GENERAL DYNAMICS
Land Systems

# Put Your Defect Data to Work:
## Using Process Performance Models and Root Cause & Corrective Action

Margaret Corr
Dawn Jaskolski
David Sobetski, PMP

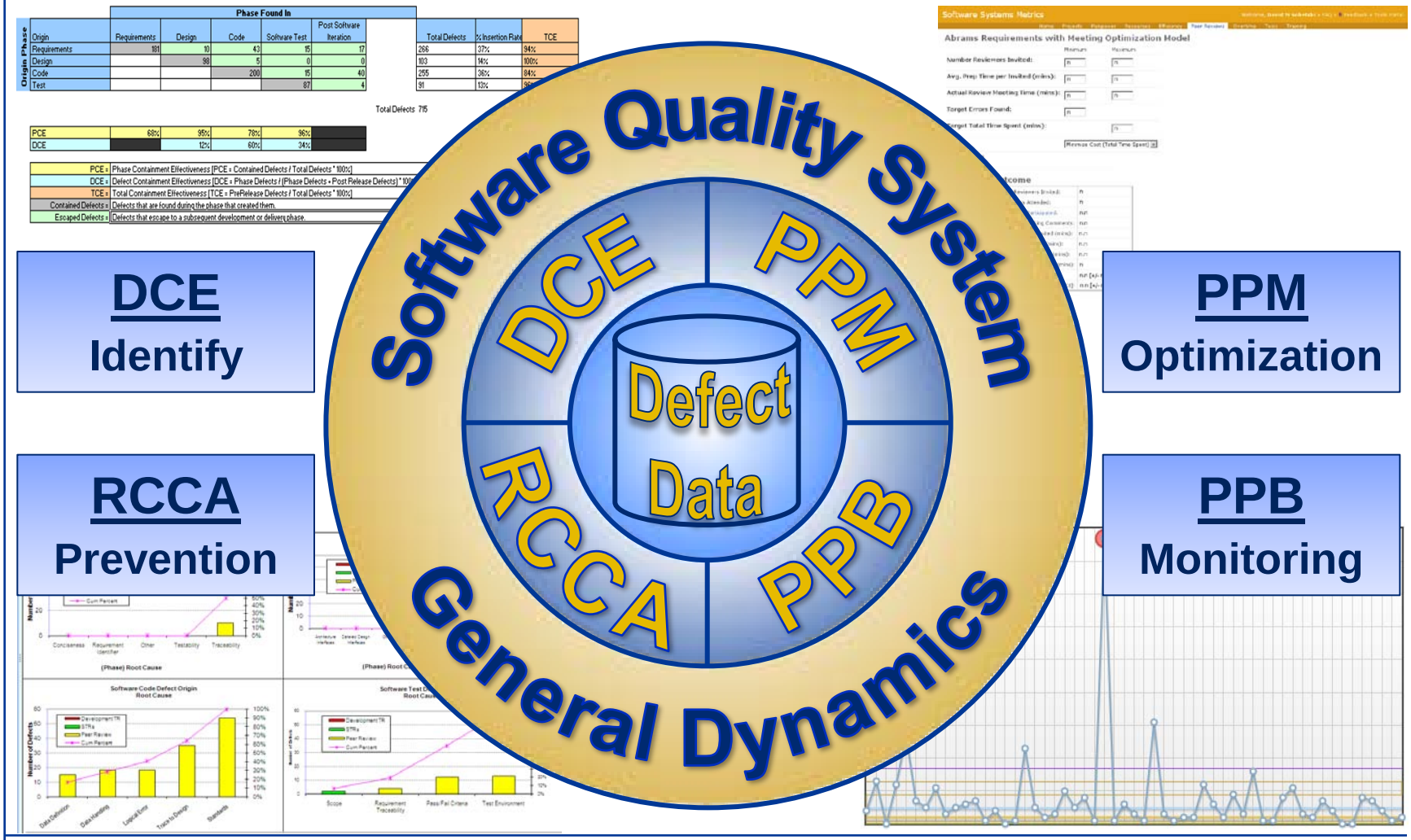
November 17, 2010

# Agenda

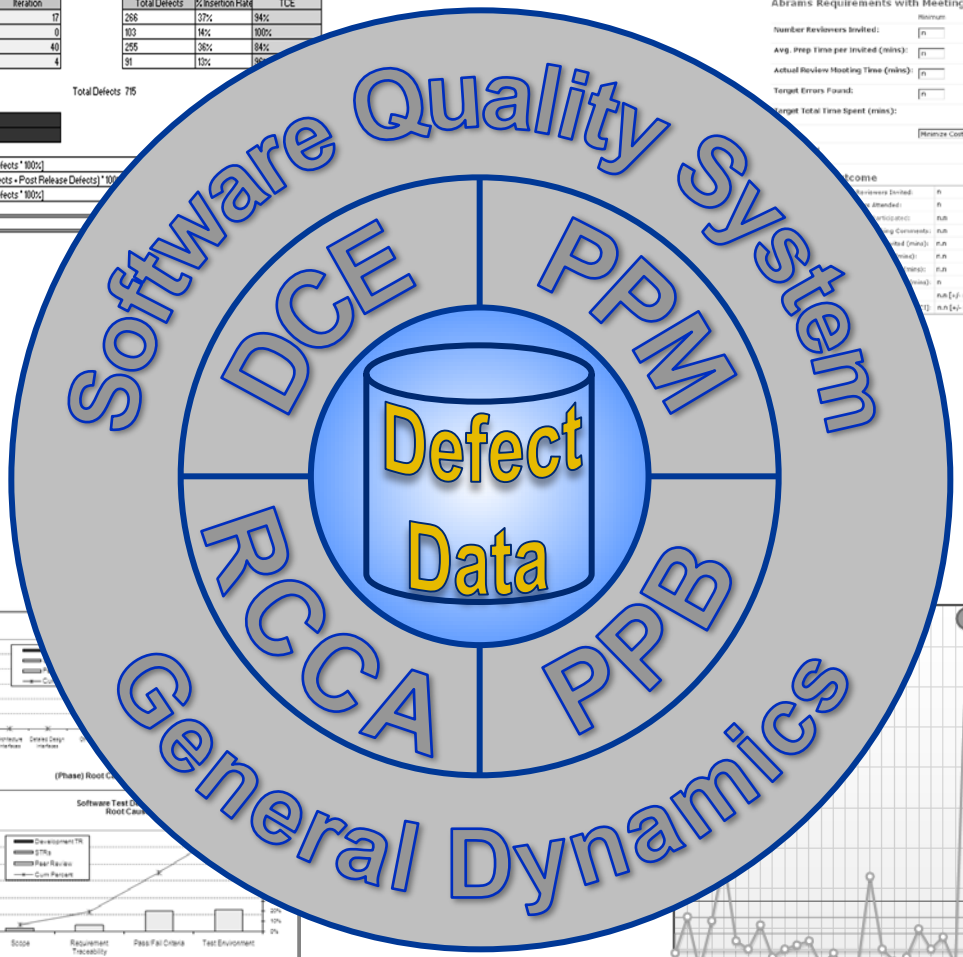
- GDLS Overview
- Software Quality System Overview
- Peer Review and Software Problem Reporting Tools
- Defect Containment Effectiveness Model (DCE)
- Process Performance Models (PPM)
- Process Performance Baselines (PPB)
- Root Cause and Corrective Action (RCCA)
- Benefits & Challenges

# Land Systems Products

# Software Quality System Overview



# Defect Data




**DCE**
Identify

**PPM**
Optimization

**RCCA**
Prevention

**PPB**
Monitoring

# Defect Data

- Defect Origin
- Root Cause
- Defect Severity
- Peer Review Data
- Software Problem Reporting Data

# Defect Origin and Root Cause

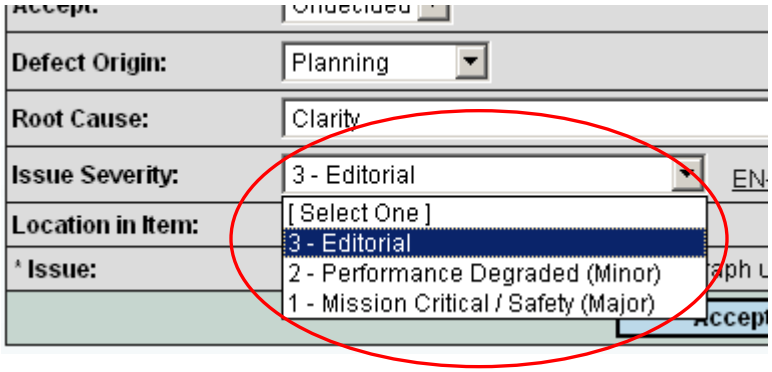
The Root Cause

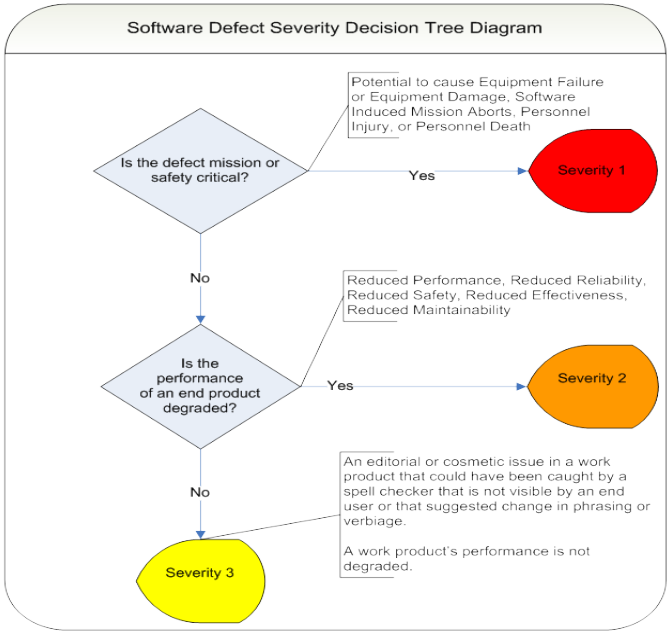
- Selection changes based upon the Defect Origin selected.
- Chosen based on what is determined to be the root cause of the problem and where it originated (Defect Origin).
- Not applicable for editorial issues.

| Issue Category (Defect Origin) | Root Cause |
|---|---|
| Planning | Clarity |
| | Completeness |
| | Scope Change Per Higher Level Documents |
| | Trace to Higher Level Documents |
| | |
| Requirements | Ambiguity |
| | Testability |
| | Traceability |
| | |
| Design | Architecture |
| | Detailed Design |
| | Interfaces |
| | Traceability |
| | |
| Code | Data Definition |
| | Data Handling |
| | Initialization |
| | Logical Error |
| | Standards |
| | Trace to Design |
| | |
| Test | Pass/Fail Criteria |
| | Requirement Traceability |
| | Test Environment |
| | Scope |

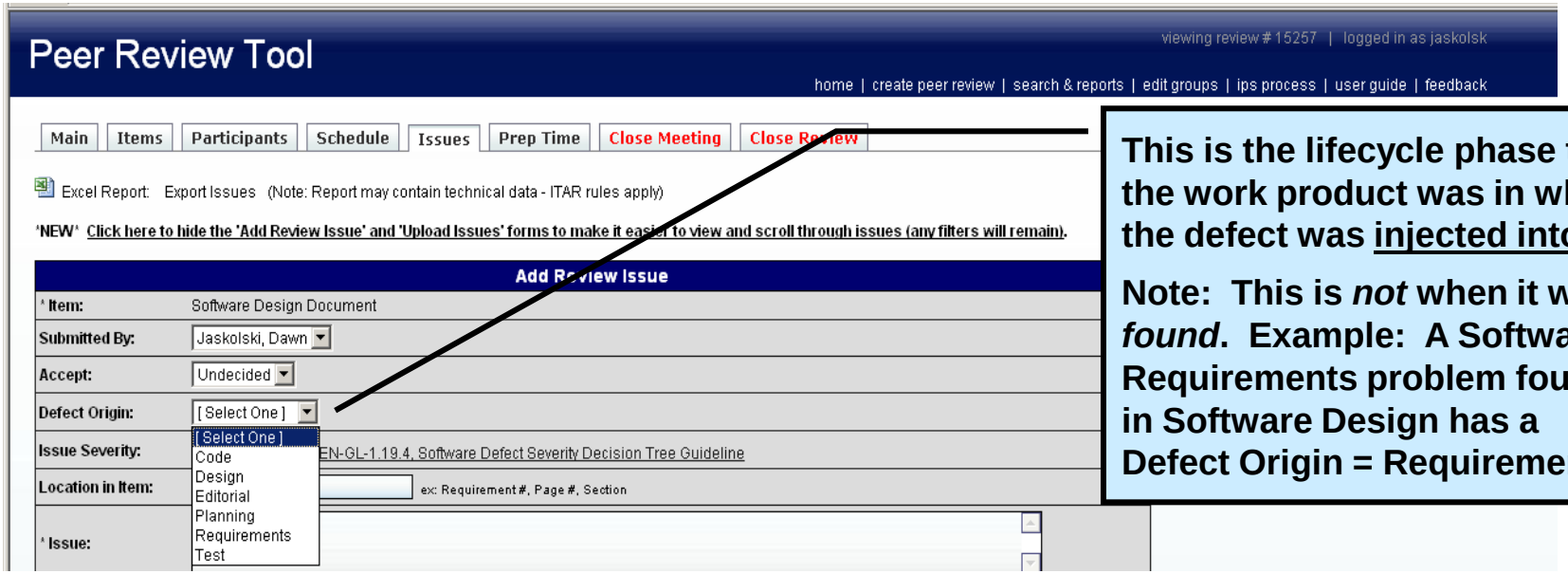
# Defect Severity

- It is important to categorize the severity of the issue correctly. This categorization helps the project and organization identify where process, tool, and training improvements are needed.
- Major and Minor issues, Severity 1 and 2 respectively, are considered technical defects that generally require further analysis and prevention measures.
- Editorial issues, Severity 3, are considered non-technical defect and are not used in the generation of project defect prevention metrics.



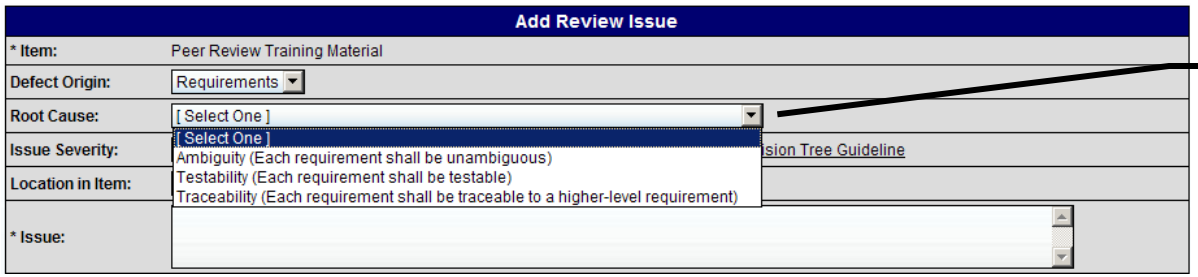



# Peer Review Tool




**This is the lifecycle phase that the work product was in when the defect was injected into it.**

**Note: This is *not* when it was *found*. Example: A Software Requirements problem found in Software Design has a Defect Origin = Requirements.**



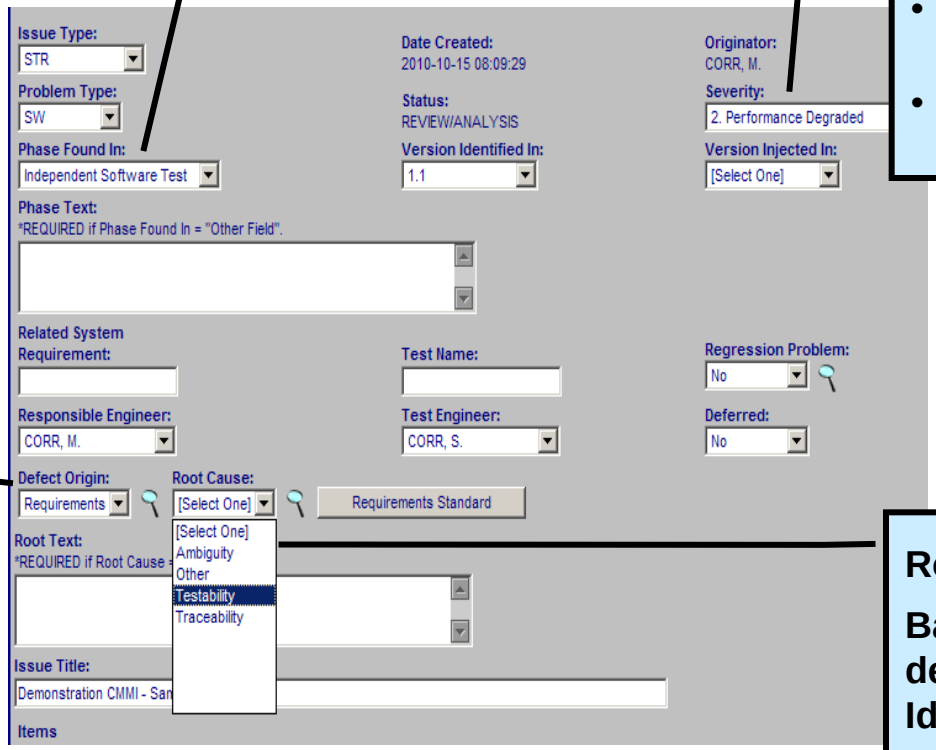

**Root Cause**

- **Dependent on the selected Defect Origin**

# Software Problem Reporting Tool

**Phase Found In**

**This is the lifecycle phase that the work product was in when the defect was identified or found**




**Severity**

- **Safety/Mission Critical**
- **Performance Degraded**
- **Performance NOT Degraded**

**Defect Origin**

**This is the lifecycle phase that the work product was in when the defect was injected into it**

**Root Cause**

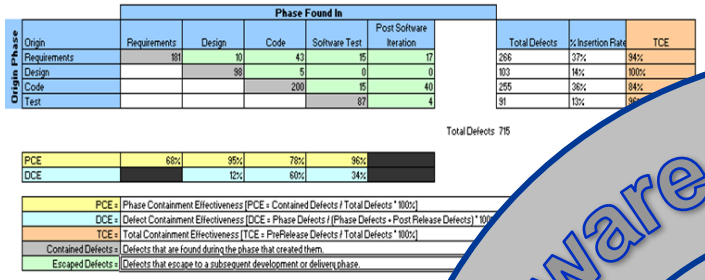
**Based on the defect origin. Identifies the root cause of the defect**

# Defect Data – Benefits and Challenges

- Benefits:
  - Automation
    - Tools enforce a more consistent process
    - Simpler data collection
    - Real-time metrics
  - Consistent data between the Peer Review and Problem Reporting Tools
  - Guidelines and Help linked into the tools for easy access

- Challenges:
  - Data Integrity
    - Consistently identifying defect severities between technical and editorial
    - Size data is often entered incorrectly
    - Root cause data is often inconsistent
  - Identifying definitions for root causes
  - Educating employees on definitions

# Defect Containment Effectiveness (DCE) Model



| Origin Phase | Phase Found In: Requirements | Design | Code | Software Test | Post Software Iteration | Total Defects | % Insertion Rate | TCE |
|---|---|---|---|---|---|---|---|---|
| Requirements | 181 | 10 | 43 | 15 | 17 | 266 | 37% | 94% |
| Design | | 98 | 5 | 0 | 0 | 103 | 14% | 100% |
| Code | | | 200 | 15 | 40 | 255 | 36% | 84% |
| Test | | | | 87 | 4 | 91 | 13% | |

Total Defects 715

| | | | | | |
|---|---|---|---|---|---|
| PCE | 68% | 95% | 78% | 96% | |
| DCE | | 12% | 60% | 34% | |

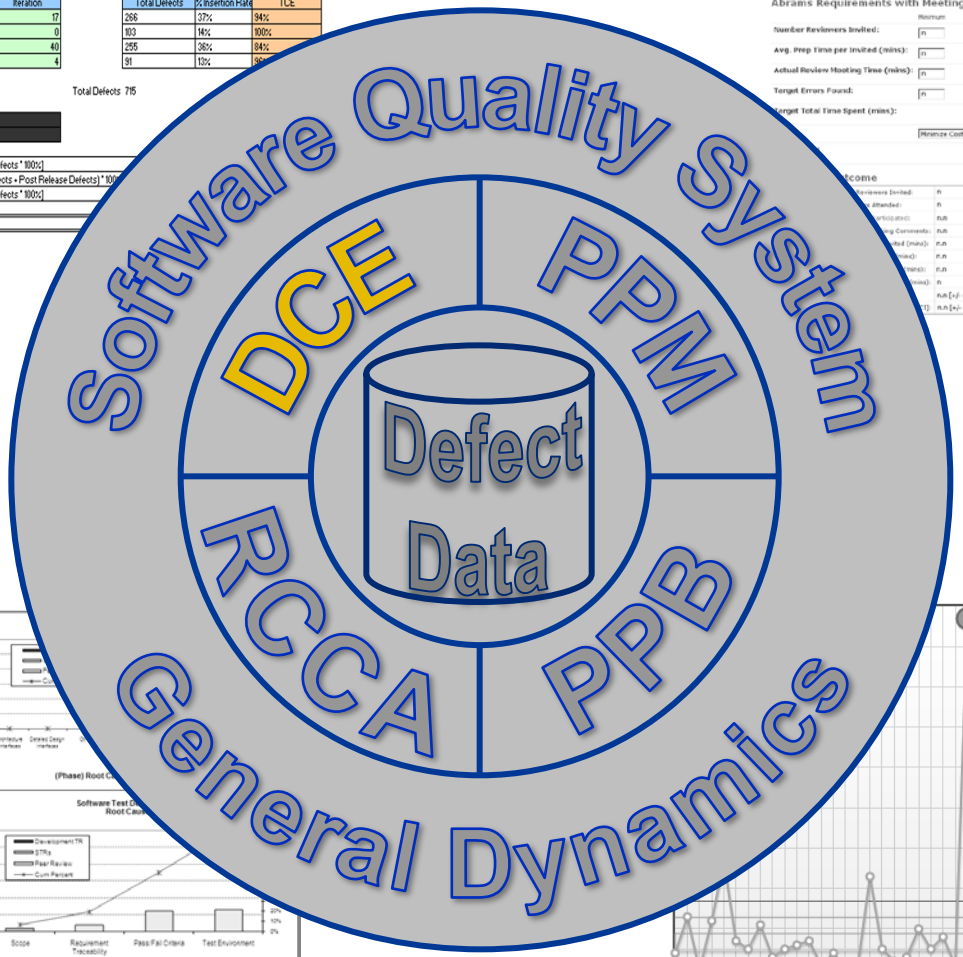
PCE = Phase Containment Effectiveness [PCE = Contained Defects / Total Defects * 100%]
DCE = Defect Containment Effectiveness [DCE = Phase Defects / (Phase Defects + Post Release Defects) * 100%]
TCE = Total Containment Effectiveness [TCE = PreRelease Defects / Total Defects * 100%]
Contained Defects = Defects that are found during the phase that created them.
Escaped Defects = Defects that escape to a subsequent development or delivery phase.

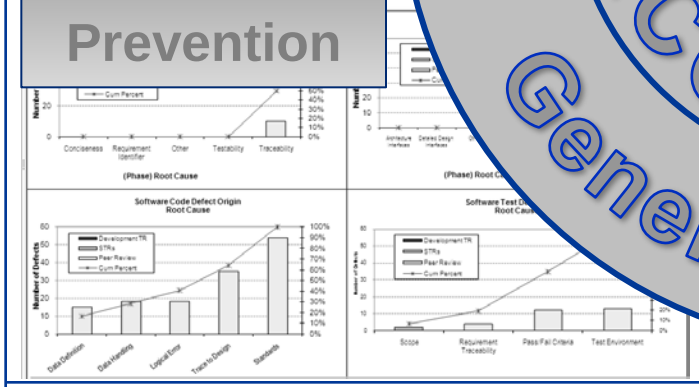

**DCE**
**Identify**

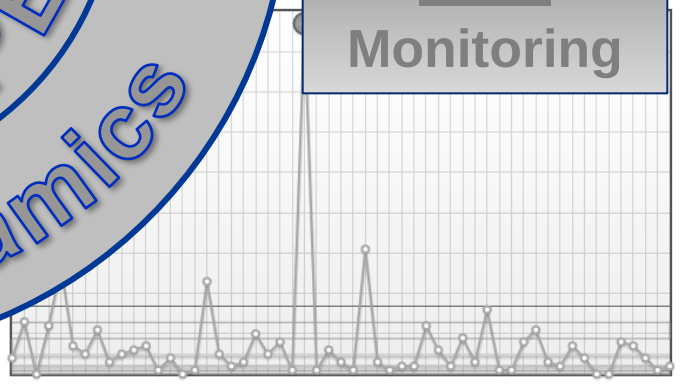
**PPM**
**Optimization**

**RCCA**
**Prevention**

**PPB**
**Monitoring**



# DCE Model - Introduction and Definitions

Software Defect Prevention
Containment Effectiveness Model

| Origin Phase | Origin | Phase Found In: Requirements | Design | Code | Software Test | Post Software Iteration | Total Defects | % Insertion Rate | TCE |
|---|---|---|---|---|---|---|---|---|---|
| | Requirements | 181 | 10 | 43 | 15 | 17 | 266 | 37% | 94% |
| | Design | | 98 | 5 | 0 | 0 | 103 | 14% | 100% |
| | Code | | | 200 | 15 | 40 | 255 | 36% | 84% |
| | Test | | | | 87 | 4 | 91 | 13% | 96% |

Total Defects 715

| | | | | | |
|---|---|---|---|---|---|
| PCE | 68% | 95% | 78% | 96% | |
| DCE | | 12% | 60% | 34% | |

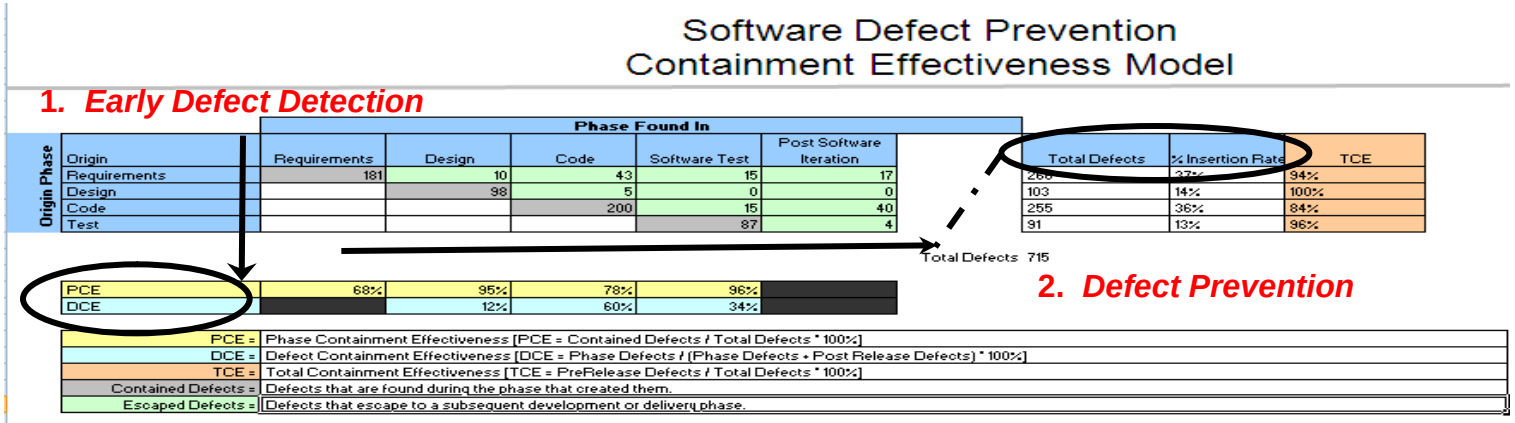
| | |
|---|---|
| PCE = | Phase Containment Effectiveness [PCE = Contained Defects / Total Defects * 100%] |
| DCE = | Defect Containment Effectiveness [DCE = Phase Defects / (Phase Defects + Post Release Defects) * 100%] |
| TCE = | Total Containment Effectiveness [TCE = PreRelease Defects / Total Defects * 100%] |
| Contained Defects = | Defects that are found during the phase that created them. |
| Escaped Defects = | Defects that escape to a subsequent development or delivery phase. |

*THIS IS SAMPLE DATA

- **Phase Containment Effectiveness (PCE):** tracks the ability of each phase to find defects before they escape that phase
- **Defect Containment Effectiveness (DCE):** tracks the ability of each phase to find defects passed to it by upstream phases
- **Total Containment Effectiveness (TCE):** tracks the ability of the project to find defects before they are released (post-release)

- Source data is Major and Minor defects collected from the peer review database and problem reporting database
- **Phase Defects**: The defects that were found in a specified software development lifecycle phase
- **Post Release Defects**: The defects that were found in a phase outside of the software development lifecycle phase
- **PreRelease Defects**: Defects that were found in a software development lifecycle phase in the current software version

# DCE Model - Goals




*THIS IS SAMPLE DATA

## Goals of the Model:

1. Early Defect Detection
   - Increase the number of defects found within the phase they originated in
     - Phase Containment Effectiveness (PCE)
   - Reduce the number of defects escaping to later development phases
     - Defect Containment Effectiveness (DCE)
2. Defect Prevention
   - Reduce total number of defects originating within a specific phase
     - Total Defects
     - % Insertion Rate

# DCE Model - Usage

When Used:

- Data collection and analysis occurs after a software release

Used For:

- Identifying organizational process and technology improvement needs
- Planning of subsequent product release(s)
  - Consider if a significant number of defects are detected in any particular life cycle phase
  - Ensure common causes of defects within a phase or phases have been identified and actions to further investigate causes of defects are assigned and tracked to completion
  - Understand the implications of not addressing the common causes of defects
  - Ensure implementation of preventive corrective actions (e.g. notify developers of common defects, increase focus on suspect or problem areas)

# DCE Model – Analysis Examples

Software Defect Prevention
Containment Effectiveness Model

| Origin Phase | Origin | Phase Found In: Requirements | Design | Code | Software Test | Post Software Iteration | Total Defects | % Insertion Rate | TCE |
|---|---|---|---|---|---|---|---|---|---|
| | Requirements | 181 | 10 | 43 | 15 | 17 | 266 | 37% | 94% |
| | Design | | 98 | 5 | 0 | 0 | 103 | 14% | 100% |
| | Code | | | 200 | 15 | 40 | 255 | 36% | 84% |
| | Test | | | | 87 | 4 | 91 | 13% | 96% |

Total Defects 715

| | | | | | |
|---|---|---|---|---|---|
| PCE | 68% | 95% | 78% | 96% | |
| DCE | | 12% | 60% | 34% | |

| | |
|---|---|
| PCE = | Phase Containment Effectiveness [PCE = Contained Defects / Total Defects * 100%] |
| DCE = | Defect Containment Effectiveness [DCE = Phase Defects / (Phase Defects + Post Release Defects) * 100%] |
| TCE = | Total Containment Effectiveness [TCE = PreRelease Defects / Total Defects * 100%] |
| Contained Defects = | Defects that are found during the phase that created them. |
| Escaped Defects = | Defects that escape to a subsequent development or delivery phase. |

***THIS IS SAMPLE DATA**

Is the number of post release defects significantly higher than expected?

Is the number of post release defects significantly lower than expected?

What is the phase with the lowest PCE percentage? Consider how early in the life cycle this phase is.

How does the PCE, DCE and TCE compare to the last release or other projects?

# Defect Containment Effectiveness Model Considerations for Analysis

Software Defect Prevention
Containment Effectiveness Model

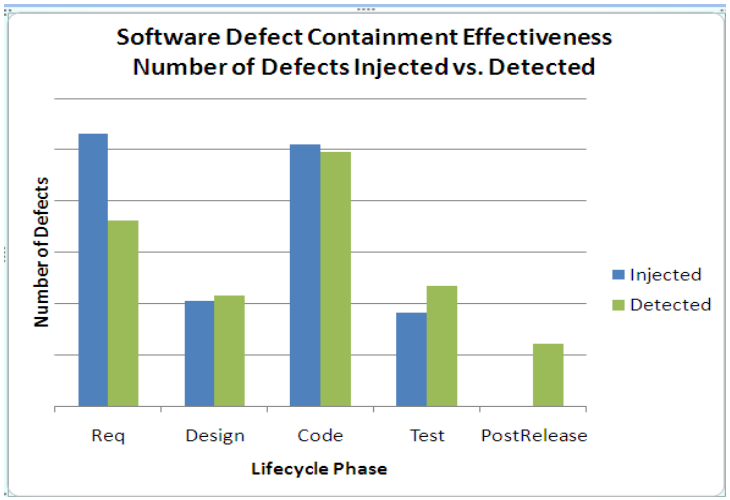
| Origin Phase | Origin | Phase Found In: Requirements | Design | Code | Software Test | Post Software Iteration | Total Defects | % Insertion Rate | TCE |
|---|---|---|---|---|---|---|---|---|---|
| | Requirements | 181 | 10 | 43 | 15 | 17 | 266 | 37% | 94% |
| | Design | | 88 | 5 | 0 | 0 | 103 | 14% | 100% |
| | Code | | | 200 | 15 | 40 | 255 | 36% | 84% |
| | Test | | | | 87 | 4 | 91 | 13% | 96% |

Total Defects 715

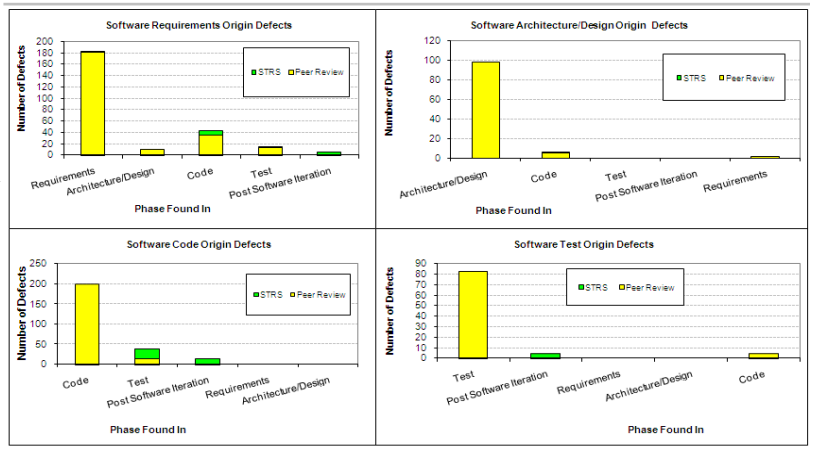
| | | | | | |
|---|---|---|---|---|---|
| PCE | 68% | 95% | 78% | 96% | |
| DCE | | 12% | 60% | 34% | |

PCE = Phase Containment Effectiveness [PCE = Contained Defects / Total Defects * 100%]
DCE = Defect Containment Effectiveness [DCE = Phase Defects / (Phase Defects + Post Release Defects) * 100%]
TCE = Total Containment Effectiveness [TCE = PreRelease Defects / Total Defects * 100%]
Contained Defects = Defects that are found during the phase that created them.
Escaped Defects = Defects that escape to a subsequent development or delivery phase.

*THIS IS SAMPLE DATA

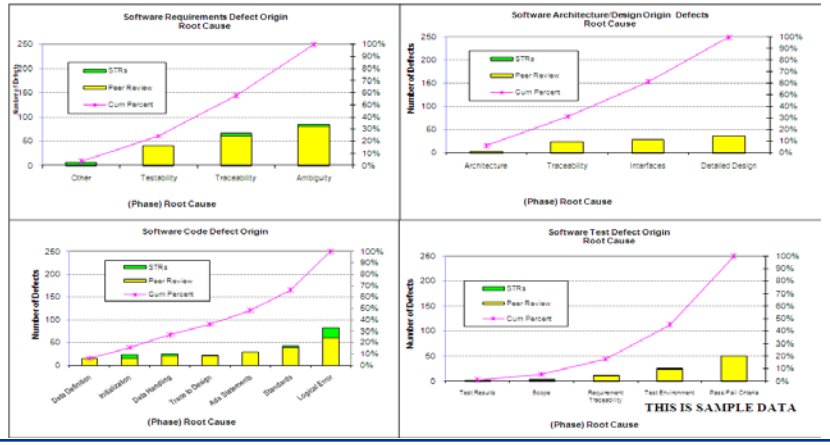



Software Defect Prevention
Escaped Defects by Origin




THIS IS SAMPLE DATA

Software Defect Prevention
Root Cause by Origin



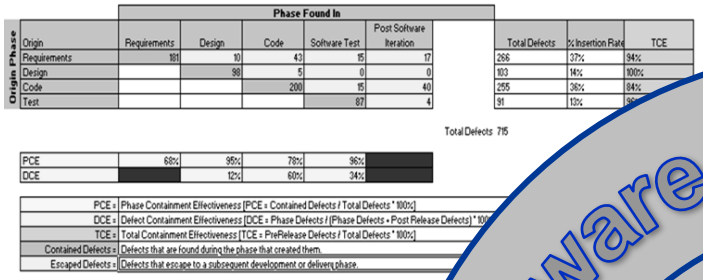

THIS IS SAMPLE DATA

# DCE Model – Benefits and Challenges

- Benefits
  - One model that can be used as a basis of identifying areas for both early defect detection and defect prevention
  - Provides an overall view of a project's quality with many ways to slice and dice the data
  - Similar project data can be rolled up as appropriate

- Challenges
  - The model can be complex to understand, so time is needed to educate users
  - Formula variables need to be well defined and understood before generating the model
  - Shows the macro view of defects, so a change in the model cannot directly be linked to a specific improvement
    - Not measuring a sub-process

# Process Performance Models (PPM)

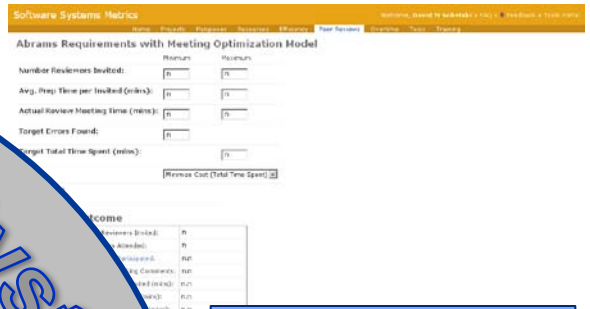


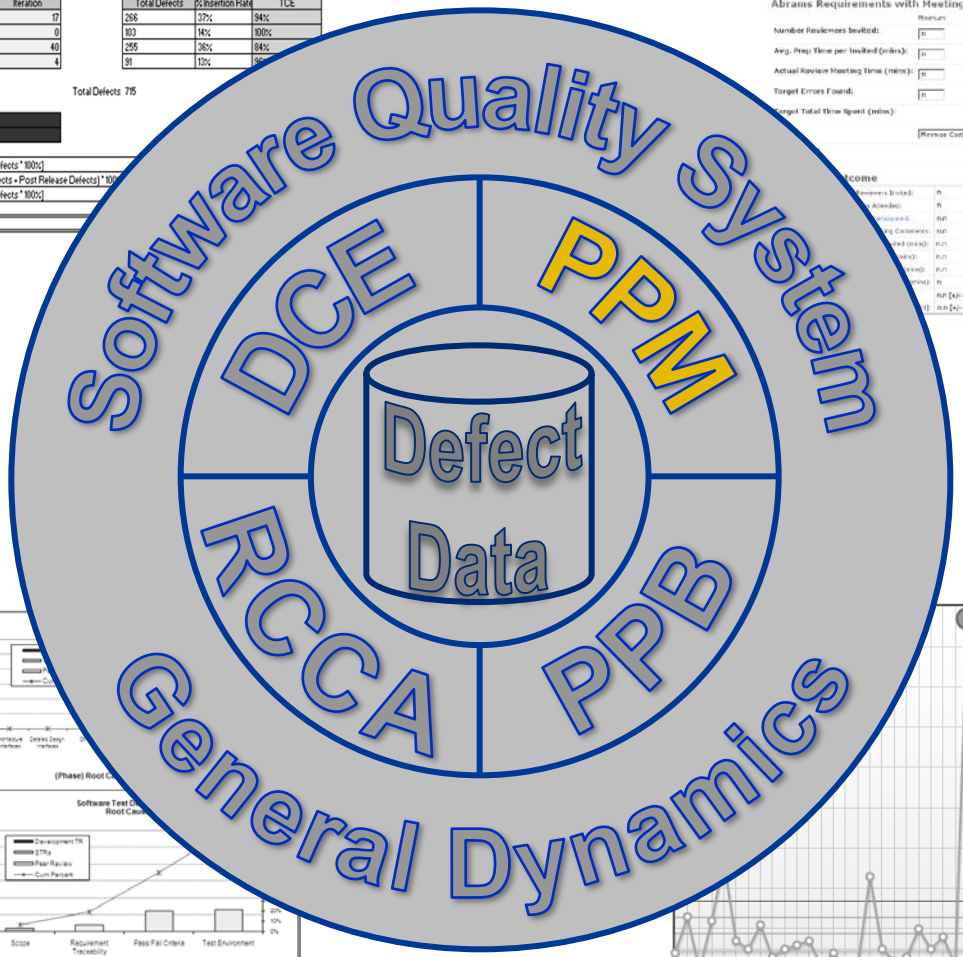
| Origin | Requirements | Design | Code | Software Test | Post Software Iteration | Total Defects | % Insertion Rate | TCE |
|---|---|---|---|---|---|---|---|---|
| Requirements | 181 | 10 | 43 | 15 | 17 | 266 | 37% | 94% |
| Design | | 98 | 5 | 0 | 0 | 103 | 14% | 100% |
| Code | | | 200 | 15 | 40 | 255 | 36% | 84% |
| Test | | | | 87 | 4 | 91 | 13% | |

Total Defects 715

| | | | | | |
|---|---|---|---|---|---|
| PCE | 68% | 95% | 78% | 96% | |
| DCE | | 12% | 60% | 34% | |

| | |
|---|---|
| PCE = | Phase Containment Effectiveness [PCE = Contained Defects / Total Defects * 100%] |
| DCE = | Defect Containment Effectiveness [DCE = Phase Defects / (Phase Defects + Post Release Defects) * 100% |
| TCE = | Total Containment Effectiveness [TCE = PreRelease Defects / Total Defects * 100%] |
| Contained Defects = | Defects that are found during the phase that created them. |
| Escaped Defects = | Defects that escape to a subsequent development or delivery phase. |



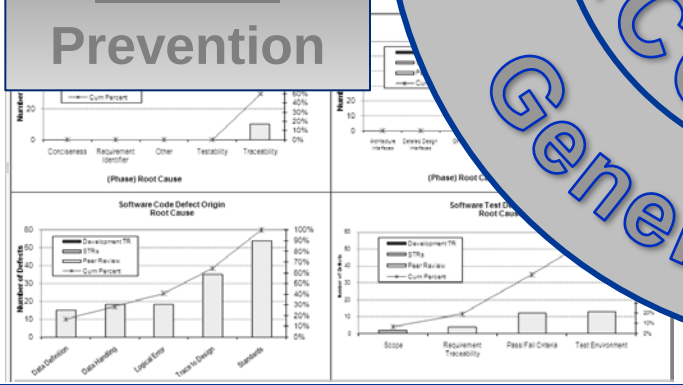



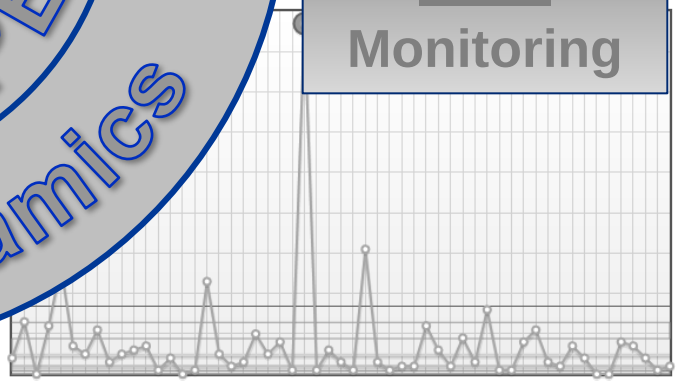

**DCE**
Identify

**PPM**
Optimization

**RCCA**
Prevention

**PPB**
Monitoring



# PPM – Early Defect Detection

## Software Defect Prevention
## Containment Effectiveness Model

| Origin Phase | Origin | Phase Found In: Requirements | Design | Code | Software Test | Post Software Iteration | Total Defects | % Insertion Rate | TCE |
|---|---|---|---|---|---|---|---|---|---|
| | Requirements | 181 | 10 | 43 | 15 | 17 | 266 | 37% | 94% |
| | Design | | 98 | 5 | 0 | 0 | 103 | 14% | 100% |
| | Code | | | 200 | 15 | 40 | 255 | 36% | 84% |
| | Test | | | | 87 | 4 | 91 | 13% | 96% |

Total Defects 715

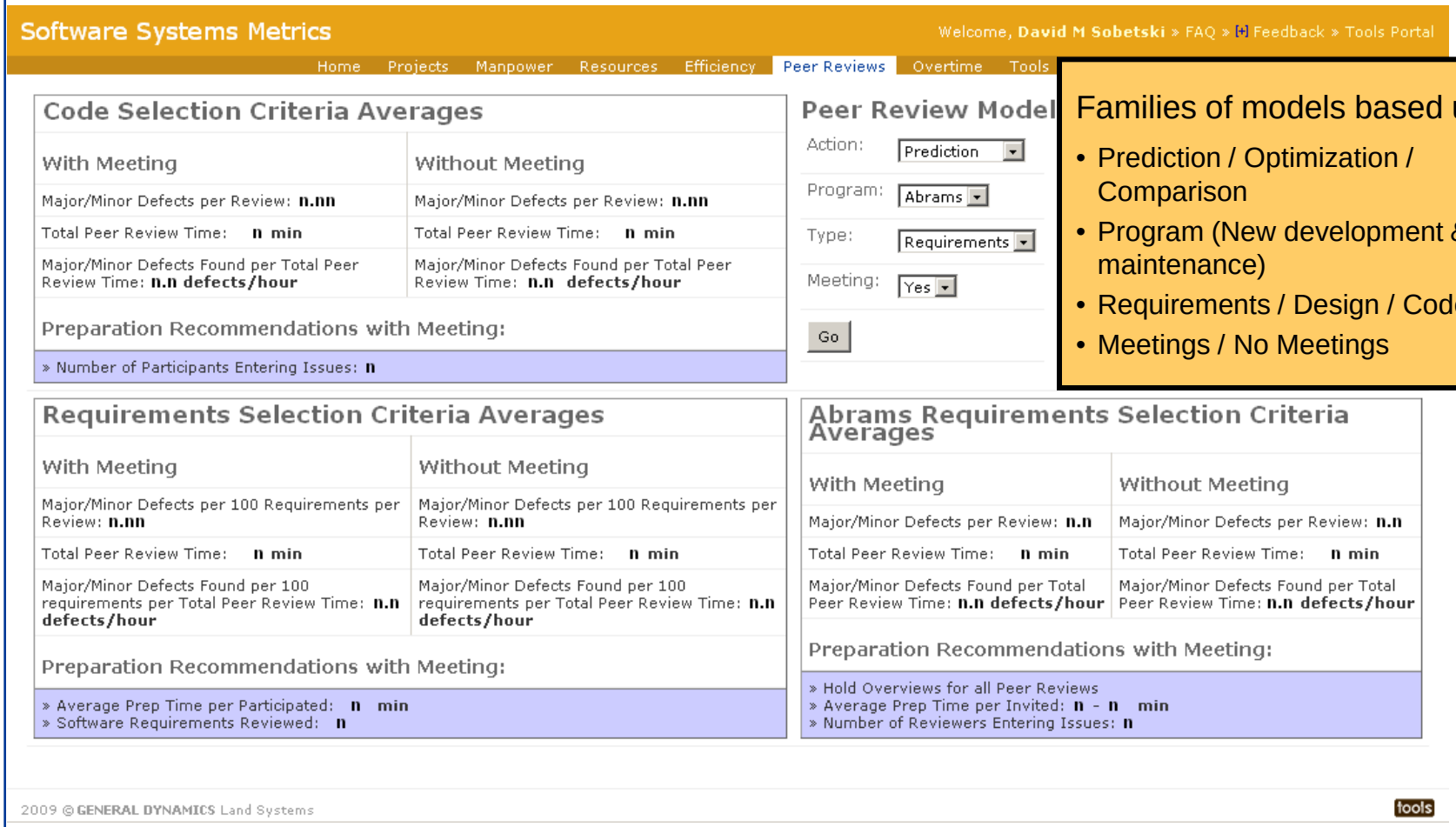
| | | | | | |
|---|---|---|---|---|---|
| PCE | 68% | 95% | 78% | 96% | |
| DCE | | 12% | 60% | 34% | |

| | |
|---|---|
| PCE = | Phase Containment Effectiveness [PCE = Contained Defects / Total Defects * 100%] |
| DCE = | Defect Containment Effectiveness [DCE = Phase Defects / (Phase Defects + Post Release Defects) * 100%] |
| TCE = | Total Containment Effectiveness [TCE = PreRelease Defects / Total Defects * 100%] |
| Contained Defects = | Defects that are found during the phase that created them. |
| Escaped Defects = | Defects that escape to a subsequent development or delivery phase. |

*THIS IS SAMPLE DATA

**Peer Review Process Performance Models were first created for Requirements in order to improve the Requirements PCE through Early Defect Detection**

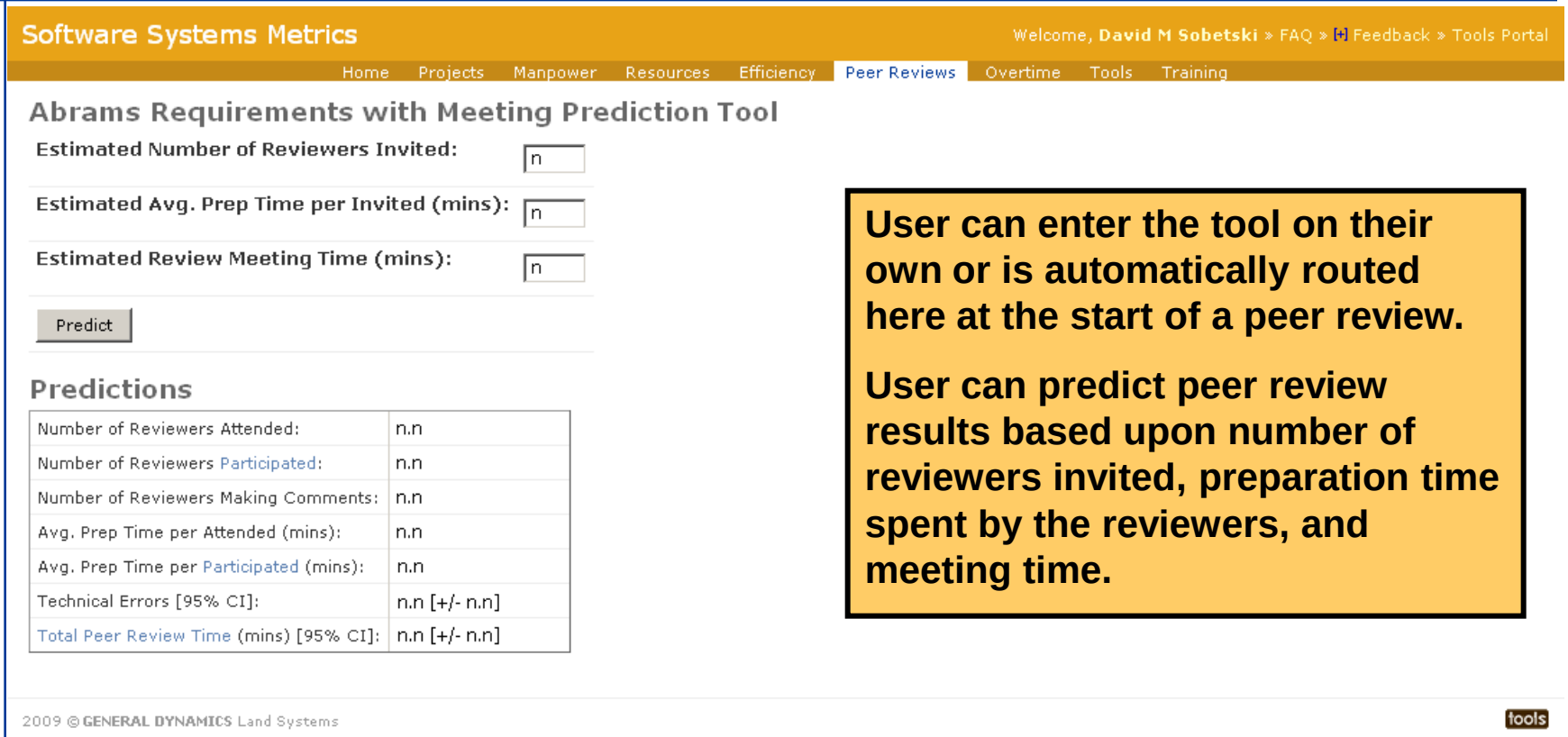
# Software Metrics Tool – PPM Main Page




Families of models based upon:

- Prediction / Optimization / Comparison
- Program (New development & maintenance)
- Requirements / Design / Code
- Meetings / No Meetings

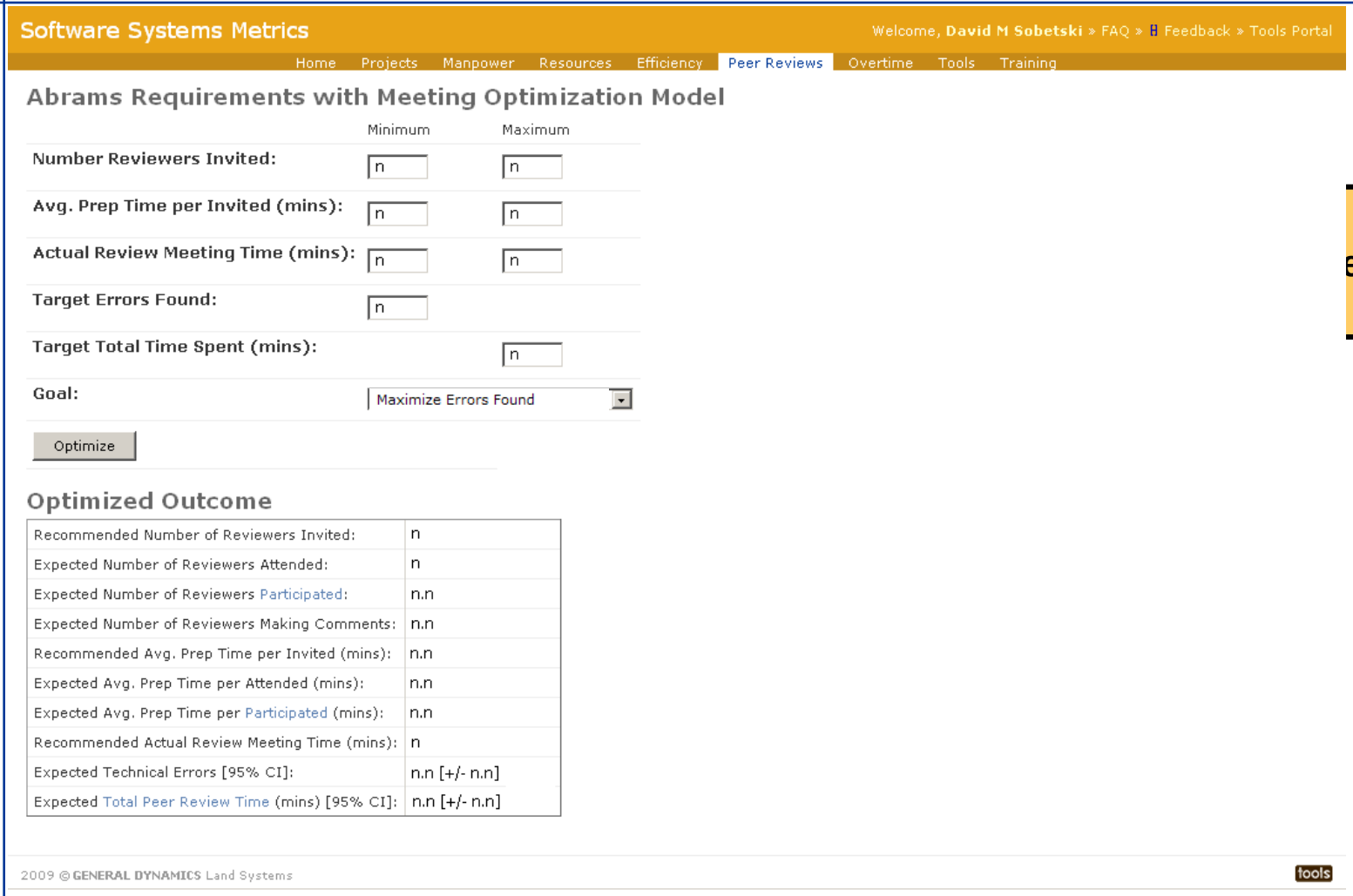
# PPM Tool – Prediction




**User can enter the tool on their own or is automatically routed here at the start of a peer review.**

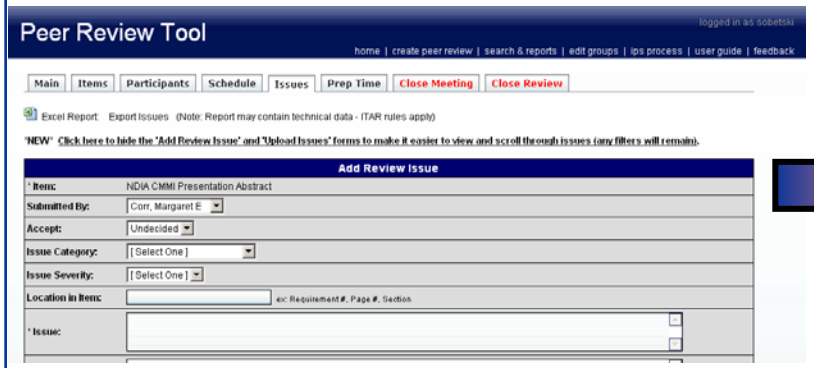
**User can predict peer review results based upon number of reviewers invited, preparation time spent by the reviewers, and meeting time.**

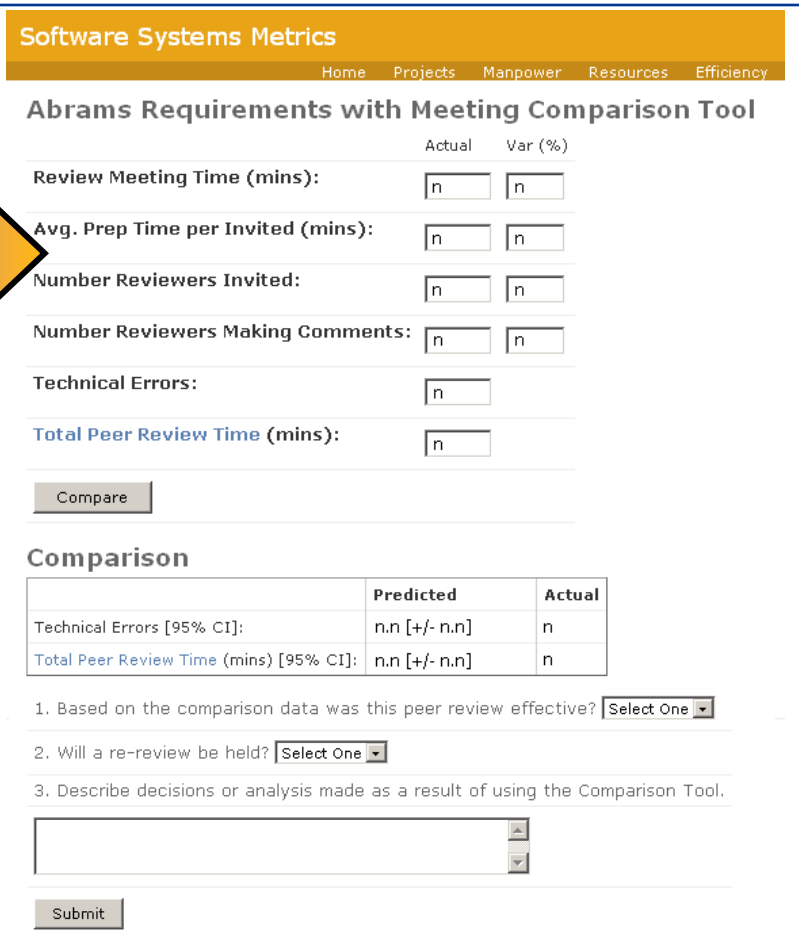
# PPM Tool – Optimize Time




e) of

# PPM Tool – Post Peer Review Comparison




**Users are directed at peer review closure from the Peer Review Tool to the Metrics Tool.**

**Data is automatically filled in for the user from the Peer Review Tool to determine if the review was within the baseline.**

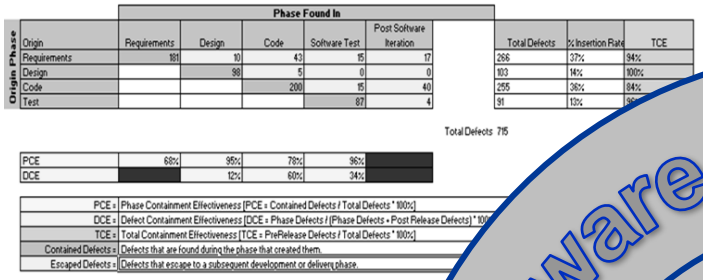
**Users are required to provide analysis information on their results.**

# PPM – Benefits and Challenges

- Benefits
  - Optimize resource utilization
  - Better able to predict future project performance
  - PPM improvements returned as high as 400% increase in technical defect detection
  - Exceeded our defect Phase Containment Effectiveness (PCE) goal of 90%.

- Challenges
  - PPM Model usage
    - Making it user-friendly and easily accessible
    - Documenting usage
  - Stakeholder buy-in
  - Keeping it from being personal, i.e. measuring the process & product and not the person performing the work
  - Ensuring data integrity in the models

# Process Performance Baselines (PPB)

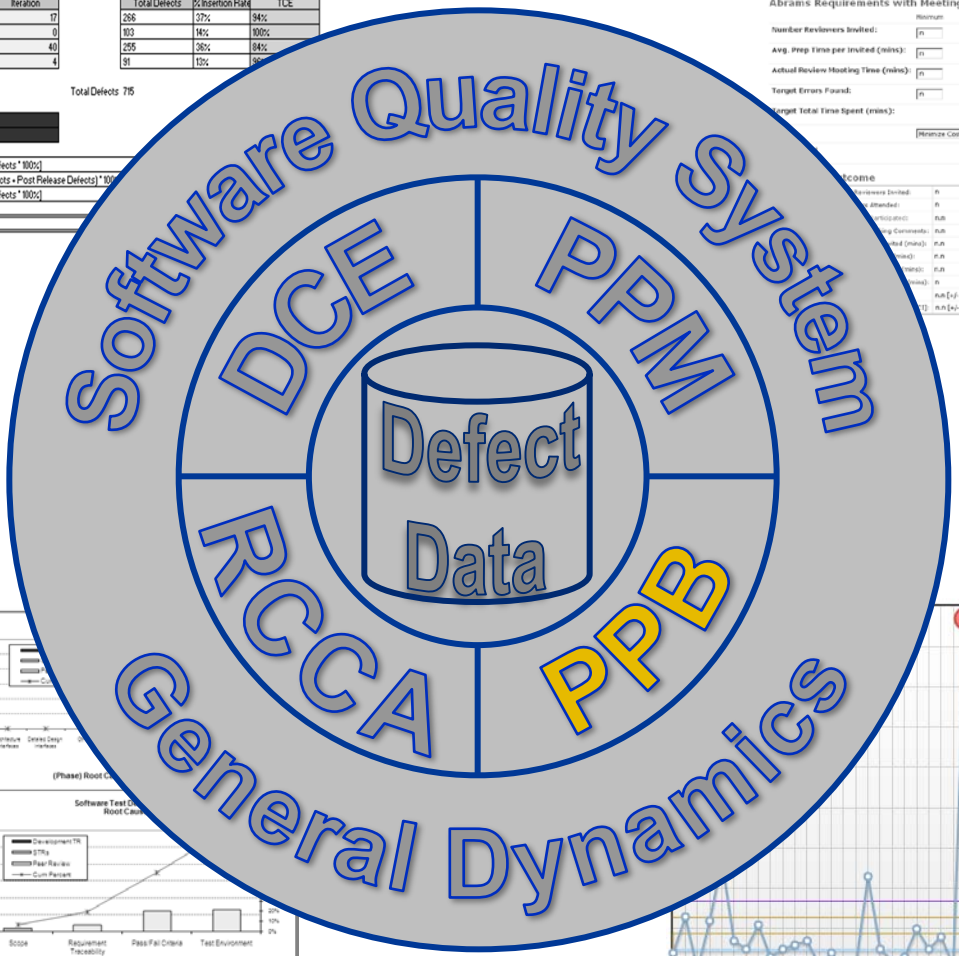


| Origin Phase | Phase Found In: Requirements | Design | Code | Software Test | Post Software Iteration | Total Defects | % Insertion Rate | TCE |
|---|---|---|---|---|---|---|---|---|
| Requirements | 181 | 10 | 43 | 15 | 17 | 266 | 37% | 94% |
| Design | | 98 | 5 | 0 | 0 | 103 | 14% | 100% |
| Code | | | 200 | 15 | 40 | 255 | 36% | 84% |
| Test | | | | 87 | 4 | 91 | 13% | |

Total Defects 715

| | | | | | |
|---|---|---|---|---|---|
| PCE | 68% | 95% | 78% | 96% | |
| DCE | | 12% | 60% | 34% | |

| | |
|---|---|
| PCE = | Phase Containment Effectiveness [PCE = Contained Defects / Total Defects * 100%] |
| DCE = | Defect Containment Effectiveness [DCE = Phase Defects / (Phase Defects + Post Release Defects)] * 100% |
| TCE = | Total Containment Effectiveness [TCE = PreRelease Defects / Total Defects * 100%] |
| Contained Defects = | Defects that are found during the phase that created them. |
| Escaped Defects = | Defects that escape to a subsequent development or delivery phase. |

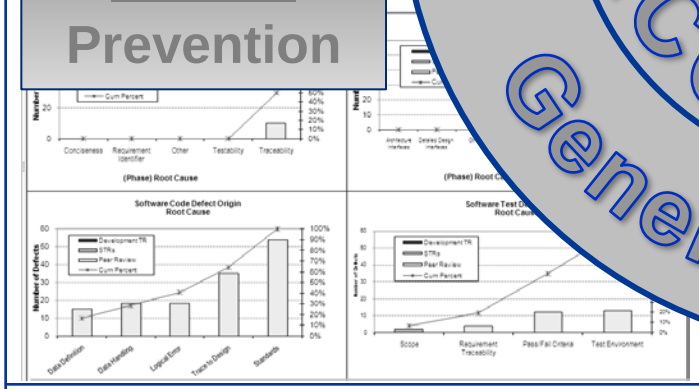



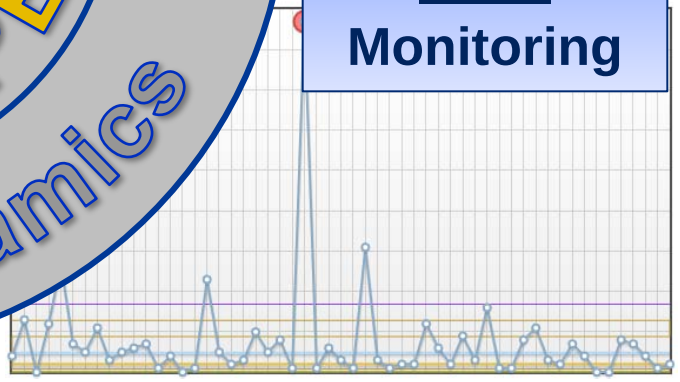

**DCE**
Identify

**PPM**
Optimization

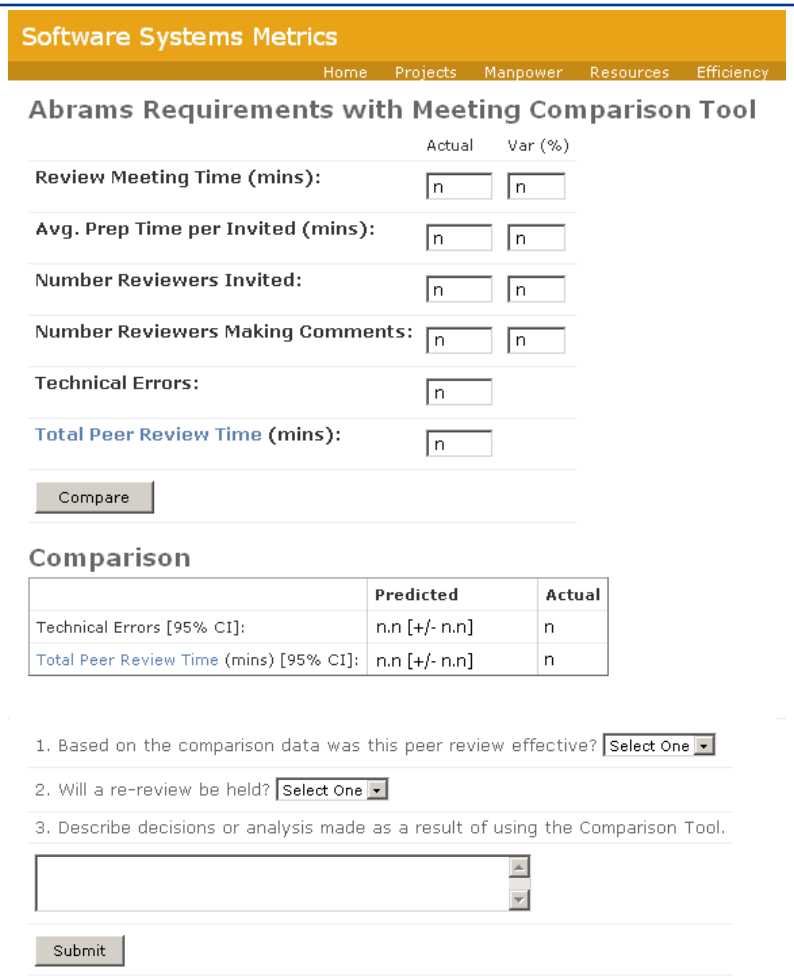
**RCCA**
Prevention

**PPB**
Monitoring



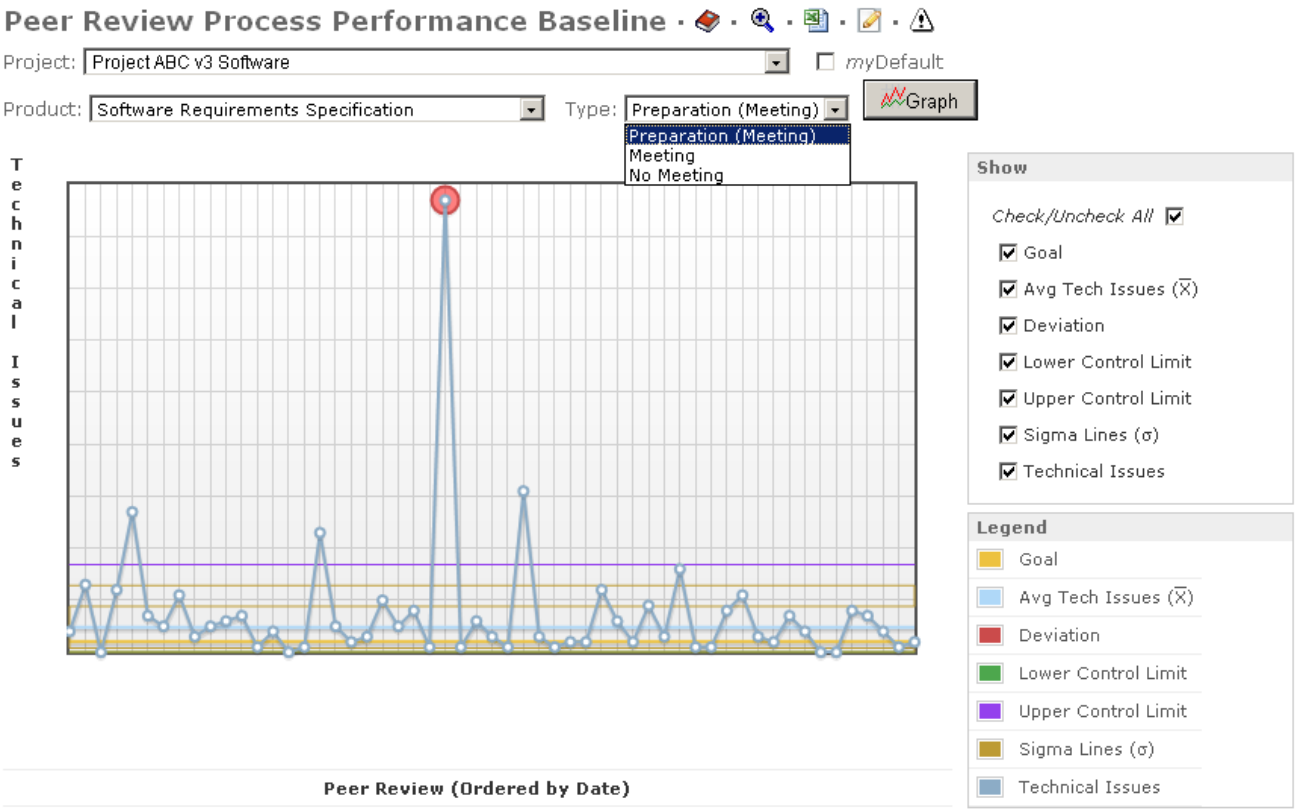
# Process Performance Baselines (PPBs) – Using PPM Tool Post Peer Review Comparison Analysis




**Data is automatically provided to the PPBs when the peer review is completed.**

**Users provide analysis information on their results. Special causes of variation can be identified and explained at the time the data was created.**

# PPBs – Automated Metrics

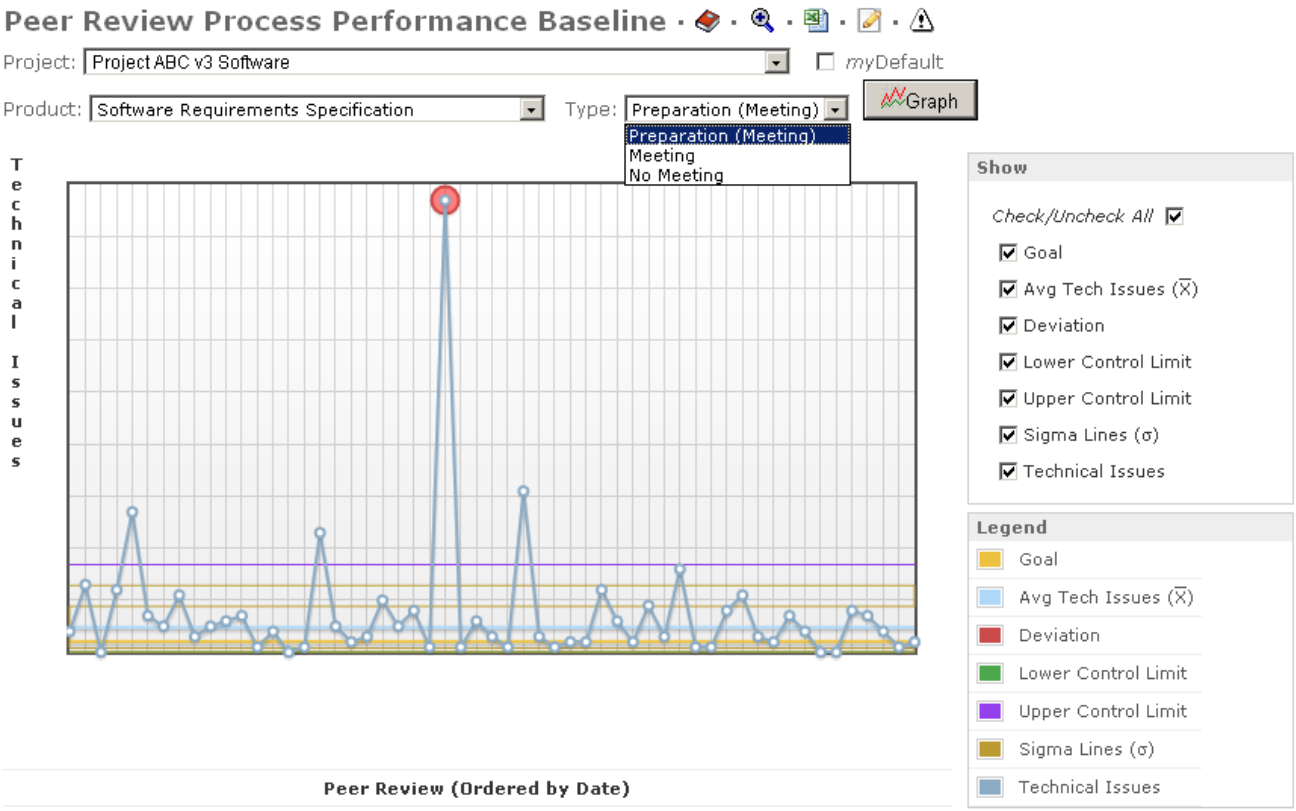



Statistical Process Control charts are generated live from Peer Review Data

User selects

- Project
- Work product type
- Meeting information
- Technical Defects or Cost (hours)
- Properties to display

# PPBs – Analysis




## Analysis

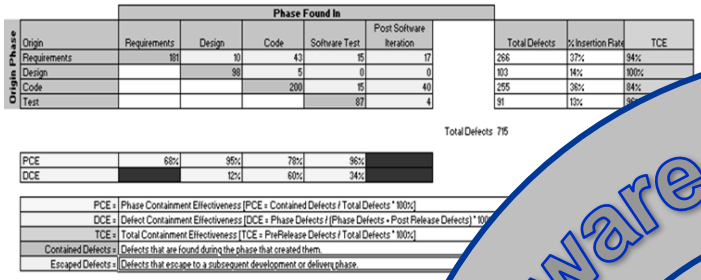
- Look for special cause variation
- Monitor for trends, shifts or drifts that may highlight process changes
- Determine if re-review should be performed

# PPBs – Benefits and Challenges

- Benefits
  - Peer reviews automatically feed PPBs
  - Control charts are automated to generate from live peer review data
  - Process is monitored to ensure process is performing as expected
  - Quickly deal with process deviations
  - Special causes of variation can be identified and documented as they occur

- Challenges
  - Educating employees on the use of the PPBs
  - Determining when to set new process baselines
  - Determining where to segregate the data
  - Ensuring data integrity
  - Upkeep of statistical data (UCL, Mean, Std Dev)

# Root Cause & Corrective Actions

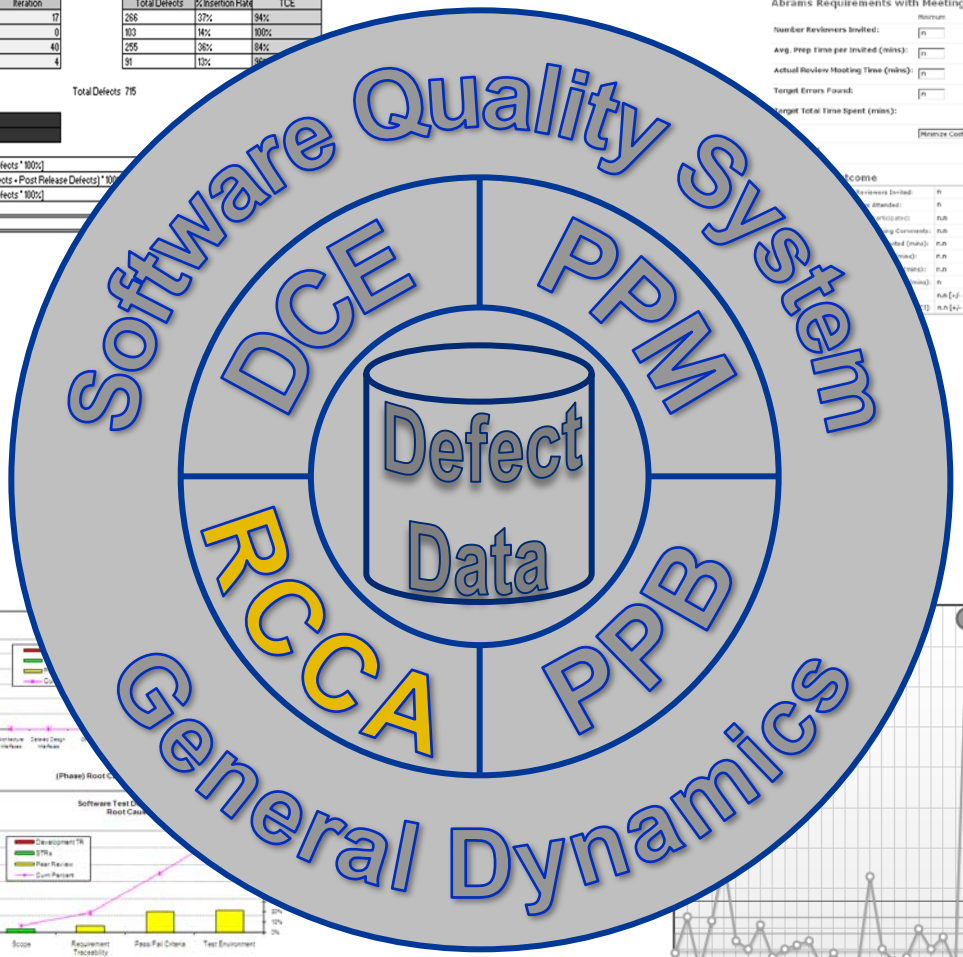


| Origin Phase | Phase Found In: Requirements | Design | Code | Software Test | Post Software Iteration | Total Defects | % Insertion Rate | TCE |
|---|---|---|---|---|---|---|---|---|
| Requirements | 181 | 10 | 43 | 15 | 17 | 266 | 37% | 94% |
| Design | | 98 | 5 | 0 | 0 | 103 | 14% | 100% |
| Code | | | 200 | 15 | 40 | 255 | 36% | 84% |
| Test | | | | 87 | 4 | 91 | 13% | 96% |

Total Defects 715

| | | | | | |
|---|---|---|---|---|---|
| PCE | 68% | 95% | 78% | 96% | |
| DCE | | 12% | 60% | 34% | |

| | |
|---|---|
| PCE = | Phase Containment Effectiveness [PCE = Contained Defects / Total Defects * 100%] |
| DCE = | Defect Containment Effectiveness [DCE = Phase Defects / (Phase Defects + Post Release Defects) * 100% |
| TCE = | Total Containment Effectiveness [TCE = PreRelease Defects / Total Defects * 100%] |
| Contained Defects = | Defects that are found during the phase that created them. |
| Escaped Defects = | Defects that escape to a subsequent development or delivery phase. |

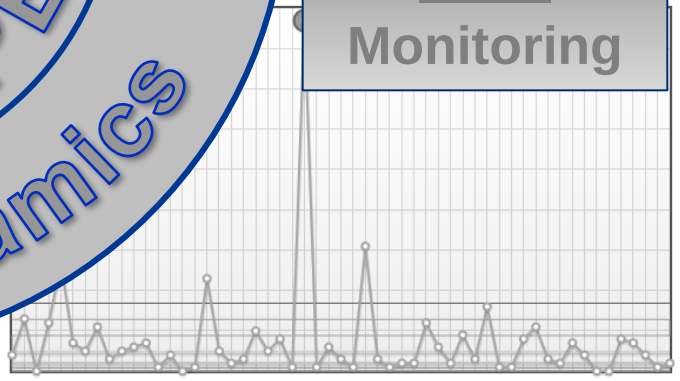




**DCE**
Identify

**PPM**
Optimization

**RCCA**
Prevention

**PPB**
Monitoring

# Root Cause and Corrective Action (RCCA) – Defect Prevention Using the DCE Model

- Considerations for analysis
  - ↗ Common Cause Defects
  - ↗ Critical Defects

## Software Defect Prevention Containment Effectiveness Model

| Origin Phase | Phase Found In | | | | | Total Defects | % Insertion Rate | TCE |
|---|---|---|---|---|---|---|---|---|
| Origin | Requirements | Design | Code | Software Test | Post Software Iteration | | | |
| Requirements | 181 | 10 | 43 | 15 | 17 | 266 | 37% | 94% |
| Design | | 98 | 5 | 0 | 0 | 103 | 14% | 100% |
| Code | | | 200 | 15 | 40 | 255 | 36% | 84% |
| Test | | | | 87 | 4 | 91 | 13% | 96% |

Total Defects 715

| | | | | | |
|---|---|---|---|---|---|
| PCE | 68% | 95% | 78% | 96% | |
| DCE | | 12% | 60% | 34% | |

| | |
|---|---|
| PCE = | Phase Containment Effectiveness [PCE = Contained Defects / Total Defects * 100%] |
| DCE = | Defect Containment Effectiveness [DCE = Phase Defects / (Phase Defects + Post Release Defects) * 100%] |
| TCE = | Total Containment Effectiveness [TCE = PreRelease Defects / Total Defects * 100%] |
| Contained Defects = | Defects that are found during the phase that created them. |
| Escaped Defects = | Defects that escape to a subsequent development or delivery phase. |

***THIS IS SAMPLE DATA**

# Root Cause and Corrective Action (RCCA) – Steps For Performing RCCA

1. Identify a Problem
2. Defect Root Cause Analysis
3. Fishbone Analysis
4. Identify Corrective Actions
5. Verify Corrective Actions

# Root Cause and Corrective Action (RCCA)
# Step 1: Identify a Problem - Example

## Software Defect Prevention
## Containment Effectiveness Model

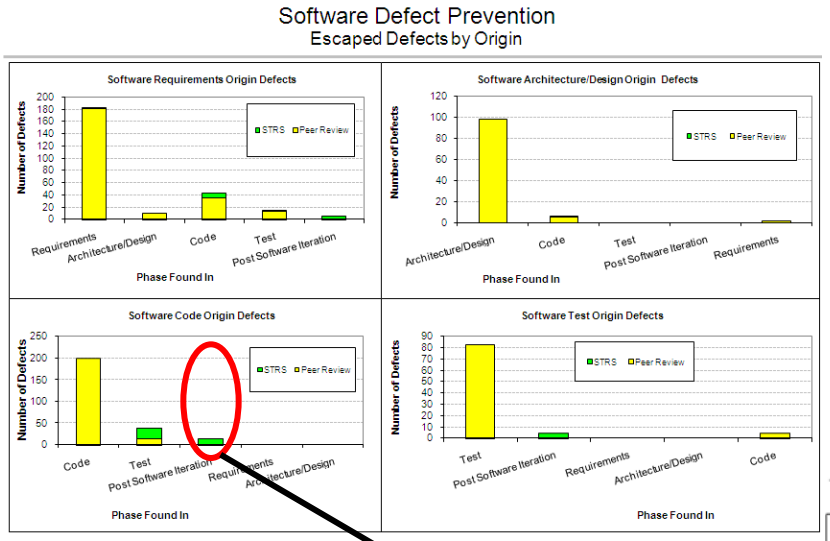
| Origin Phase | Origin | Phase Found In: Requirements | Design | Code | Software Test | Post Software Iteration | Total Defects | % Insertion Rate | TCE |
|---|---|---|---|---|---|---|---|---|---|
| | Requirements | 181 | 10 | 43 | 15 | 17 | 266 | 37% | 94% |
| | Design | | 98 | 5 | 0 | 0 | 103 | 14% | 100% |
| | Code | | | 200 | 15 | 40 | 255 | 36% | 84% |
| | Test | | | | 87 | 4 | 91 | 13% | 96% |
| | | | | | | Total Defects 715 | | | |
| | PCE | 68% | 95% | 78% | 96% | | | | |
| | DCE | | 12% | 60% | 34% | | | | |

| | |
|---|---|
| PCE = | Phase Containment Effectiveness [PCE = Contained Defects / Total Defects * 100%] |
| DCE = | Defect Containment Effectiveness [DCE = Phase Defects / (Phase Defects + Post Release Defects) * 100%] |
| TCE = | Total Containment Effectiveness [TCE = PreRelease Defects / Total Defects * 100%] |
| Contained Defects = | Defects that are found during the phase that created them. |
| Escaped Defects = | Defects that escape to a subsequent development or delivery phase. |

*THIS IS SAMPLE DATA

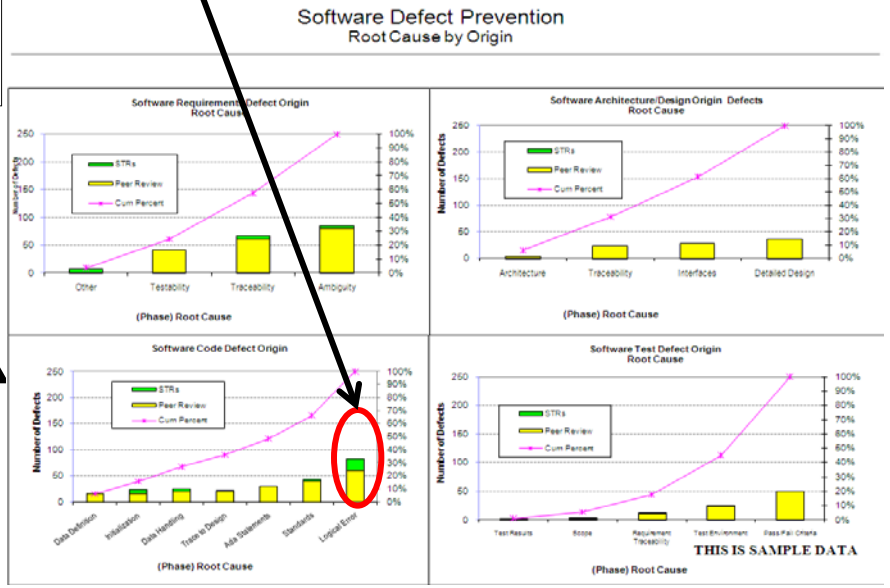
**The DCE Model is showing that 40 Code defects were found in the Post Software Iteration Phase**

# Root Cause and Corrective Action (RCCA) – Step 2: Defect Root Cause Analysis - Example

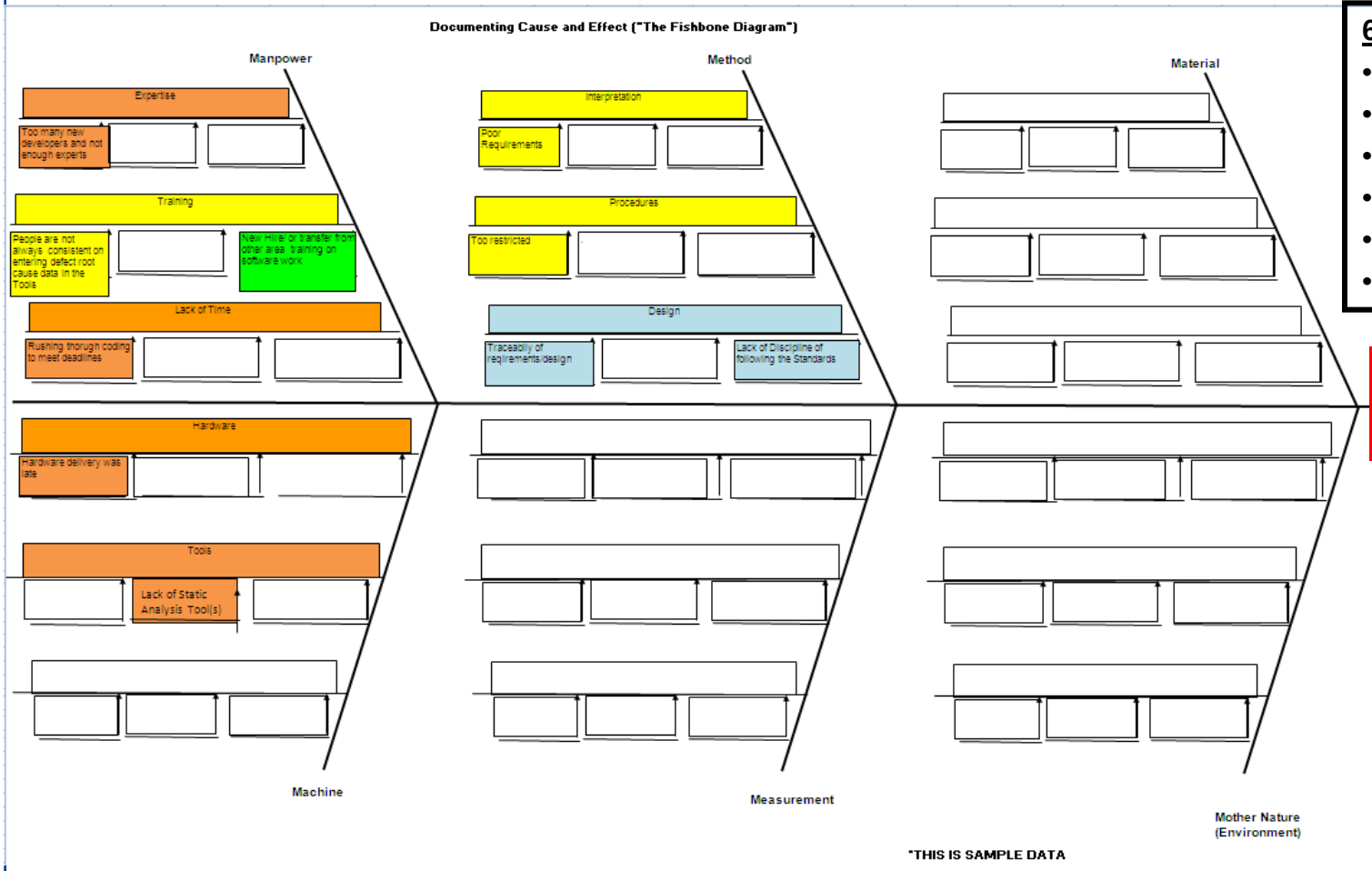



**Need to identify the Root Cause of why the defect escaped.**

**-The Code Defect Origin by Root Cause chart shows that the root cause of the Post Software Iteration Phase defects was Logical Error.**



# Root Cause and Corrective Action – Step 3: Fishbone Analysis - Example




**6 Ms**

- **Manpower**
- **Method**
- **Material**
- **Machine**
- **Measurement**
- **Mother Nature**

**Why were the Logical coding defects injected?**

# Root Cause and Corrective Action – Step 4: Identify Corrective Actions - Example

| Root Cause: (*usually High Probability) | Corrective Action: |
|---|---|
| Too many new developers and not enough experts | Add a review of the resource allocation plan |
| Rushing through coding to meet deadlines | Need to plan more time for peer reviews |
| Incomplete requirements | Pilot agile development methods |
| Lack of static analysis tool(s) | Allocate effort and budget to identifying and purchase static analysis tool(s) |

*THIS IS SAMPLE DATA

# Root Cause and Corrective Action – Step 5: Verify Corrective Actions - Example

## Before:

Software Defect Prevention
Containment Effectiveness Model

| Origin Phase | Phase Found In: Requirements | Design | Code | Software Test | Post Software Iteration | Total Defects | % Insertion Rate | TCE |
|---|---|---|---|---|---|---|---|---|
| Requirements | 181 | 10 | 43 | 15 | 17 | 266 | 37% | 94% |
| Design | | 98 | 5 | 0 | 0 | [illegible] | [illegible] | [illegible] |
| Code | | | 200 | 15 | 40 | 255 | 36% | 84% |
| Test | | | | 87 | 4 | 91 | 13% | 96% |

Total Defects 715

| | | | | |
|---|---|---|---|---|
| PCE | 68% | 95% | 78% | 96% |
| DCE | | 12% | 60% | 34% |

| | |
|---|---|
| PCE = | Phase Containment Effectiveness [PCE = Contained Defects / Total Defects * 100%] |
| DCE = | Defect Containment Effectiveness [DCE = Phase Defects / (Phase Defects + Post Release Defects) * 100%] |
| TCE = | Total Containment Effectiveness [TCE = PreRelease Defects / Total Defects * 100%] |
| Contained Defects = | Defects that are found during the phase that created them. |
| Escaped Defects = | Defects that escape to a subsequent development or delivery phase. |

*THIS IS SAMPLE DATA

## After:

Software Defect Prevention
Containment Effectiveness Model

| Origin Phase | Phase Found In: Requirements | Design | Code | Software Test | Post Software Iteration | Total Defects | % Insertion Rate | TCE |
|---|---|---|---|---|---|---|---|---|
| Requirements | 181 | 10 | 43 | 15 | 17 | 266 | 38% | 94% |
| Design | | 98 | 5 | 0 | 0 | [illegible] | [illegible] | [illegible] |
| Code | | | 200 | 15 | 20 | 235 | 34% | 91% |
| Test | | | | 87 | 4 | [illegible] | [illegible] | 96% |

Total Defects 695

| | | | | |
|---|---|---|---|---|
| PCE | 68% | 95% | 85% | 96% |
| DCE | | 12% | 60% | 45% |

| | |
|---|---|
| PCE = | Phase Containment Effectiveness [PCE = Contained Defects / Total Defects * 100%] |
| DCE = | Defect Containment Effectiveness [DCE = Phase Defects / (Phase Defects + Post Release Defects) * 100%] |
| TCE = | Total Containment Effectiveness [TCE = PreRelease Defects / Total Defects * 100%] |
| Contained Defects = | Defects that are found during the phase that created them. |
| Escaped Defects = | Defects that escape to a subsequent development or delivery phase. |

*THIS IS SAMPLE DATA

- **This model alone cannot be used to verify the results of the corrective action implemented.**
- **PPBs need to be created/modified at the sub-process level**

# Root Cause & Corrective Actions – Benefits and Challenges

- Benefits
  - Able to eliminate defects and make process improvements to prevent reoccurrence
  - DCE Model showing fewer total defects and lower insertion rates

- Challenges
  - Focusing on prevention versus a correction
  - New methods require training
  - Identifying where the best return on investment is
  - Maintaining the scope of the effort
  - Ensuring involvement of SMEs

# Challenges

- Stakeholder buy-in
  - Understanding the intent and purpose of the quality system
    - Getting past, “Why do I have to do this?”
  - Keeping it from being personal, i.e. measuring the processes & products and not the person performing the work
- Data Integrity
  - Trusting the data
- Documenting savings / cost benefit

# What Worked Well

- Automation – keep it simple
  - Web-based tools (easy access)
  - Integrated tools
  - Automation leads to data and process consistency
  - Users able to focus on products, not process
- Communication and education
  - Strong and repeated communication with users
  - Educating key stakeholders on the quality system and its benefits to help others buy-in
  - Updating processes and guidelines to identify usage of quality system
  - Incorporating user feedback

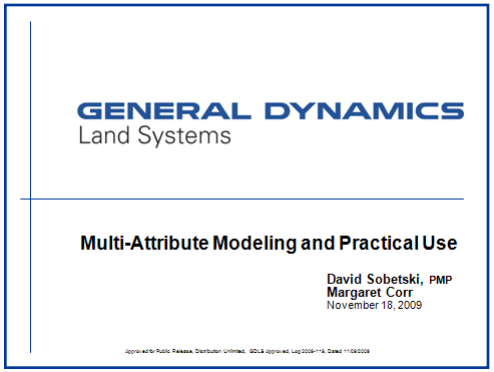
# Contact Information

Margaret Corr
Software Engineering Process Group Lead
Section Manager, Software Process, Tools & Environment
38500 Mound Road
Sterling Heights, MI 48310
586-825-5787
corrm@gdls.com

Dawn Jaskolski
Software Engineering Process Group Lead
Senior Software Engineer
38500 Mound Road
Sterling Heights, MI 48310
586-825-4418
jaskolsk@gdls.com

David Sobetski, PMP
Sr. Specialist Business Processes, Systems Engineering Process Excellence
38500 Mound Road
Sterling Heights, MI 48310
586-825-5362
sobetski@gdls.com

# References


GENERAL DYNAMICS
Land Systems

Multi-Attribute Modeling and Practical Use

David Sobetski, PMP
Margaret Corr
November 18, 2009

Approved for Public Release, Distribution Unlimited. GDLS approved, Log 2009-114, Dated 11/09/2009


- David Sobetski and Margaret Corr, “Multi-Attribute Modeling and Practical Use” General Dynamics Land Systems November 18, 2009 http://www.dtic.mil/ndia/2009CMMI/9407WednesdayTrack4Sobetski.pdf

GENERAL DYNAMICS