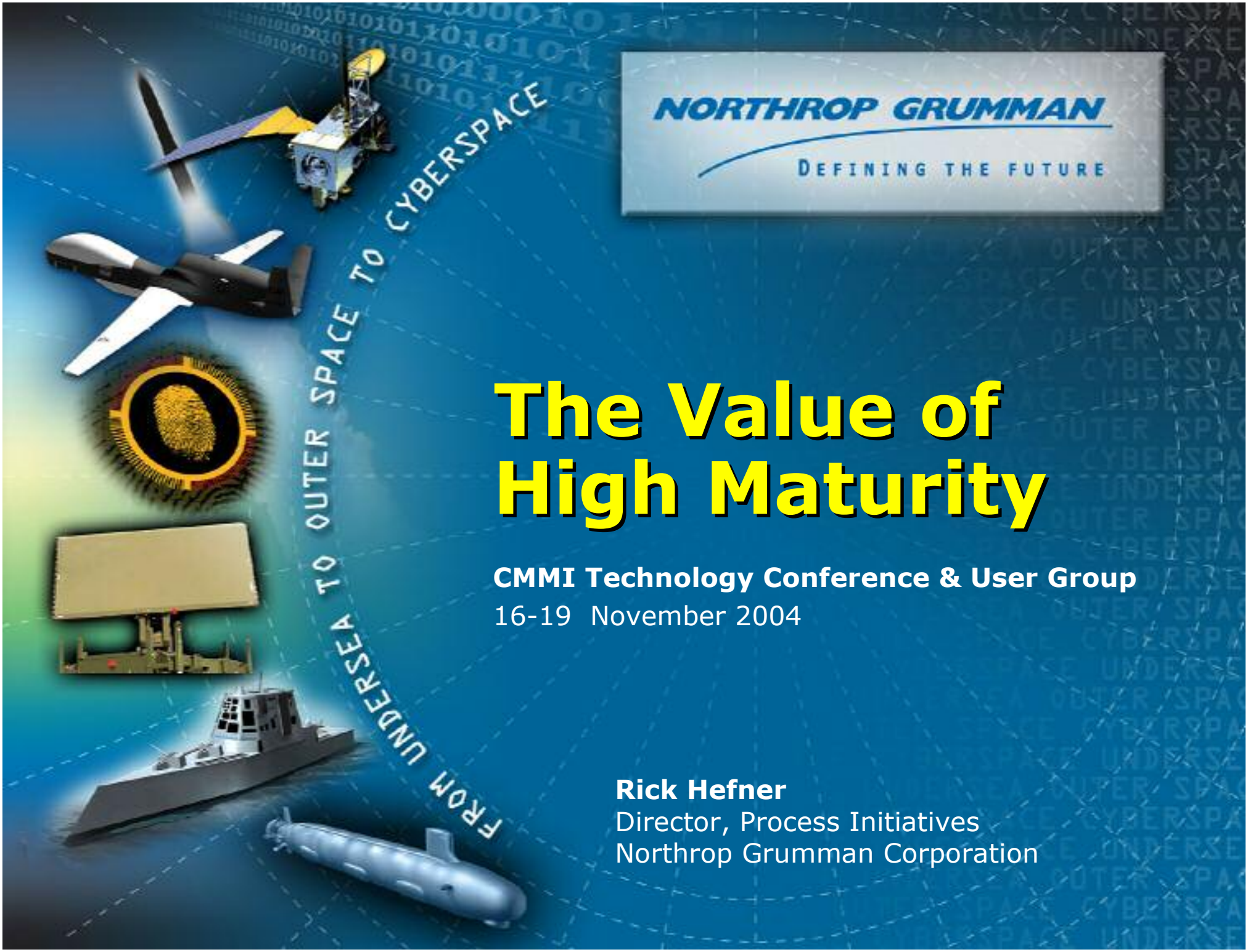


The Value of High Maturity

CMMI Technology Conference & User Group

16-19 November 2004

Rick Hefner
Director, Process Initiatives
Northrop Grumman Corporation

Background

- **Until recently, Level 3 has been considered an industry standard**
- **Now, many organizations have achieved high maturity**
- **Others are considering it, but little has been published about the costs and value of high maturity**

What are the differences between Level 3 and Level 5?

What are the advantages of a high maturity organization?

CMMI

	Level	Process Areas
Improving, addressing common causes of variation	5 Optimizing	Causal Analysis and Resolution Organizational Innovation and Deployment
Quantitatively managed, eliminating special causes of variation	4 Quantitatively Managed	Quantitative Project Management Organizational Process Performance
Work proactively managed, organizational standard processes	3 Defined	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition Organizational Training Risk Management Integrated Project Management (for IPPD*) Integrated Teaming* Integrated Supplier Management** Decision Analysis and Resolution Organizational Environment for Integration*
Work planned and tracked (reactively managed)	2 Managed	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
Work performed, but in an ad hoc fashion	1 Performed	

The Project Manager's Dilemma at Level 3

I want to use the organization's standard process, but…

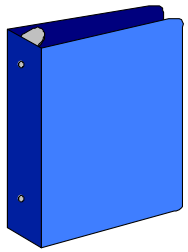
… Does it's performance and quality meet my customer's expectations?

… If not, how should I tailor the process?

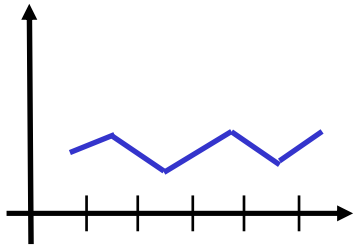
Organizational Process Performance (Level 4)

- **The organization:**
  - **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**

organizational measurement repository



organizational standard process

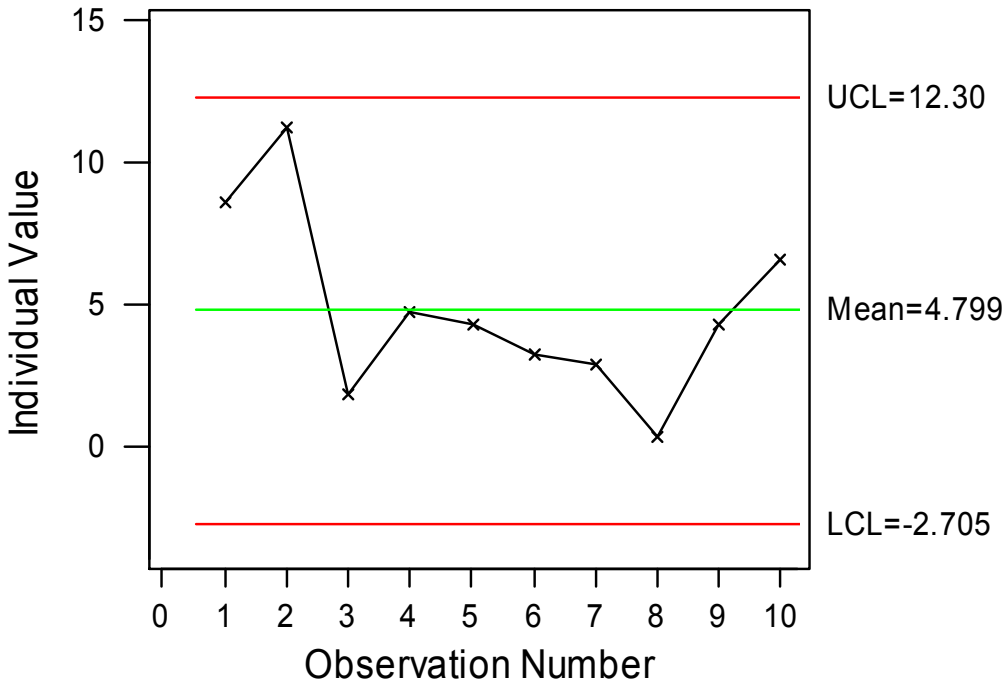


organizational performance data & models

Peer Reviews – Understanding the Process

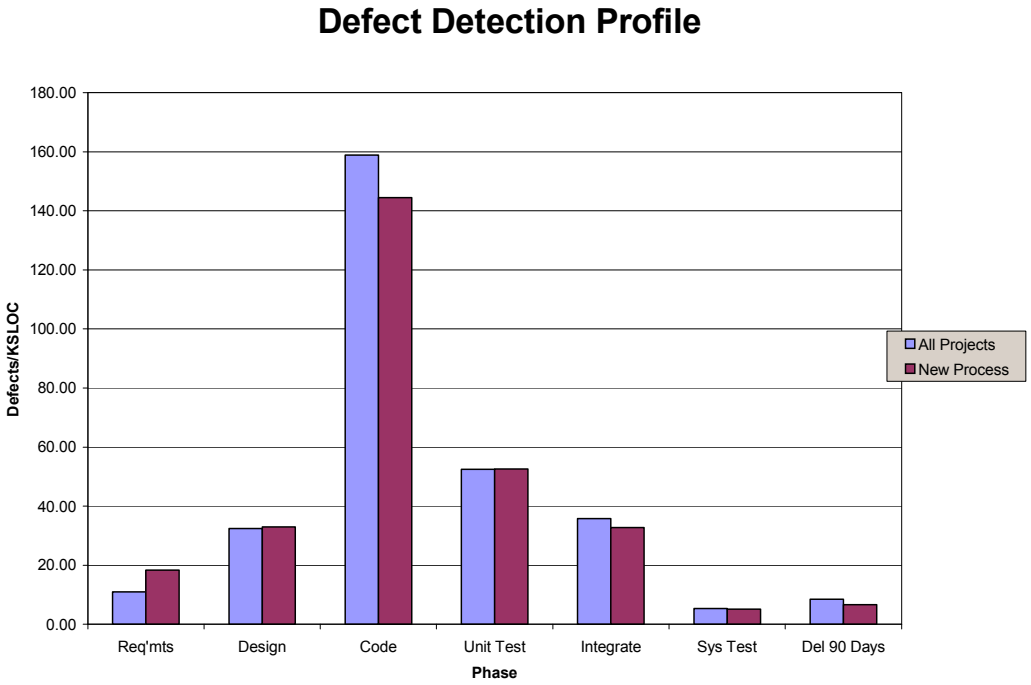
Managing by Variation

- **How many errors does the team typically find in reviewing an interface specification?**
- **Useful in evaluating future reviews**
  - Was the review effective?
  - Was the process different?
  - Is the product different?



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)



What Can a Level 4 Organization Do?

- Determine whether processes are behaving consistently or have stable trends (i.e., are predictable)
- Identify processes where the performance is within natural bounds that are consistent across process implementation teams
- Establish criteria for identifying whether a process or process element should be statistically managed, and determine pertinent measures and analytic techniques to be used in such management
- Identify processes that show unusual (e.g., sporadic or unpredictable) behavior
- Identify any aspects of the processes that can be improved in the organization's set of standard processes
- Identify the implementation of a process which performs best

New Questions at Level 4

- What characteristics of the organizational standard process would be useful to understand?
- Which subprocesses would be useful to understand, for predictive purposes?
- Are these subprocesses predictable (stabilizable)?
- What data should the organization collect?
- To what level of detail should the organizational standard process go?
- What differences in project subprocesses are permissible? How do they impact the historical data?

Organizational Process Performance

SG 1 Establish Performance Baselines and Models

Baselines and models that characterize the expected process performance of the organization's set of standard processes are established and maintained.

SP 1.1 Select Processes

Select the processes or process elements in the organization's set of standard processes that are to be included in the organization's process performance analyses.

SP 1.2 Establish Process Performance Measures

Establish and maintain definitions of the measures that are to be included in the organization's process performance analyses.

SP 1.3 Establish Quality and Process-Performance Objectives

Establish and maintain quantitative objectives for quality and process performance for the organization.

SP 1.4 Establish Process Performance Baselines

Establish and maintain the organization's process performance baselines.

SP 1.5 Establish Process Performance Models

Establish and maintain the process performance models for the organization's set of standard processes.

Selected subprocesses, NOT the whole process

Objectives deal with eliminating sources of variation, not setting "stretch" goals

The organization meets these goals by modifying the standard process, not driving the projects

Baselines characterize the "voice of the process", based on the existing historical data

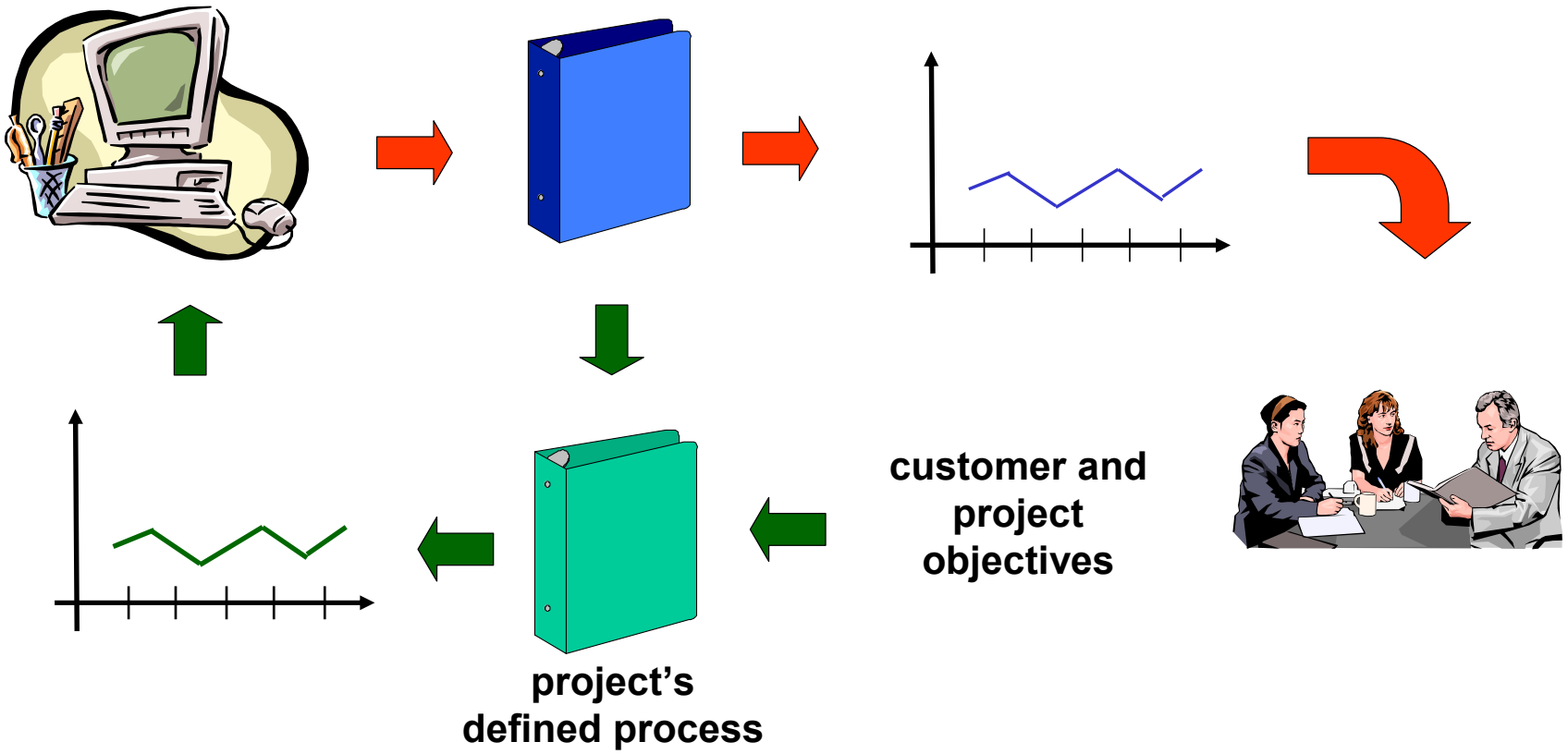
- What is the current mean and variation?

May need to subgroup the data

Models allow projects to estimate their quantitative performance based on the historical data of other projects executing the process

Quantitative Project Management

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



The Project Manager's Challenge at Level 4

I understand the capabilities of the organization's standard process, but…

… What are the project's quality and process performance objectives?

… How should I tailor the process?

… What project subprocesses do I need to quantitatively manage?

Quantitative Project Management (Goal 1)

SG 1 Quantitatively Manage the Project

The project is quantitatively managed using quality and process-performance objectives.

SP 1.1 Establish the Project's Objectives

Establish and maintain the project's quality and process performance objectives.

SP 1.2 Compose the Defined Process

Select the subprocesses that compose the project's defined process based on historical stability and capability data.

SP 1.3 Select the Subprocesses that Will Be Statistically Managed

Select the subprocesses of the project's defined process that will be statistically managed.

SP 1.4 Manage Project Performance

Monitor the project to determine whether the project's objectives for quality and process performance will be satisfied, and identify corrective action as appropriate.

Quality: defect levels of key work products or deliverables

Process: productivity, efficiency, effectiveness of the project's processes

Rationale for how the project tailored the organization's standard process, in order to meet their quality & process performance objectives

- E.g., adding procedures to reduce variation

Assumes the standard process includes subprocesses to select from

Only some subprocesses selected for statistical management

- Need not be the same as those selected by the organization

Monitoring against the objectives established in SP 1.1

Quantitative Project Management (Goal 2)

SG 2 Statistically Manage Subprocess Performance

The performance of selected subprocesses within the project's defined process is statistically managed.

SP 2.1 Select Measures and Analytic Techniques

Select the measures and analytic techniques to be used in statistically managing the selected subprocesses.

SP 2.2 Apply Statistical Methods to Understand Variation

Establish and maintain an understanding of the variation of the selected subprocesses using the selected measures and analytic techniques.

SP 2.3 Monitor Performance of the Selected Subprocesses

Monitor the performance of the selected subprocesses to determine their capability to satisfy their quality and process performance objectives, and identify corrective action as necessary.

SP 2.4 Record Statistical Management Data

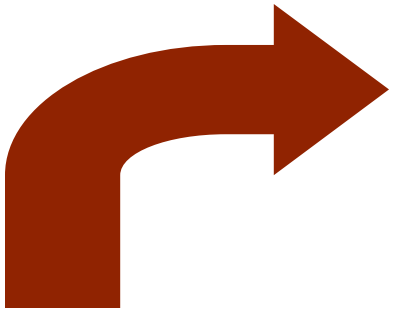
Record statistical and quality management data in the organization's measurement repository.

Type of analysis to be performed (e.g., control charts)

Key is understanding variation in the selected subprocesses (e.g., be able to computer standard deviation), NOT just metrics

Given the stability and variation in the subprocesses, will we be able to meet our project-level quality and process performance objectives?

What Does Level 5 Add to the Organization?



Organizational Process Focus

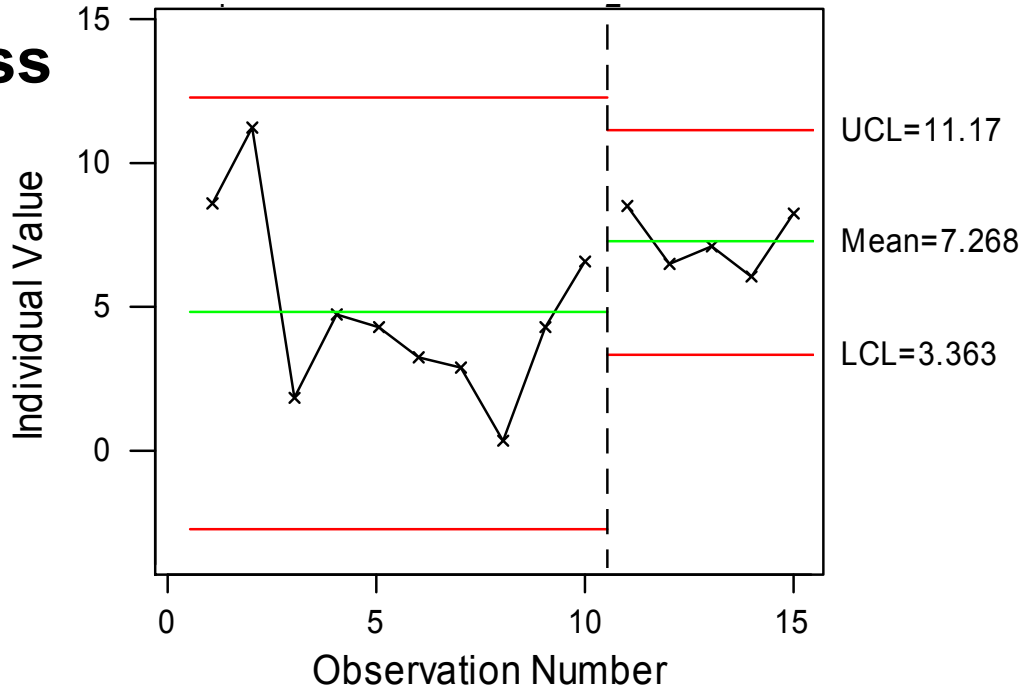
- **Goals are typically qualitative**
- **The effects of the improvements are not estimated or measured**

Organizational Innovation & Deployment

- **Goals are typically quantitative (reduce variation by X%, reduce mean by Y%)**
- **Incremental improvements – eliminate special causes of variation**
- **Innovative improvements - cause a major shift in process capability**
- **Potential improvements are analyzed to estimate costs and impacts (benefits)**
- **Improvements are piloted to ensure success**
- **Improvements are measured in terms of variation and mean**

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



Organizational Innovation and Deployment

SG 1 Select Improvements

Process and technology improvements that contribute to meeting quality and process-performance objectives are selected.

SP 1.1 Collect and Analyze Improvement Proposals

Collect and analyze process- and technology-improvement proposals.

SP 1.2 Identify and Analyze Innovations

Identify and analyze innovative improvements that could increase the organization's quality and process performance.

SP 1.3 Pilot Improvements

Pilot process and technology improvements to select which ones to implement.

SP 1.4 Select Improvements for Deployment

Select process- and technology-improvement proposals for deployment across the organization.

SG 2 Deploy Improvements

Measurable improvements to the organization's processes and technologies are continually and systematically deployed.

SP 2.1 Plan the Deployment

Establish and maintain the plans for deploying the selected process and technology improvements.

SP 2.2 Manage the Deployment

Manage the deployment of the selected process and technology improvements.

SP 2.3 Measure Improvement Effects

Measure the effects of the deployed process and technology improvements.

The effects should be measured quantitatively (as opposed to qualitatively in OPF)

What Does Level 5 Add to the Project?

- **Casual Analysis & Resolution**
  - Identify and analyze causes of defects and other problems
  - Take specific actions to remove the causes

- **The project may take actions to prevent the occurrence of those types of defects and problems in the future**

- **Most projects implement Causal Analysis & Resolution at Level 4**
  - Identify and eliminate special cause variations, I.e., stabilize the process

Causal Analysis & Resolution

SG 1 Determine Causes of Defects

Root causes of defects and other problems are systematically determined.

SP 1.1 Select Defect Data for Analysis

Select the defects and other problems for analysis.

SP 1.2 Analyze Causes

Perform causal analysis of selected defects and other problems and propose actions to address them.

SG 2 Address Causes of Defects

Root causes of defects and other problems are systematically addressed to prevent their future occurrence.

SP 2.1 Implement the Action Proposals

Implement the selected action proposals that were developed in causal analysis.

SP 2.2 Evaluate the Effect of Changes

Evaluate the effect of changes on process performance.

SP 2.3 Record Data

Record causal analysis and resolution data for use across the project and organization.

Can apply to any cause and effect relationship, not just defects

Typically, projects will establish a list of potential areas in which to apply CAR, and select some from that list

Determine cause and effect (e.g., fishbone diagram, brainstorming) and potential improvement action list

Select some actions on the list to implement

Implemented for each selected action
- Evidence will provide samples

Measures the effect of the change

The effect need not be positive

Lessons Learned

Based on 6 Northrop Grumman CMMI Level 5 organizations

- **Six Sigma is an enabler for higher maturity**
  - Focus on data, measurement systems, process improvement
  - Tying improvements to business goals
  - Tools and methods support the level 4/5 analysis tasks
- **Level 3 metrics, measurement processes, and goal setting are generally inadequate for Levels 4 and 5**
  - Better definitions of the measures
  - Lower level metrics of lower level subprocesses
- **Trying to understand and stabilize the key subprocesses will naturally drive you to the right metrics**
- **Projects have different quality and process performance needs, and should select different subprocesses to quantitatively manage**