Q-Labs®

Shaping your Processes for Competitive Advantage

Understanding "Why?"

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Agenda

- The Problem
- Basic Concepts
- Defect Classifications
- Causal Analysis in the CMM and CMMI®
- An Opportunity
- Summary

The Problem

- Many of the potential benefits of measurement and analysis activities depend on effective causal analysis
- Causal analysis often produces superficial or no meaningful action, even in “mature” organizations

Examples of Weak Results

- Identified cause does not lead to any action
  - Bad data
  - Personnel issues
- Causes and actions are superficial
  - Defect rates from inspections are low, so *reinspect*
  - Defect rates from inspections are high, so *orient* the producer
- Only a small number of problems may result in false OOC signals or OBE (overcome by events) situations
- Tendency to stop at “first plausible explanation”

Contributors to the Problem

- Misunderstanding of basic concepts
  - Causality
  - Causal system
- Inadequate defect classification schemes
- Ad hoc causal analysis processes
  - Bad habits
  - Differences between CMM and CMMI

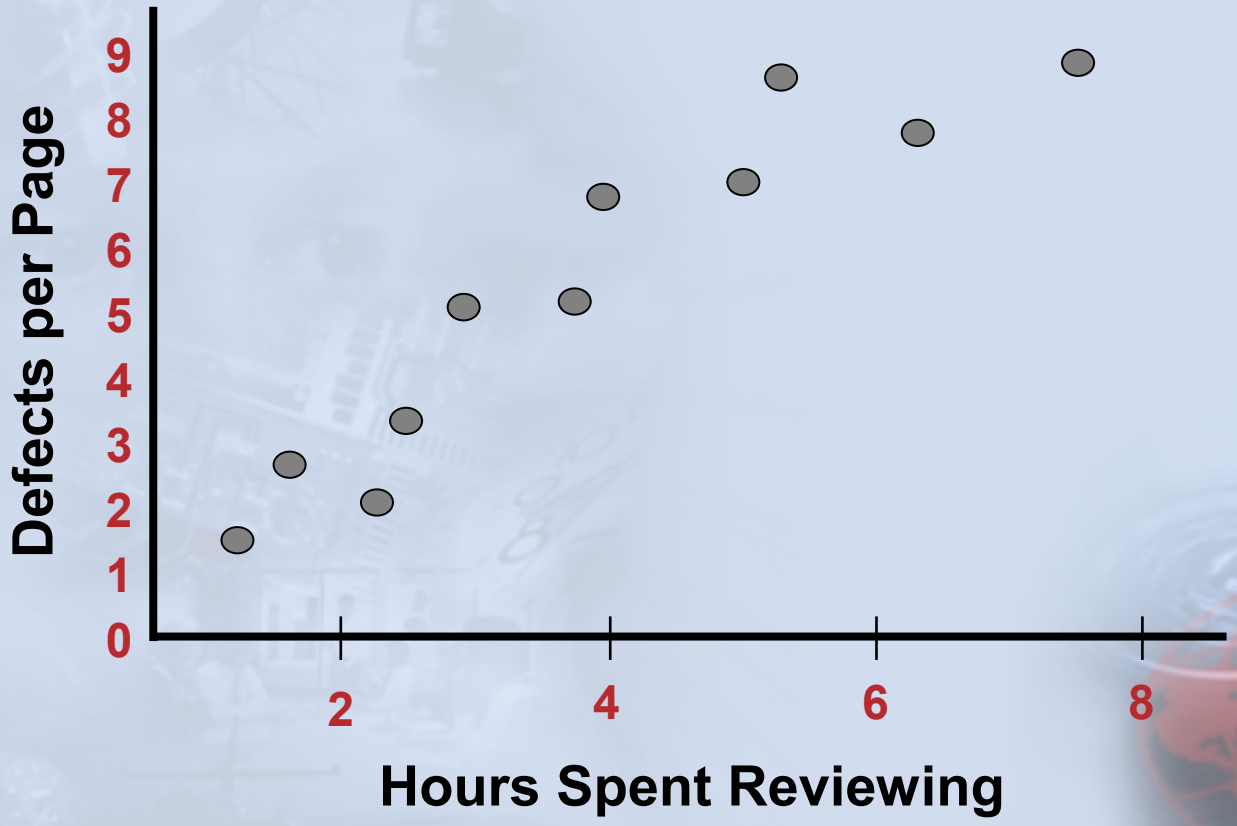
Causal Analysis

- Examination of information about problems, with
- Intent to identify causes of defects so that they can be prevented or detected earlier, or so that appropriate corrective action can be taken
- Many different approaches, called defect causal analysis or root cause analysis, employ many different techniques
- Performed in response to an *anomaly* or as part of a continual improvement program

Concept of Causality

- Conditions of causality
  - *Cause* and *effect* must demonstrate association or correlation
  - *Cause* must precede the *effect* in time
  - Mechanism by which the cause produces the effect must be identified
- Assignment of cause in a “human-intensive system” always includes a significant element of subjectivity

A Causal Relationship?



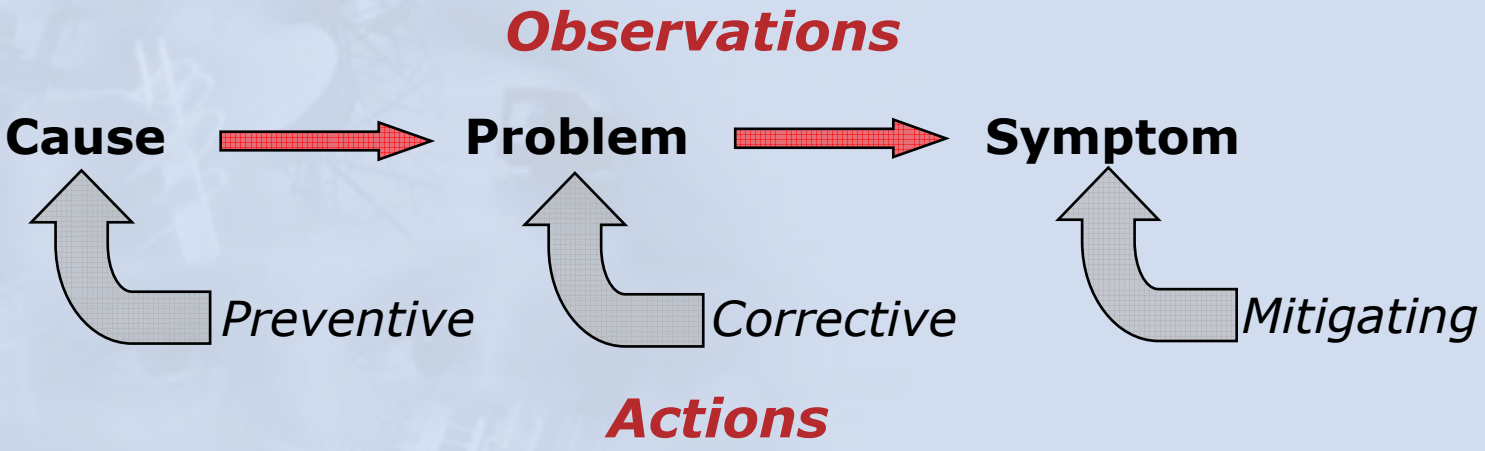
Causal System

- Network of interacting factors that affect an outcome of interest
  - Causes may linked hierarchically or laterally — causes may be effects, too!
  - A vocabulary limited to *cause* and *effect* usually isn't sufficient for reasoning about a causal system

Terminology for Causal Analysis

- The *problem* is the critical issue
- *Symptoms* usually are the most readily visible consequences of the problem
- *Causes* contribute to the occurrence of the problem
- *Systematic problems* are those that repeat

Elements of a Causal System



- Action may be taken on many different elements of a causal system
- Selecting the right action depends on the cost of the action and the expected impact on the system

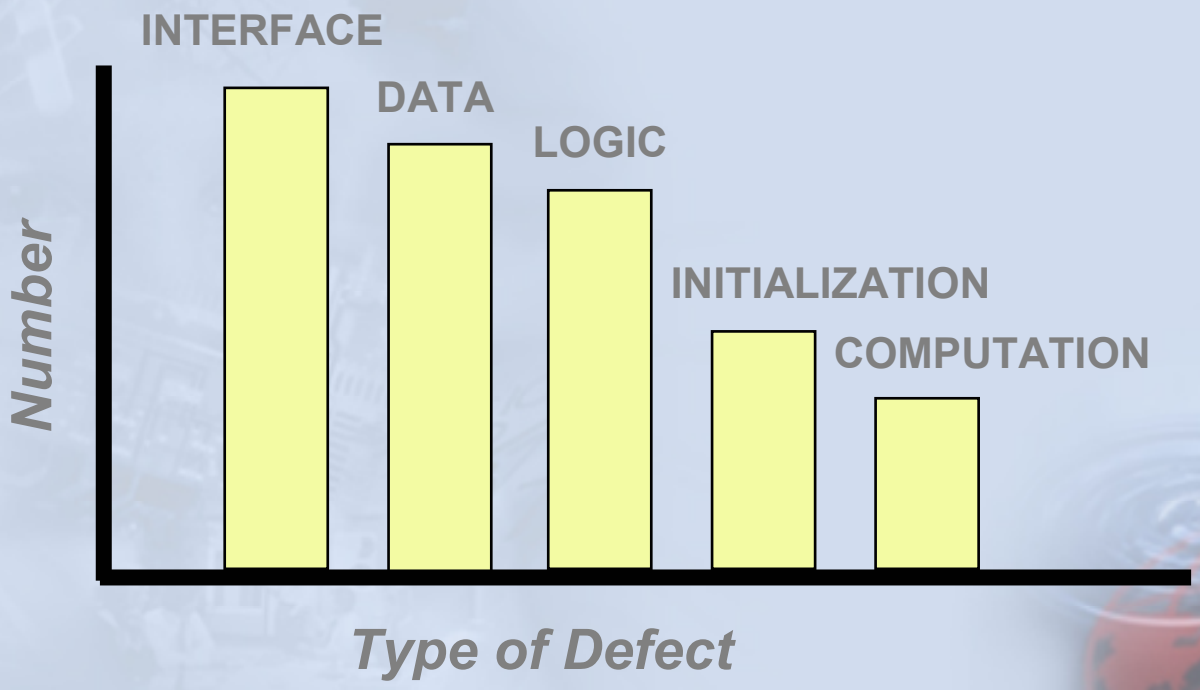
Defect Classifications

- Meaningful classifications are essential to identify trends and “systematic errors”
- Most common dimensions include:
  - when inserted (activity)
  - when found (activity)
  - type of error made
- Type of error may be specific to the work product or phase
- Classifications are intended as a tool for gaining insight
  - May require customization to problem domain
  - Must be understandable to engineers

"Ideal" Attributes of Classifications

- Orthogonal Dimensions
- Mutually Exclusive Categories within a Dimensions
- Objective Criteria for Assigning Categories
- Sensitivity to Behavior – changes in behavior result in changes in meaures

Example Pareto Chart



NASA Software Engineering Laboratory Classification

Causal Analysis Process

- Causal analysis assumed to be “intuitive”
- Processes, procedures, and tools often minimal
- Insufficient emphasis on ensuring that the right people participate
- CMM/CMMI-required “structure” added later

Relationship to CMM

- Level 4 — Defect Causal Analysis
  - May be ad hoc, bad habit!
  - Performed in response to *out of control* situations
- Level 5 — Defect Prevention
  - A Key Process Area (KPA) of CMM
  - Systematic approach required for DCA – "in accordance with a documented procedure"
  - Performed even when process is *in control*
  - Additional planning and feedback requirements

DP Planning

- Based on results of process performance analysis provided by (Quantitative Process Management (QPM), Software Quality Management (SQM), Process Change Management (PCM) activities
- Defines
  - Focus of DP activities (e.g., problem area)
  - Charter, composition, roles, and responsibilities of defect causal analysis team(s)
  - Charter, composition, roles, and responsibility of action team(s)
  - Schedules for phase kickoff meetings
- May not address all project activities and products

Phase Kickoff Meeting

- Provides regular feedback from DCA sessions
- Entire project staff participates
- Typical topics
  - Lessons learned (Dos and Don’ts) from previous projects and builds
  - Defect causal analysis and other process improvement activities to be conducted
  - Goals and objectives for this phase
  - Changes to methods and tools for this phase

Causal Analysis and Resolution

- CMMI Process Area at Level 5
- Differences from CMM DP
  - Phase Kick-off Meetings not addressed
  - Planning requirements relaxed (management versus technical plan)
  - Scope broadened to include all types of anomalies, not just defects
- DP provides the more challenging set of requirements

Relationship to Six Sigma

- Many causal analysis techniques provided in typical Six Sigma training programs (e.g, Error Modes and Effects Analysis)
- Defect prevention planning and team-based approach to DCA (CMM requirements) usually are not explicit elements of Six Sigma
- DP in the SW-CMM, and CAR in the CMMI, assume processes are defined; the need to define processes prior to DCA increases the time and effort required

Opportunity – IEEE 1044

- IEEE Standard 1044 – Classification of Software Anomalies (1995)
- Working group established to revise this standard
- Goals of revision
  - Incorporate current concepts
    - Inspection defects
    - Orthogonal defect classification
    - Defect causal analysis
    - CMMI, Six Sigma, etc.
  - Extend to defect prevention and improvement from just problem management
- Some face-to-face meetings, but most work to be accomplished off-line

Summary

- Regular and effective causal analysis is an essential element of any continuous improvement program
- Many concepts of causal analysis are misunderstood
- DP (CMM) and CAR (CMMI) requirements differ in some important ways
- Do causal analysis right – from the start!
  - Training
  - Good classifications
  - Systematic process

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- Consulting and Appraisals in Software Measurement, CMM/CMMI, ISO 9000, SPICE, etc.
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