CMMI and Six Sigma – Perfect Together

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Overview

- Lockheed Martin IS&GS and its companies, GSS, M&CSS, and EI Group, continue to value its CMMI appraisal rating at Maturity Level 5
- CMMI-DEV, Version 1.2 provides additional clarification of the expectations of high maturity (maturity levels 4 and 5)
- These additional clarifications strengthen our understanding that better utilizing Lean Six Sigma methods, tools, and practitioners can improve institutionalization of high maturity practices
- The pull of CMMI Level 5 improves utilization of the Lean Six Sigma methods, tools, and practitioners
- Using Lean Six Sigma and and High Maturity together supports the Lockheed Martin goal of perfect program performance

Striving for Perfect

- Characteristics of a culture striving for *Perfect:*
  - Regular analysis of what works and what does not
  - Causes of problems are identified and action taken to prevent them from occurring in the future
  - Causes of improved performance are identified and action taken to repeat them in the future
  - Objective data is used to make effective and efficient improvement decisions
    - What to change
    - What to leave alone
    - What benefits are expected
  - Changes are based on objective criteria and data, and piloted where appropriate

The oldest definition of "perfection," goes back to Aristotle. In Book *Delta* of the *Metaphysics*, he distinguishes three meanings. That which is perfect:

- is complete - contains all the requisite parts
- is so good that nothing of its kind could be better
- has attained its purpose

What is High Maturity All About?

- High maturity involves the following qualities:
  - Statistical and other quantitative methods are used by projects and organizations to *understand* past and *predict* future process performance and product quality
  - Organizations establish objectives for quality and process performance based on business objectives
  - Projects establish their objectives based on those of the organization and the needs of customers and end users
  - Projects and individuals use statistical and quantitative methods in their activities to plan, monitor, and control progress against their objectives
  - Organizations use the resulting information to understand process performance, understand variation, target areas for continuing improvement, and evaluate the impact of proposed improvements.

From “Understanding High Maturity Practices, Module 2”, Software Engineering Institute, 2007 Carnegie Mellon University

Lean Six Sigma at Lockheed Martin

- Achieve the highest performance level for a business process or program
- The integration of lean thinking and six sigma methodologies
- A change in our paradigm of routine day-to-day work practices
- Achieved through the relentless pursuit of finding a better and smarter way to work

From “Green Belt Training, LM21 Overview, Part 1”, 2003 Lockheed Martin

Lean Six Sigma Objectives

- Drive process capability to world-class levels
- Deliver on customer value
- Provide common focus for productivity
- Use disciplined principles and tools to achieve lean process with six sigma capability

From “Green Belt Training, LM21 Overview, Part 1”, 2003 Lockheed Martin

What Is Six Sigma?

- Philosophy
- Methodology
- Set of Tools
- A Measurement
- Y = f (x)

Six Sigma Provides A Framework For Successful Process Improvement

From “Green Belt Training, LM21 Overview, Part 2”, 2003 Lockheed Martin

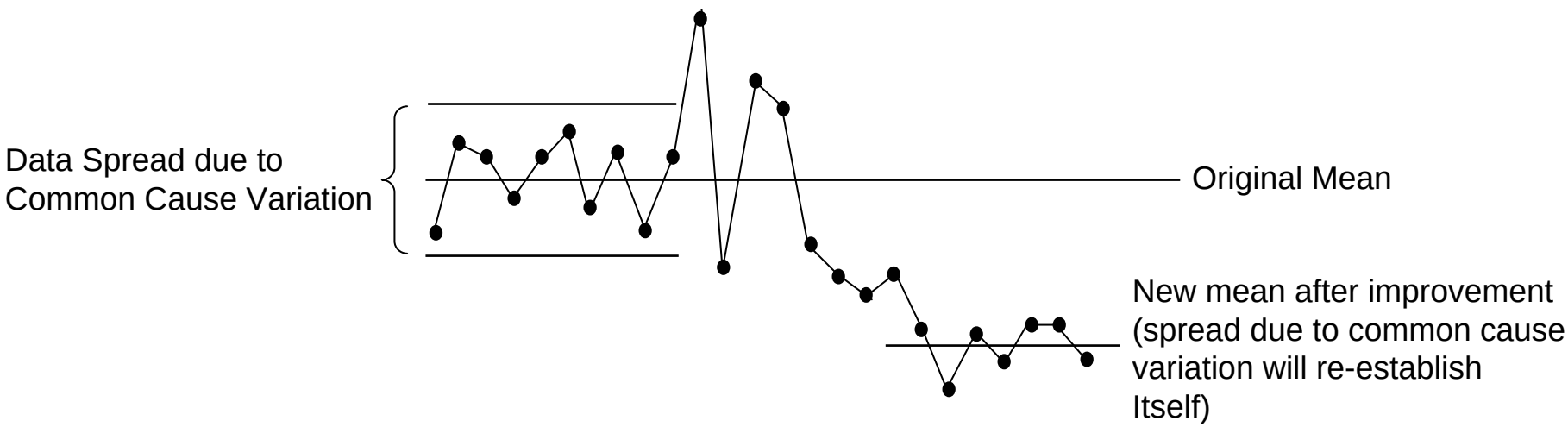
What Does Sigma Mean?

- In statistics, sigma represents standard deviation, a measure of variation for process performance
- Sigma provides information on the amount of variation in a process
- Sigma also provides the ability to “predict” process performance
- Sigma provides a benchmark to determine if actions have produced results

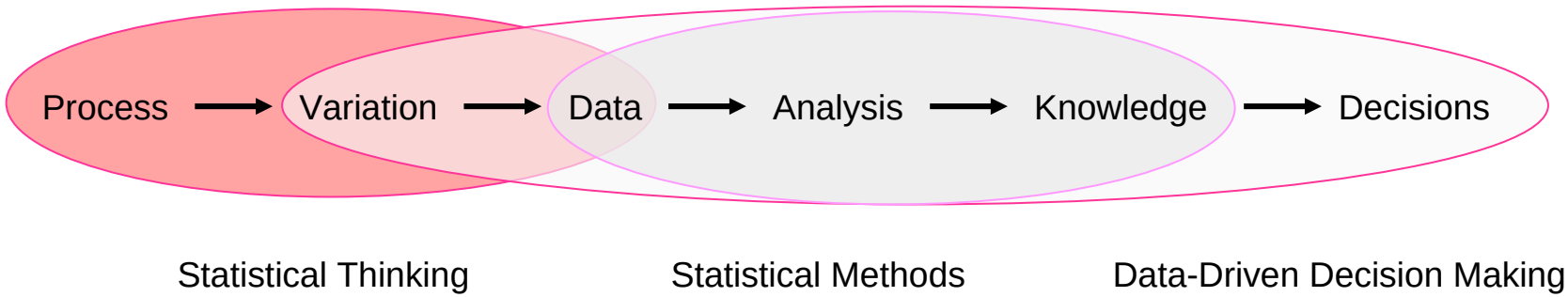
From “Green Belt Training, LM21 Overview, Part 2”, 2003 Lockheed Martin

Statistical Thinking: A Paradigm

- Everything is a process
- All processes have inherent variability
- Data are used to understand variation and to drive decisions to improve the process



Statistical Thinking To Data Driven-Decision Making



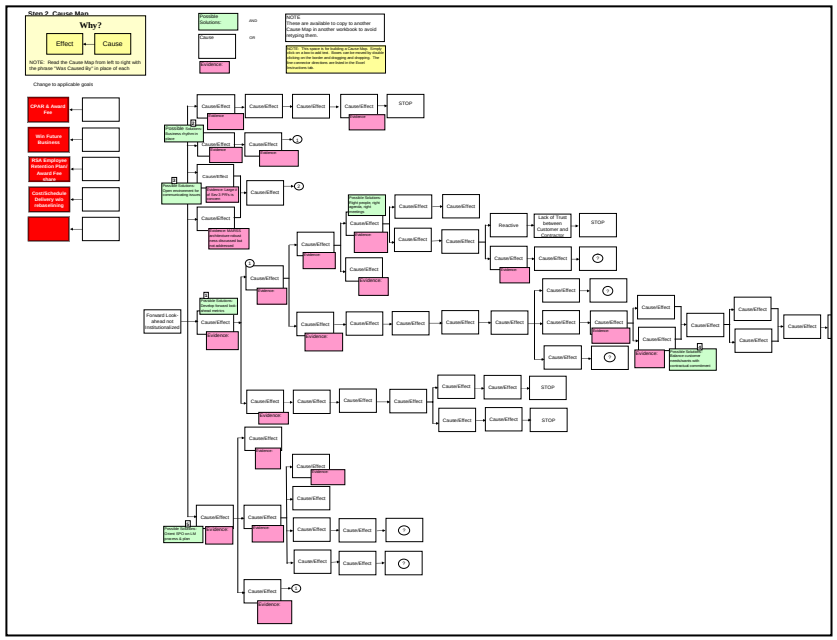
- Statistical thinking ensures that we seek data that describes how process variation affects customers
- Statistical methods give us the power to extract knowledge from the data
- Data-driven decision making enables us to turn that knowledge into appropriate decisions for the good of our customers, and ultimately for the organization's benefit

High Maturity Causal Analysis – What You Need to Know

- Lockheed Martin's approach to Causal Analysis is grounded in the book "Apollo Root Cause Analysis" by Dean Gano
- Root Cause Analysis, or RCA, is a problem solving process built on the premise that "the better we understand the underlying causes of an event, the better we can control it and the more causal relationships (i.e., causes and effects) we understand, the better we can predict the future"
- The practice of RCA is predicated on the belief that problems are best solved by attempting to correct or eliminate root causes, as opposed to merely addressing the immediately obvious symptoms
- Lockheed Martin's RCA approach surfaces the entire system of causes and effects, leading to effective solutions to prevent recurrence

What is Cause Mapping?

- Cause Mapping is a problem resolution methodology based on the Apollo Root Cause Analysis method developed by Dean Gano:
  - focuses on cause-effect relationships
  - surfaces systemic, latent causes
  - leads to more effective solutions to prevent
  - recurrence of undesired effects
  - applies mistake proofing techniques to solutions



A completed cause map includes impact and significance to goals, action and condition causes, evidence, and solutions

Causal Analysis with a Solutions Focus

Causal Analysis with Six Sigma

- Causal Analysis with Six Sigma assumes:
  - Objectives are established for process performance
  - Variation is understood (process is stable)
  - Team members who use data and understand the results of common statistical analysis
  - Access to appropriate statistical support
  - Capability to measure, track, and report performance against objectives

Six Sigma Concept: Variation
Processes have two types of variation. Upstream from the problem, factors of variation are “the Xs” – the causes. Downstream, changes in the Xs result in effects, called “the Ys”. Y = f(X)

Six Sigma and High Maturity

- Operating at 6 Sigma Capability
  - Data driven decision making
  - Meeting customer's requirements
  - Measurable processes
  - Processes under control "Y = f(x)"
  - Variation has been reduced
  - Future performance can be predicted
  - Results of actions can be assessed
- High Maturity
  - Gather and use data at all levels of the organization
  - Provide insight into the operation of an organization and its processes based on data and statistical analysis
  - Statistical and other quantitative methods are used by projects and organizations to understand past and predict future process performance and product quality
  - Organizations use the resulting information to understand process performance, understand variation, target areas for continuing improvement, and evaluate the impact of proposed improvements

Statistical Tools for Causal Analysis

Tool	Application	Usage
Statistical Process Control and Control Charts	Problem Identification	Monitoring current process performance, predicting future performance, suggesting need for corrective action
Process Performance Analysis (PPMs and PPBs	Problem Identification	Monitoring current process performance, predicting future performance, suggesting need for corrective action
Tests of Statistical Significance (Chi-square, *t*-tests, ANOVA)	Problem Definition Root Cause Analysis	Confirming a problem or meaningful change in performance; developing, validating, disproving a root-cause hypothesis
Correlation and Regression	Root Cause Analysis Prediction of Results	Testing root-cause hypothesis to see if there's a link between cause (X) and effect (Y); predict performance of a process under certain conditions
Design of Experiments	Solution Analysis Results Validation	Pilot or test combinations of possible solutions to find optimal improvement strategy

Non-Statistical Tools

Tool	Application	Usage
Cause Mapping	Root Cause Analysis	Cause and effect diagramming
Process Mapping	Root Cause Analysis Solution Implementation	Shows flow of work
Pareto Analysis	Problem Identification Results Validation	Stratifying data into groups from largest to smallest; identifying common causes of a problem
Histogram or Freguency Plot	Problem Identification Results Validation	Show range and depth of variation in a group of data
Run Chart	Problem Identification Results Validation	Shows variation in a process over time
Scatter Plot or Correlation Diagram	Root Cause Analysis Prediction of Results	Shows link or correlation between two factors
Failure Modes Effects Analysis (FMEA)	Solutions Identification	Identification, analysis, and priortiziation of failure modes as part of evaluation of a proposed solution
Mistake Proofing (Poka-Yoke)	Solutions Implementation	Preventing errors by designing the process so that it can't be performed incorrectly

Using Lean Six Sigma to Institutionalize High Maturity

- Lean Six Sigma practitioners (master, black and green belts) are trained and experienced with the six sigma philosophy, methodology and tool set
- These practitioners can be deployed to mentor programs to:
  - Analyze subprocess performance
  - Establish process performance baselines and process performance models
  - Use statistical and quantitative methods to plan, monitor, and control progress against objectives
  - Establish objectives based on those of the organization and the needs of customers and end users
- These practitioners can also be deployed to organizational elements to:
  - Establish objectives for quality and process performance based on business objectives
  - To understand process performance

Using Operating Excellence to Institutionalize High Maturity, cont

- The LM21 infrastructure supports High Maturity:
  - Program Excellence Plans (PEPs) can be utilized to link strategic and tactical goals with process improvement initiatives, target areas for continuing improvement
  - LM21 repositories provide record of improvement activities