Root Cause Analysis Driven Improvement

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Root Cause Analysis Defined

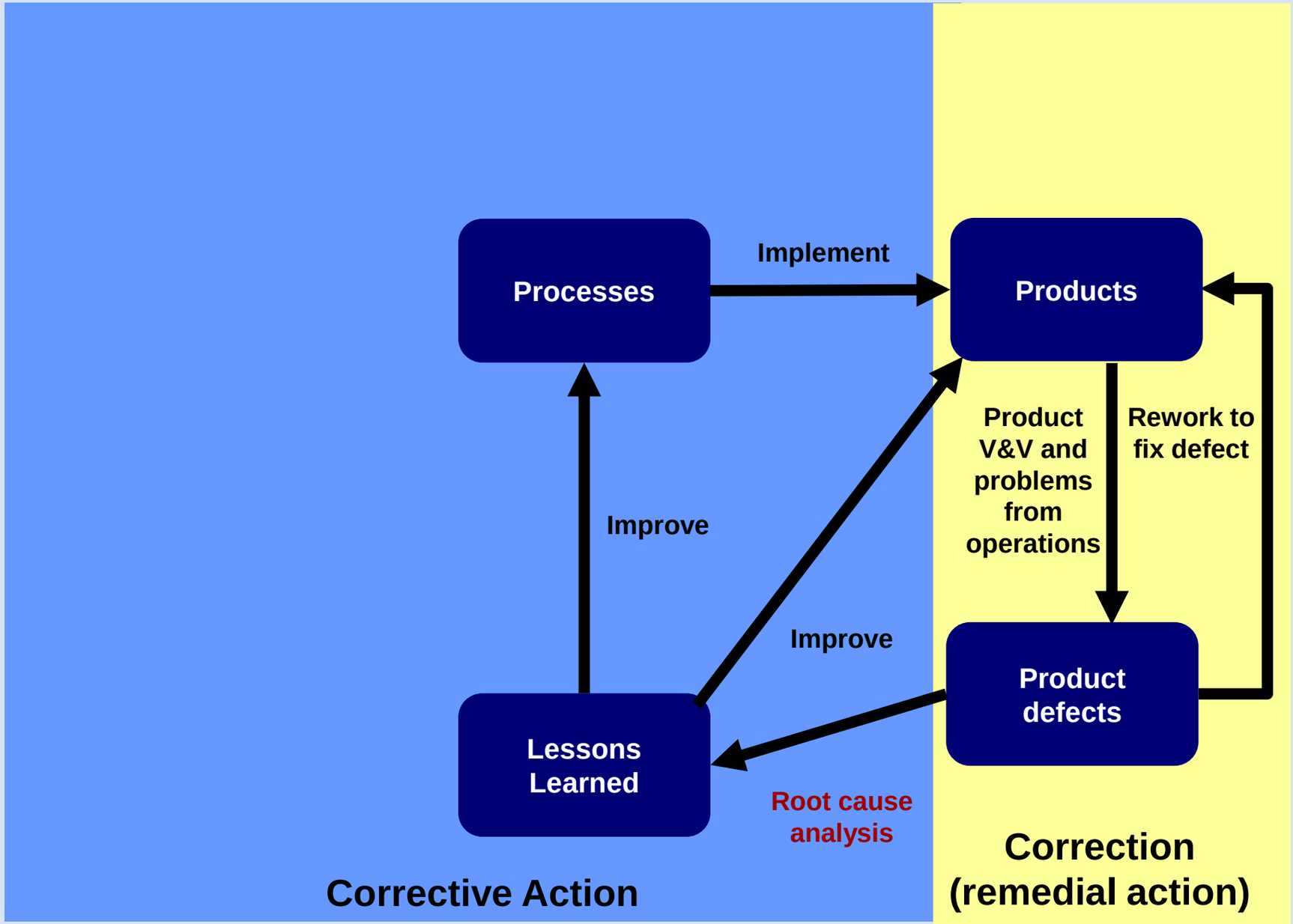
Root cause analysis is an investigative process used to assess sets of product defects or process problems to identify the underlying factors and systemic causes of those defects or problems.

Benefits of Root Cause Analysis

The benefits of root cause analysis include:

- Addressing underlying factors & systemic causes – not just a band aid on the symptoms
- Preventing reoccurrence of similar defects or problems
- It is logical & systematic approach based on facts – focuses thinking
- Concentrating on product & process – helps eliminate blaming
- Promoting organizational learning
- It can be applied to risks, as well as defects & problems

Product Correction vs. Corrective Action



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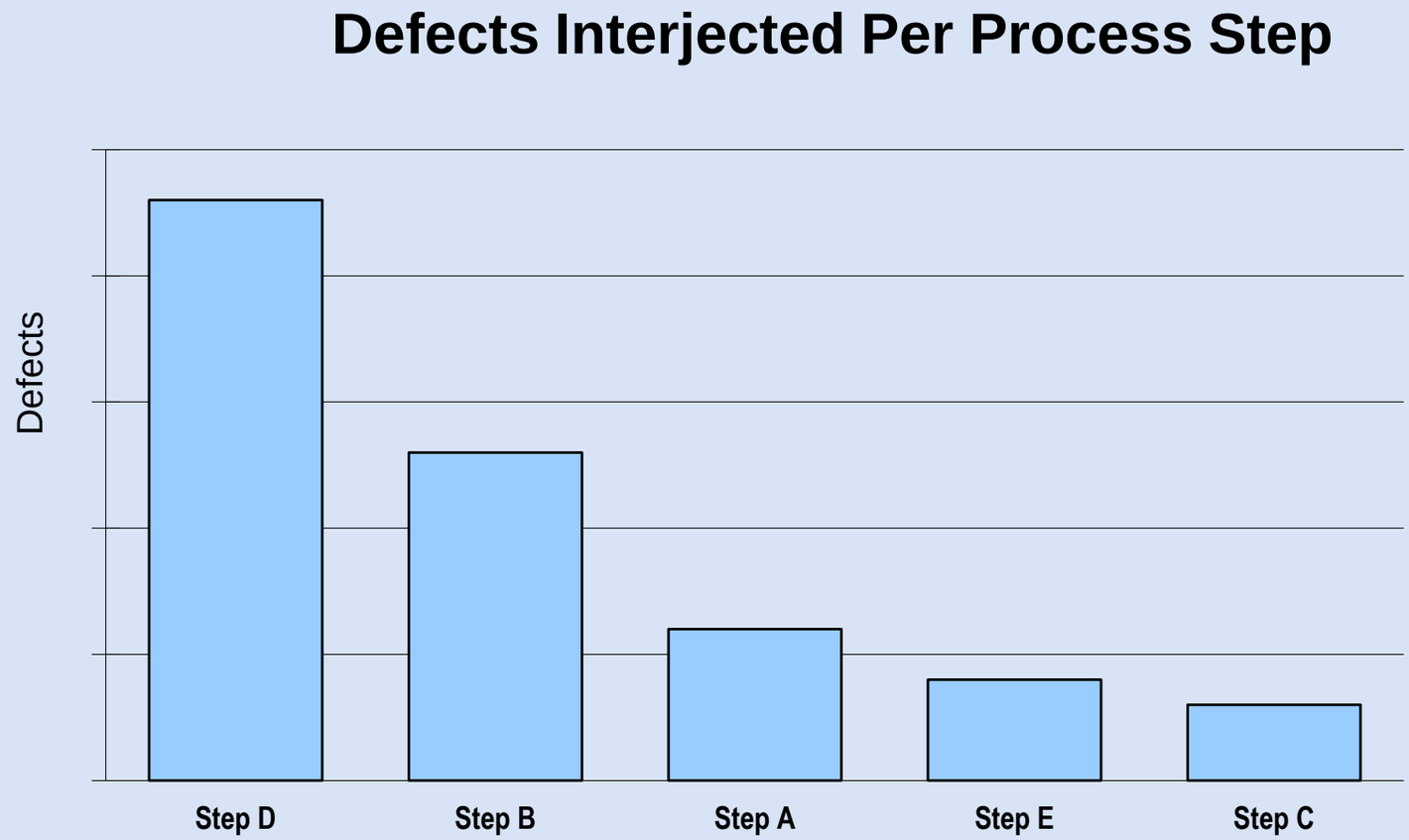
Product Defects – When Introduced?

Types of Root Cause Analysis	Opportunity
• When introduced?	• Prevention process

When Introduced? – Pareto Charts

Purpose: To help identify areas that are causing the most problems.



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Defect Containment Effectiveness

Defect containment effectiveness: Used to evaluate the effectiveness of defect detection techniques utilized during each phase of the software life cycle.

Phase containment is calculated as:

$$\frac{\text{\# of defects found that were introduced in the phase}}{\text{Total defect introduced during the phase}} \times 100\%$$

Phase Containment Effectiveness – Example

Phase Detected	Phase Detected Defect Was Introduced		
	Requirements	Design	Code
Requirements	15		
Design	5	29	
Code	1	7	86
Test	3	3	19
Field	1	2	7
Total	25	41	112

Requirements: 15 / 25 = 60%

Design: 29 / 41 = 71%

Code: 86 / 112 = 77%

Product Defects – What Types?

Types of Root Cause Analysis	Opportunity
• When introduced?	• Prevention process
• **What types?**	• **Prevention & detection process**

Using Check Sheets

Purpose: To create frequency distribution tally sheets.

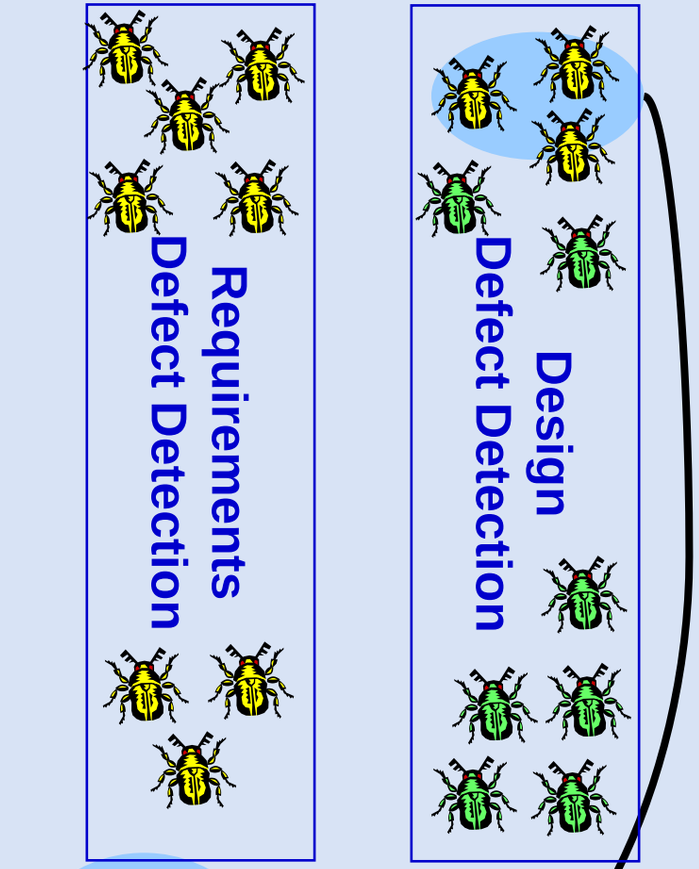
Root Cause	Frequency
Missing requirement	𝍸 III
Ambiguous requirement	𝍸 𝍸 II
Incomplete requirement	𝍸 I
Incorrect requirement	𝍸 IIII
Contradictory requirement	III
Change to requirements not communicated	IIII

Example: Check sheet for root cause analysis of requirements defects found after the requirements phase.

Product Defects – When Detected?

Types of Root Cause Analysis	Opportunity
When introduced?	Prevention process
What types?	Prevention & detection process
When detected?	**Detection process**

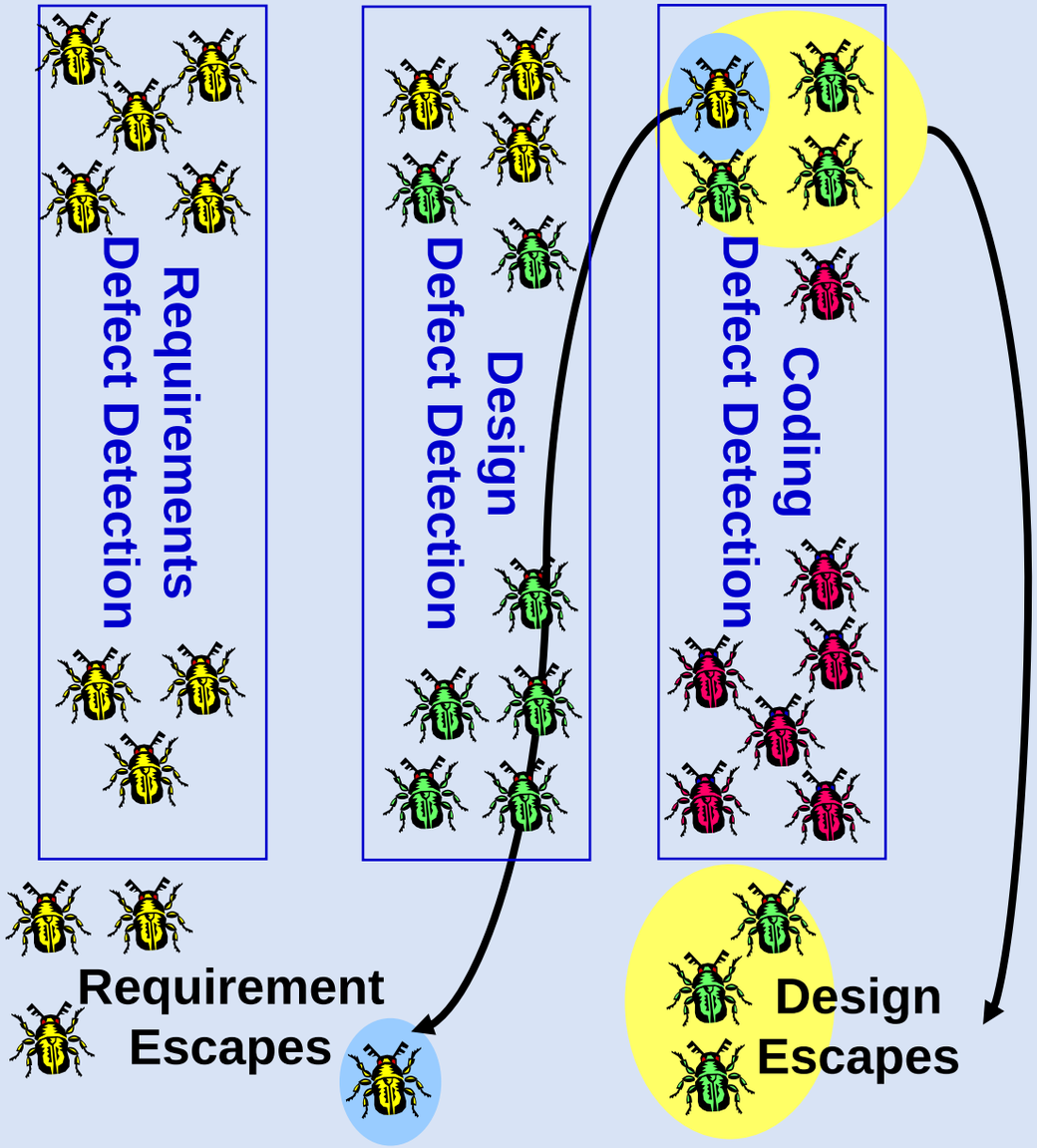
Measuring Escapes



Design
Escapes

Code
Escapes

Measuring Escapes



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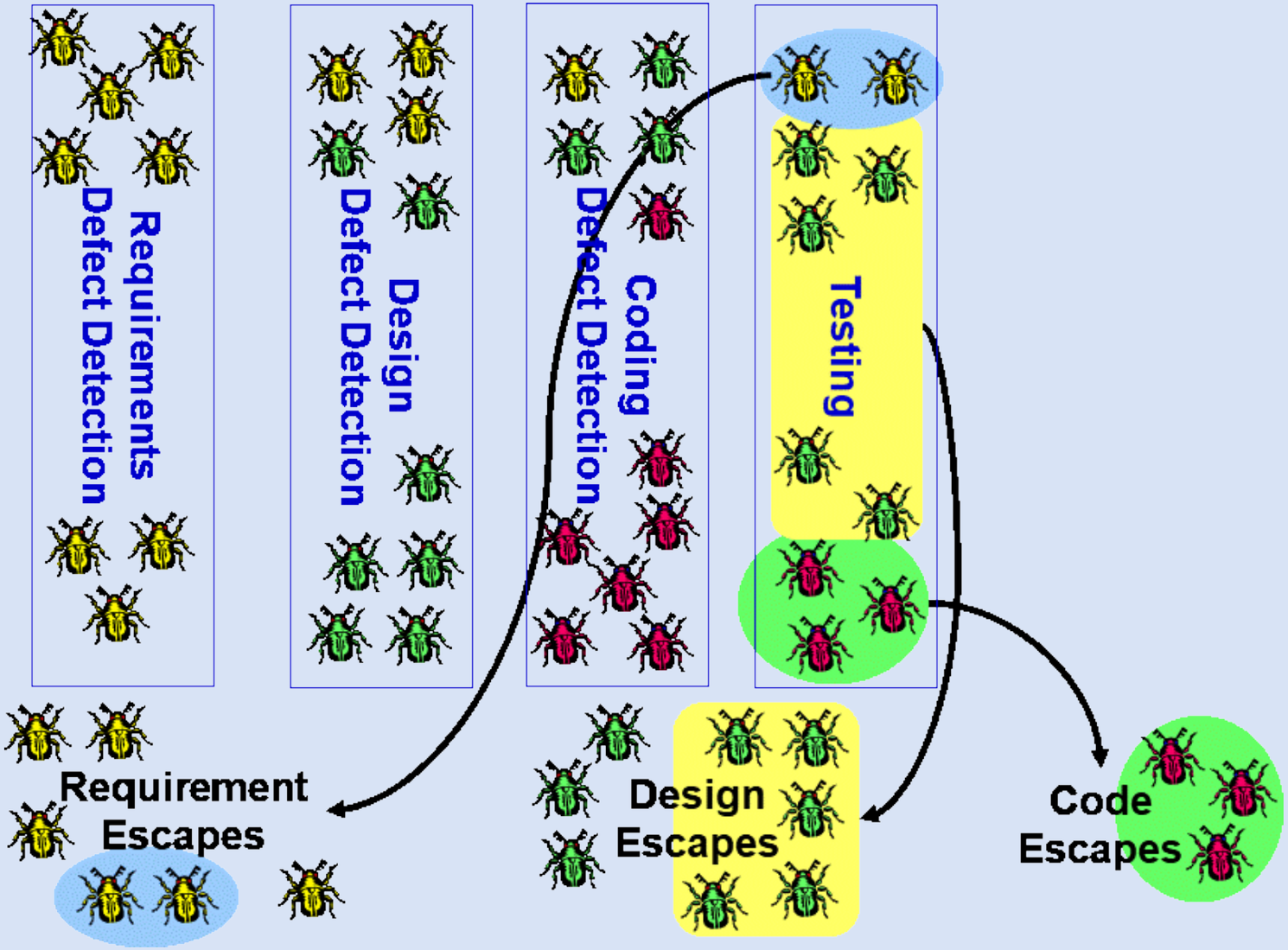
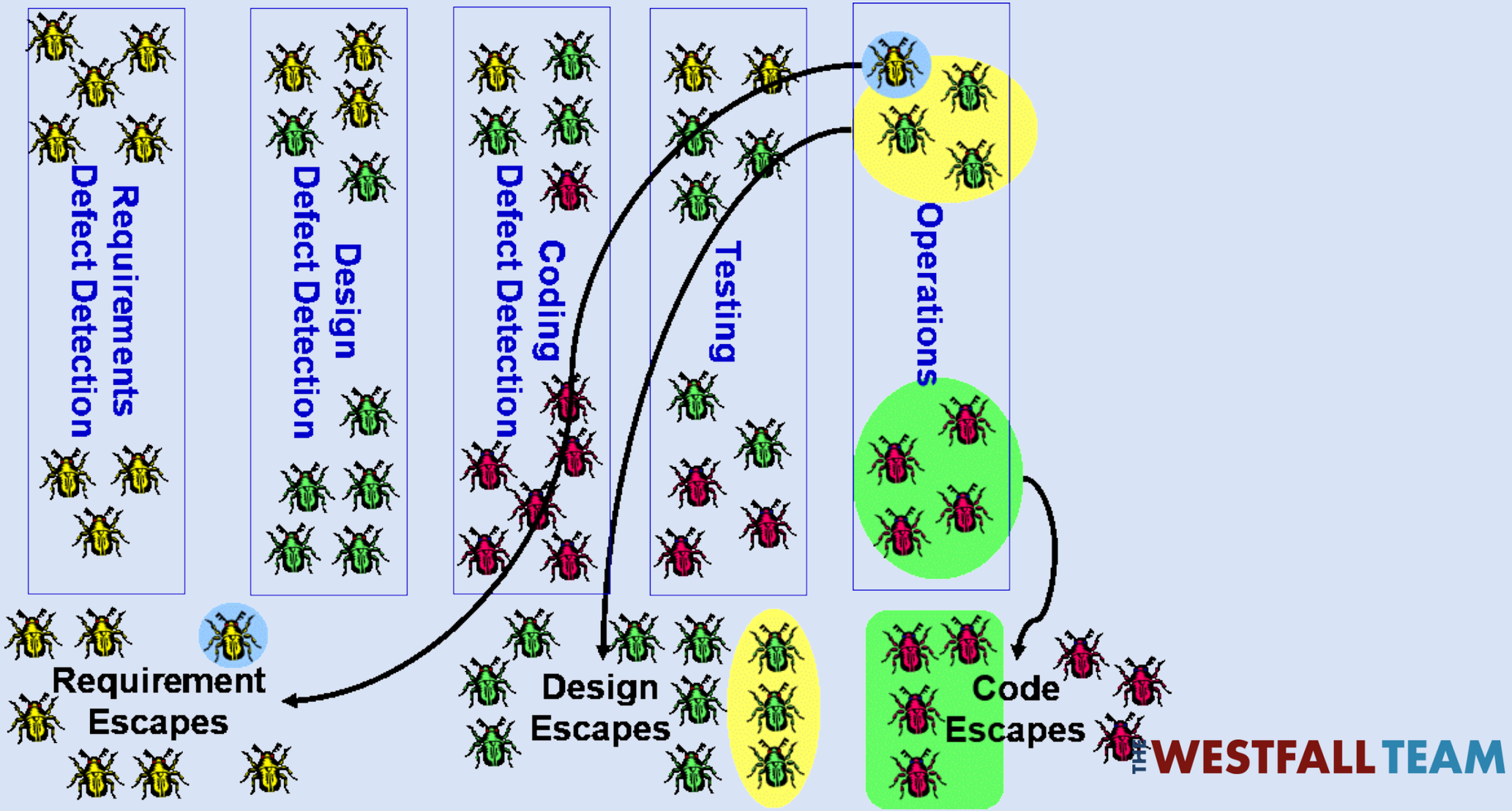
Measuring Escapes



Measuring Escapes



Defect Removal Efficiency (DRE)

Defect Removal Efficiency: Used to evaluate the effectiveness of defect detection techniques utilized during each phase of the software life cycle

Defect removal efficiency is calculated as:

$$\frac{\text{Number of defects found (removed) by the activity}}{\text{Total number of defects present at the activity}} \times 100\%$$

Defect Removal Efficiency – Example

Detection Technique	Phase Detected Defect Was Introduced		
	Requirements	Design	Code
Requirements Review	15		
Design Review	5	29	
Code Review	1	3	54
Unit Testing	0	4	32
Integration Testing	1	3	13
System Testing	2	0	6
Operations	1	2	7
Total	25	41	112

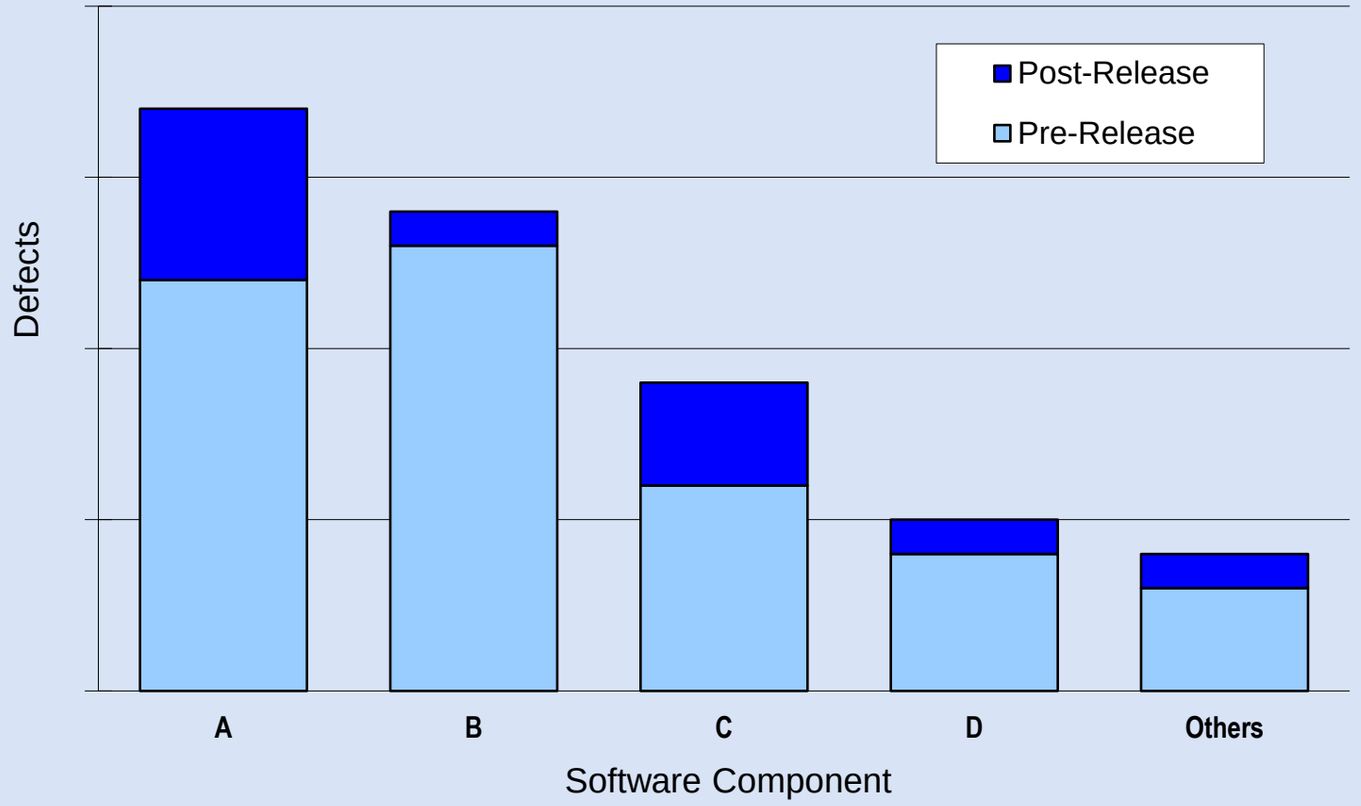
Design Review: (5+29) / (5+29+5+12) = 34 / 51 ≈ 67%

Product Defects – What Component?

Types of Root Cause Analysis	Opportunity
When introduced?	Prevention process
What types?	Prevention & detection process
When detected?	Detection process
What component?	**Re-engineering**

Defect Prone Components or Features

Metrics: Pre-release & post-release defect counts for each component.



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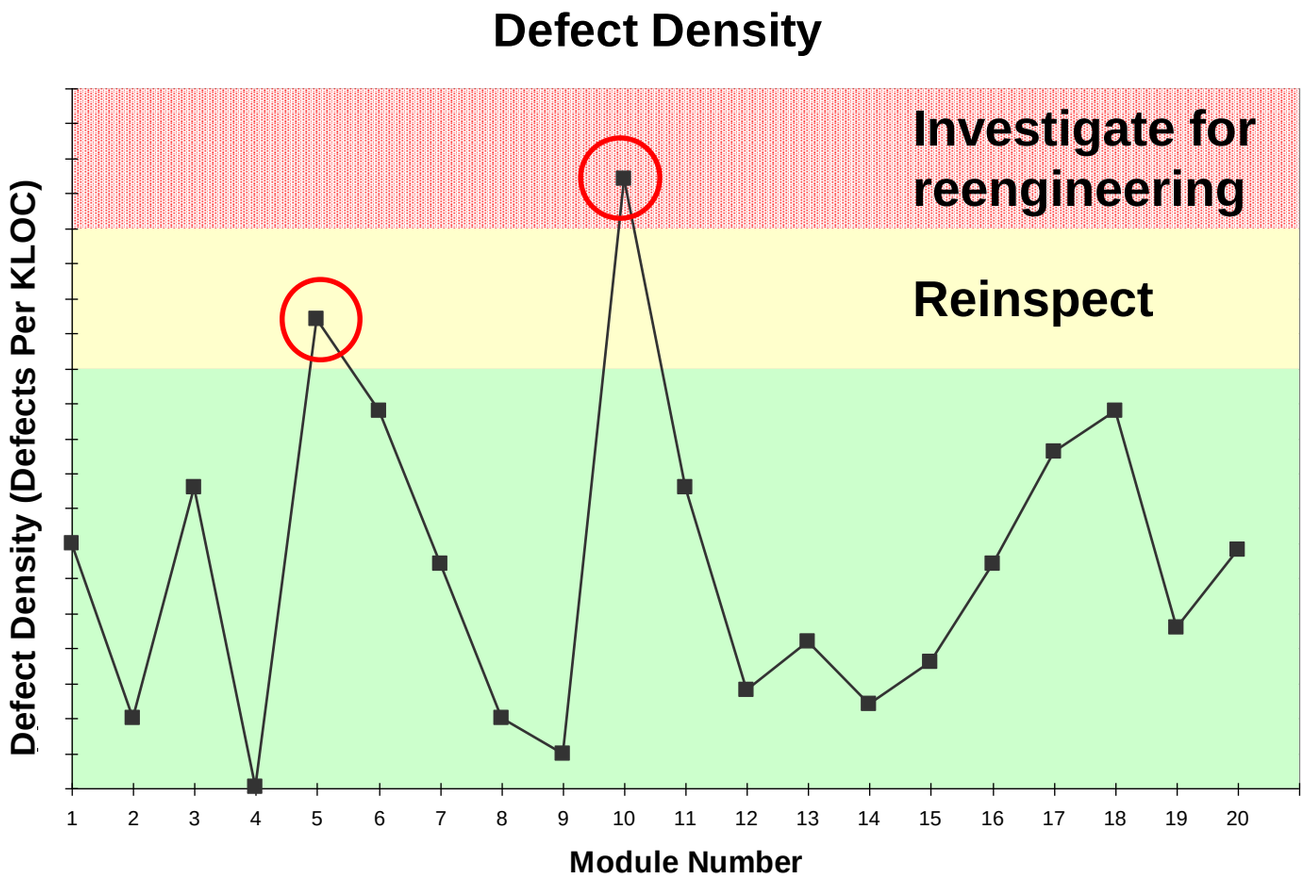
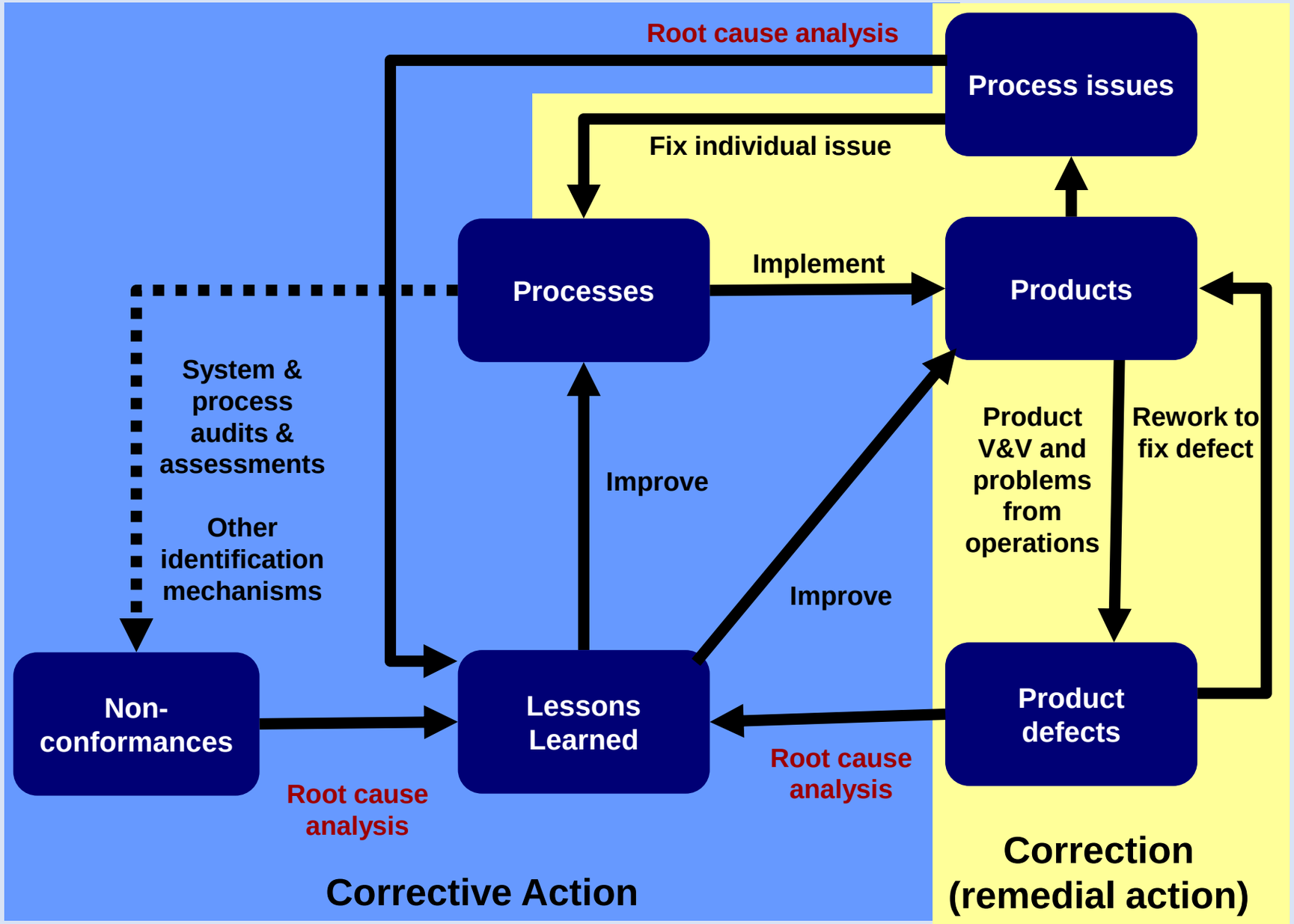
Defect Density



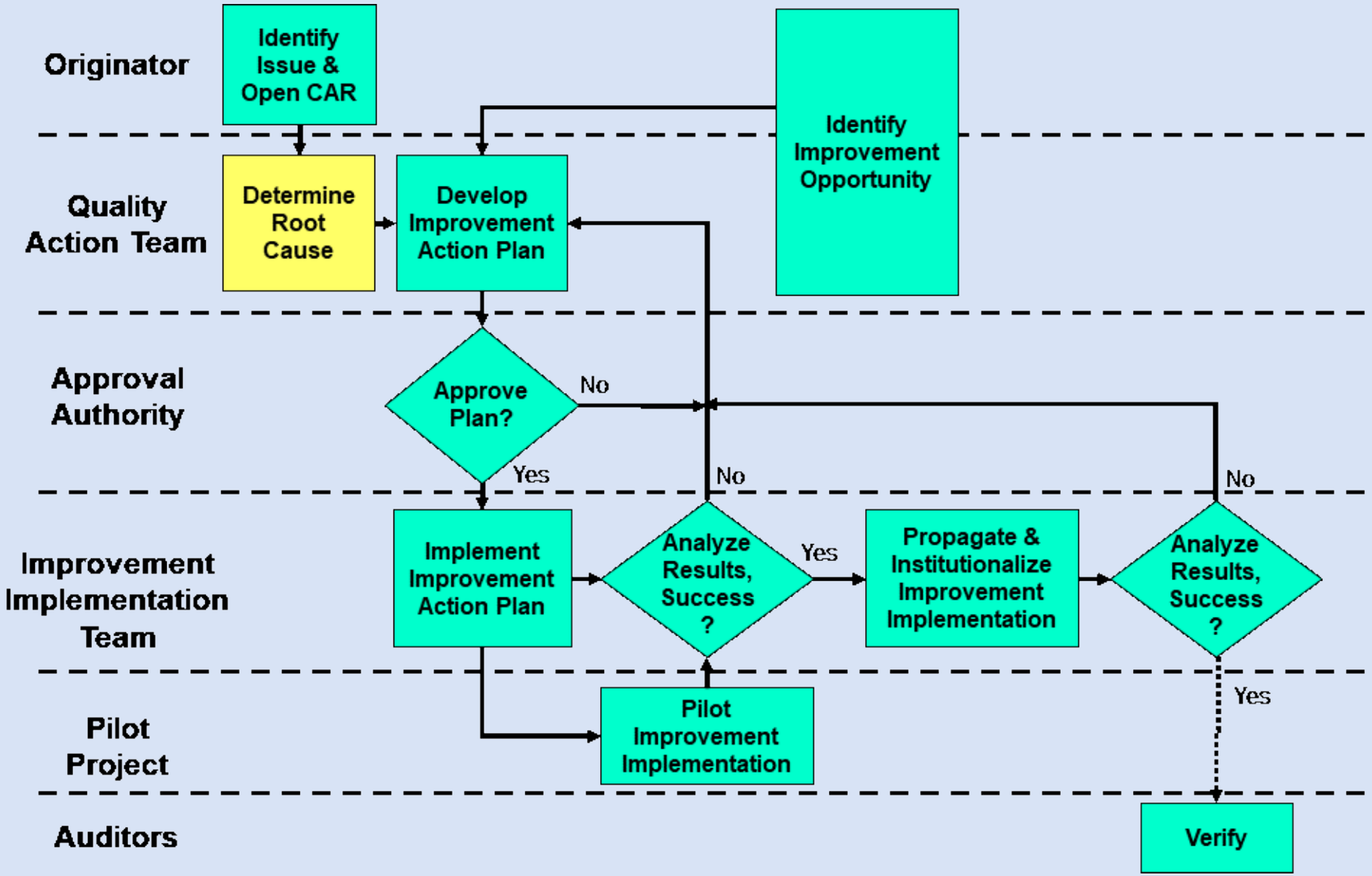
Product Defects – Similar Components?

Types of Root Cause Analysis	Opportunity
When introduced?	Prevention process
What types?	Prevention & detection process
When detected?	Detection process
What component?	Re-engineering
Similar components?	**Investigation**

Process Correction vs. Corrective Action



Process Improvement Process



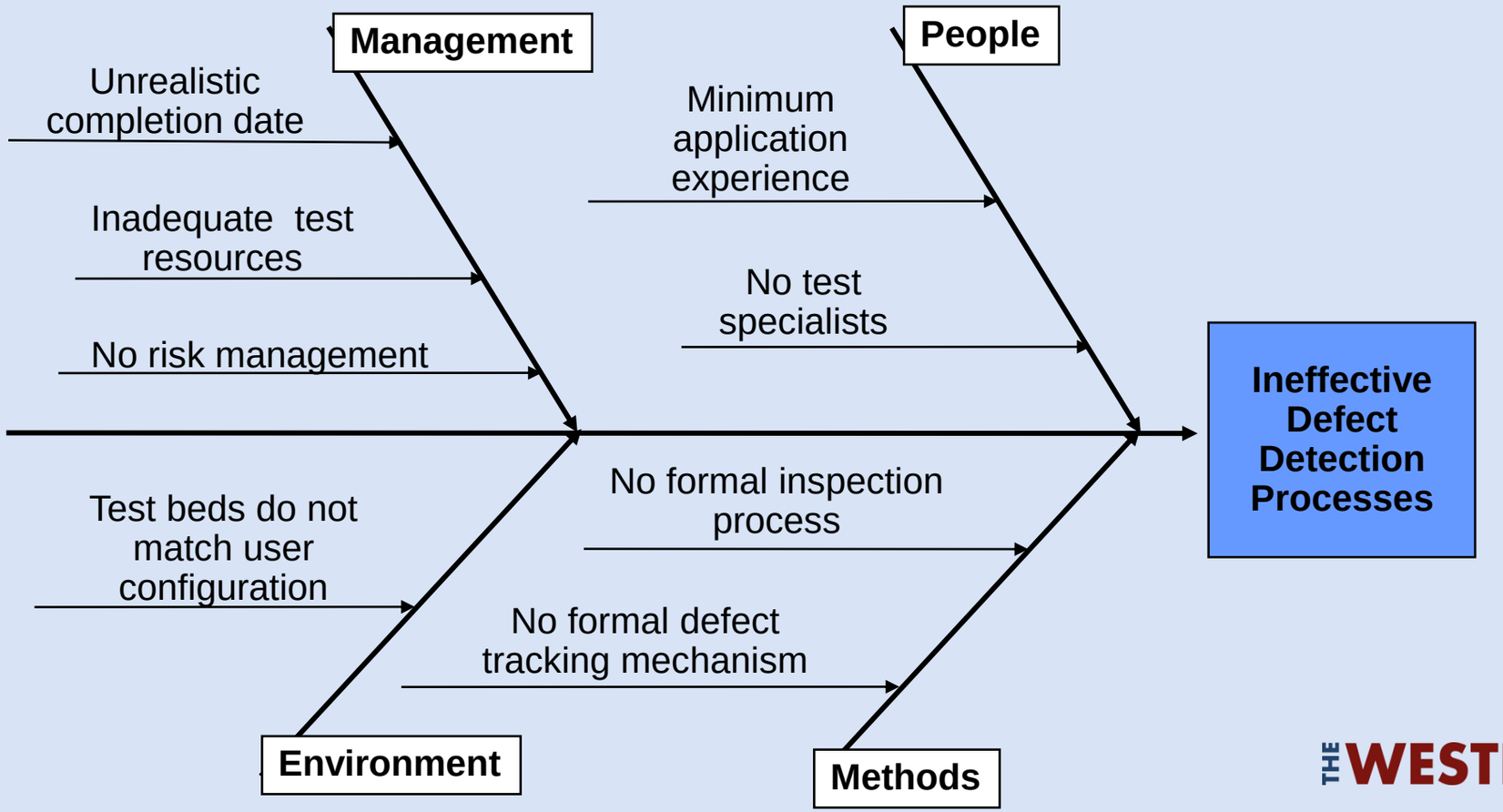
Identifying Process Issues – Examples

Process issues are identified in many ways, for example:

- Performance of root cause analysis on one or more product defects
- Problems identified during process implementation
- Customer dissatisfaction
- Negative trends or out-of-control states discovered using metrics
- Nonconformances or negative observations from audits & reviews
- Identification of poor performance during process assessments
- Identification of a waste during lean analysis

Cause-and-Effect Diagrams

Purpose: To organize & graphically represent the causes of a particular problem.



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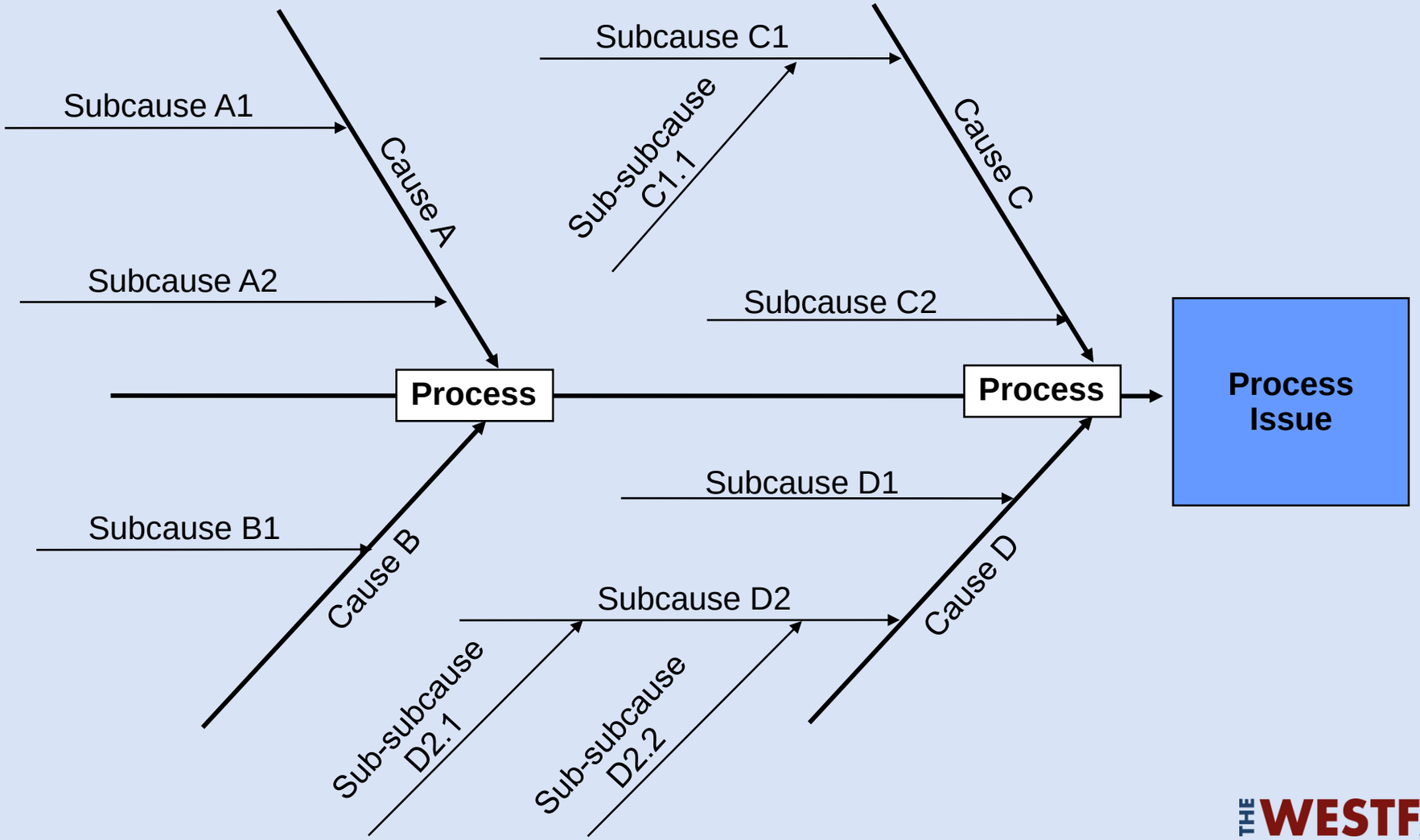
Process Type Cause-and-Effect Diagrams



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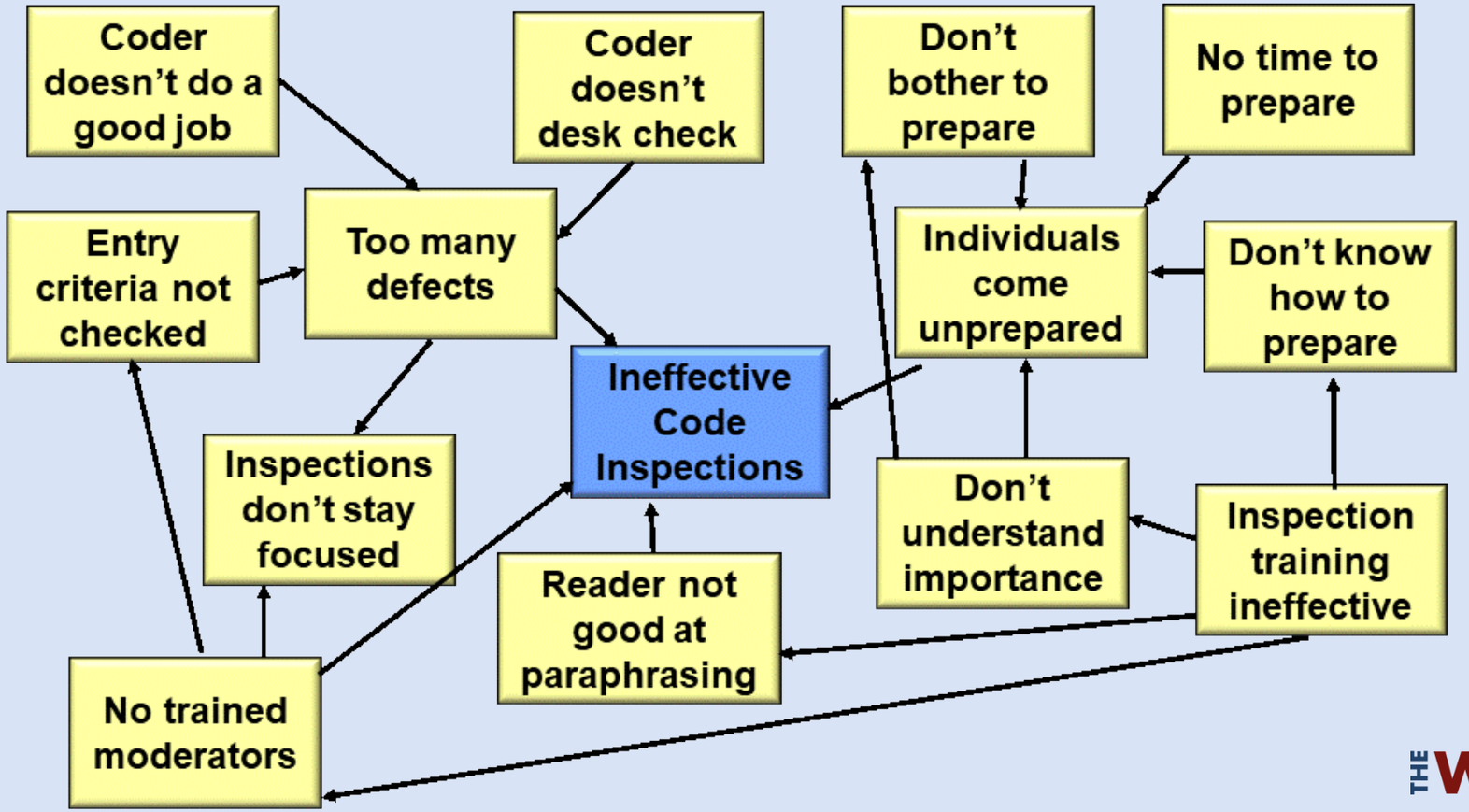
Interrelationship Digraph

Purpose: To organize ideas & define the ways in which ideas influence each other.



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Other Root Cause Analysis Tools

There are many other tools that can be used to determine root cause, including:

- Five whys technique
- Analyzing process flow diagrams
- Fault tree analysis
- Practitioner observations
- Brainstorming
- Nominal group techniques
- Etc.

Questions?

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