Requirements Engineering Process Design for Six Sigma (REDFSS)

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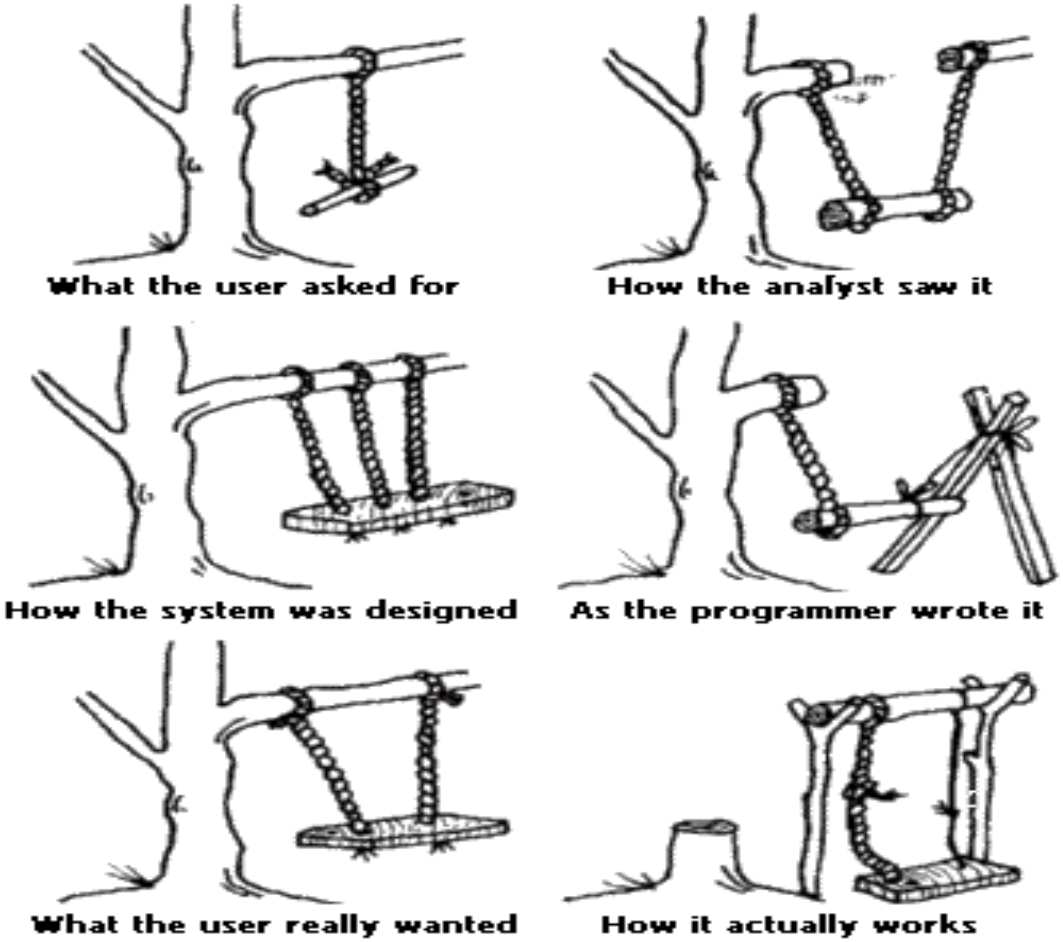
Requirements Engineering Process Design for Six Sigma (REDFSS)

Requirements Engineering Process Design for Six Sigma



Agenda

Requirements Engineering Process Design for Six Sigma

- Introduction
- Background
- Literature Review
- Problem Statement
- Technical Approach
- Experimental Investigation

Introduction

Requirements Engineering Process Design for Six Sigma

- Requirements are the backbone of the system
  - What but not How
- 0ver 40% of the projects fail
  - *Poor set of quality attributes for requirements and process*
- Quality is achieved through defect prevention
  - *Prevention of low quality requirements moving to later stages in system development life cycle*
  - *Doing it right the first time*
- Six Sigma is a quantitative methodology to systematically improve processes by eliminating defects.
  - (SS) equals to 3.4 defects per million opportunities.

Background

Requirements Engineering Process Design for Six Sigma

- Adaptation of Six Sigma in Software Engineering
  - Integrating the tools, metrics, and the DMAIC framework

- One research of Six Sigma in RE
  - No individual requirement quality assessment
  - No process analysis – process capacity and reliability assessment
  - No root cause analysis

Literature Review

Requirements Engineering Process Design for Six Sigma

- Requirements Management Process Models
  - [Ayad Y. Aldaijy], [Sommerville], [Kotonya], [York], [Dorf], [Buede], [Davis], [Herb], [Krasner]
  - Elicitation – Analysis – Documentation – Verification

- Requirements Engineering Techniques
  - [York 2001], [Romano 97], [Kotonya & Sommerville]

Literature Review

Requirements Engineering Process Design for Six Sigma

- Quality Attributes of Requirements

- Unambiguous - Complete - Correct - Understandable - Verifiable - Internally Consistent - Externally Consistent - Achievable - Concise - Design Independent - Traceable - Modifiable	- Electronically Stored - Executable / Interpretable - Annotated by Relative Importance - Annotated by Relative Stability - Annotated by Version - Not Redundant - At Right Level of Detail - Precise - Reusable - Traced - Organized - Cross-Referenced

[Knauss and Boustani 2008], IEEE 1233-1998, Sommerville, [David 93], [York 2001], [Buede 00], [Mar 94], [Easterbrook].

Literature Review

Requirements Engineering Process Design for Six Sigma

- Quality Attributes of Requirements that will be used in the research
  - Attributes in Literature
    - Complete
    - Unambiguous
    - Correct
    - Consistent
    - Understandable
    - Achievable
    - Traced
    - Testable
  - Attributes designed by the Authors
    - Potential to be impacted by the new technology
    - Level of Uncertainty
    - Lack of Domain Knowledge
    - Organization's Requirements Process Maturity Level
    - Elicitation Technique used and the organization's experience level with it

[Knauss and Boustani 2008], IEEE 1233-1998, Sommerville, [David 93], [York 2001], [Buede 00], [Mar 94], [Easterbrook].

Literature Review

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- Six Sigma DMAIC Approach (Detective)
  - Define
  - Measure
  - Analyze
  - Improve
  - Control
- Design for Six Sigma (ICOV) Approach (Preventive)
  - *Identify*
  - *Characterize*
  - *Optimize*
  - *Verify/Validate*

Literature Review

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- Six Sigma Tools
  - Cause and Effect Analysis
  - 5 Whys
  - Pareto Charts
  - Quality Function Deployment
    - House of Quality
  - Failure Mode and Effect Analysis

Problem Statement

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- Low Quality Requirements have potential to change, to be modified, and not to be understood
- Low quality requirements result in increased cost, low reliability and maintainability, and a system that does not meet with stakeholders' requirements.
- The current requirements engineering research is largely based on creating new tools to get over the barriers in the process
- Not much research on the relationship between "the quality of requirements" and "requirements engineering process"
- No structured methodology to identify, measure, and eliminate the root causes behind the low quality requirements

Need Statement

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- *We need comprehensive and appropriate metrics and indicators of software quality to be able to obtain an early warning indicator of potential difficulties and make appropriate design changes early in the software development life cycle.*" (A. Sage)

- *Quality in requirements can be improved by improving the requirements engineering process (Sommerville)*

Research Objectives

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- Objectives of the intended research are to
  - Define a methodology to identify and measure defects in requirements
  - Establish a process to identify, measure and eliminate the root causes
  - Prevent defects from moving to the later stages of the system development life cycle
  - Help requirements engineers to make better judgments.
  - Analyze the relationship between quality of the requirements and the process

Technical Approach

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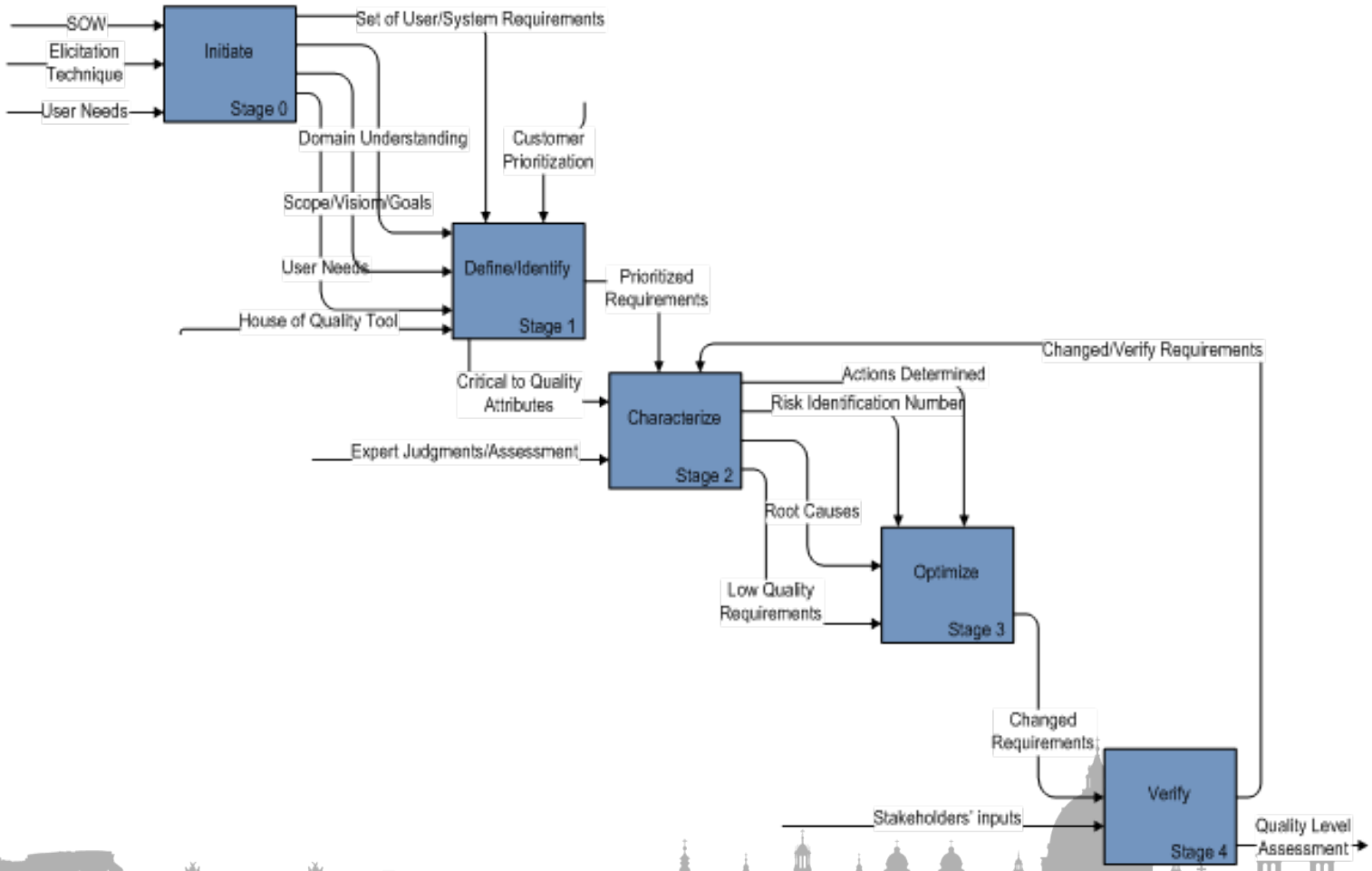


Technical Approach

Requirements Engineering Process Design for Six Sigma

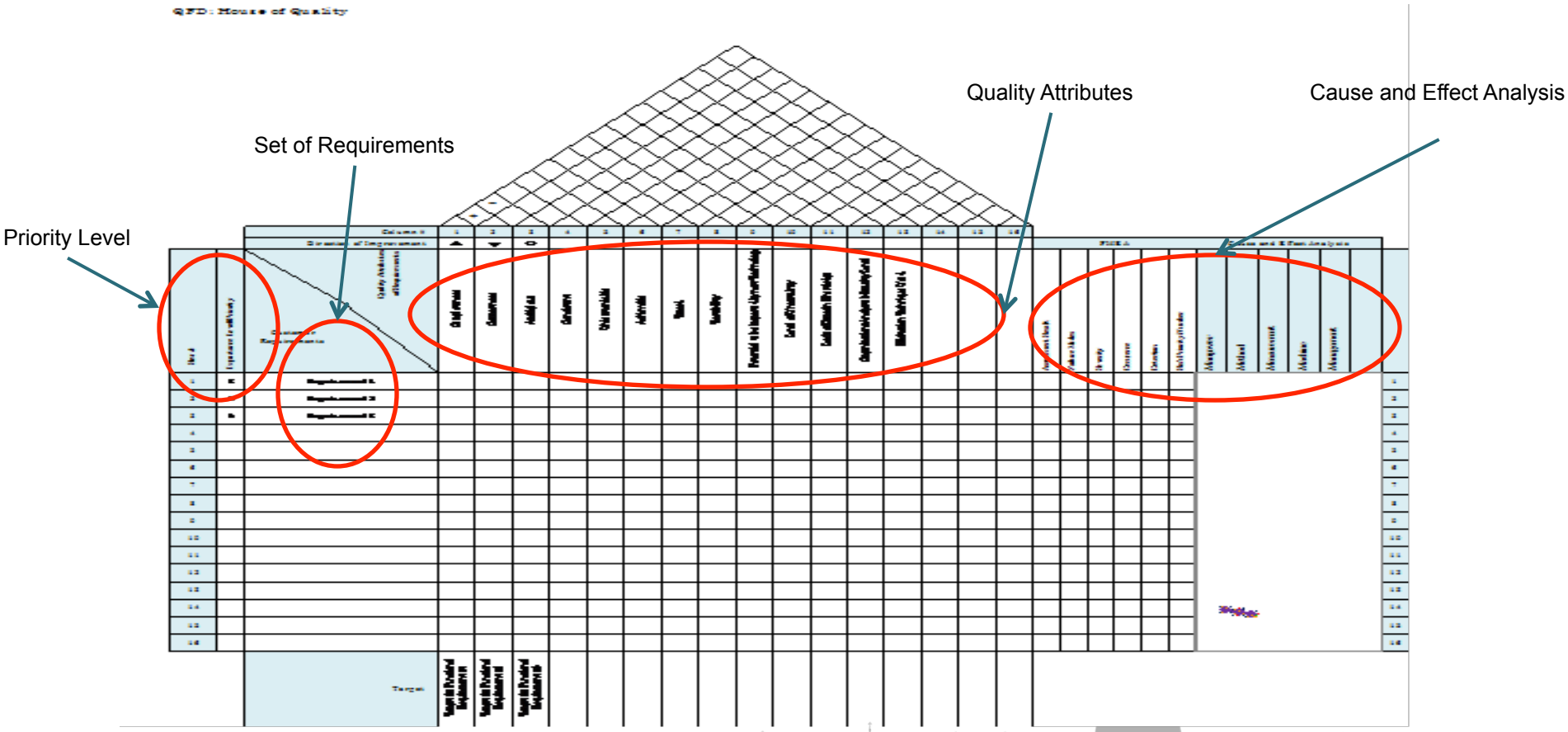
Stage 0: Initiate

- Identify roles and responsibilities (stakeholders).
- Define project goals, scope, objectives and problem statement
- Requirements are gathered through one of many elicitation techniques.
  - REDFSS does not propose any elicitation techniques
  - But evaluates the effectiveness of the technique

Technical Approach

Requirements Engineering Process Design for Six Sigma

Stage 1: Identify (Define)



Technical Approach

Requirements Engineering Process Design for Six Sigma

Stage 1: Identify (Define)

- Prioritize Requirements
- Define a set of quality attributes of requirements (Critical to Quality factors)
  - Complete
  - Ambiguous
  - Correct
  - Consistent
  - Understandable
  - Achievable
  - Traced
  - Testability
  - Potential to Impacted by New Technology
  - Level of Uncertainty
  - Lack of Domain Knowledge
  - Organizations Maturity Level
  - Elicitation Technique used and Experience level with it

Technical Approach

Requirements Engineering Process Design for Six Sigma

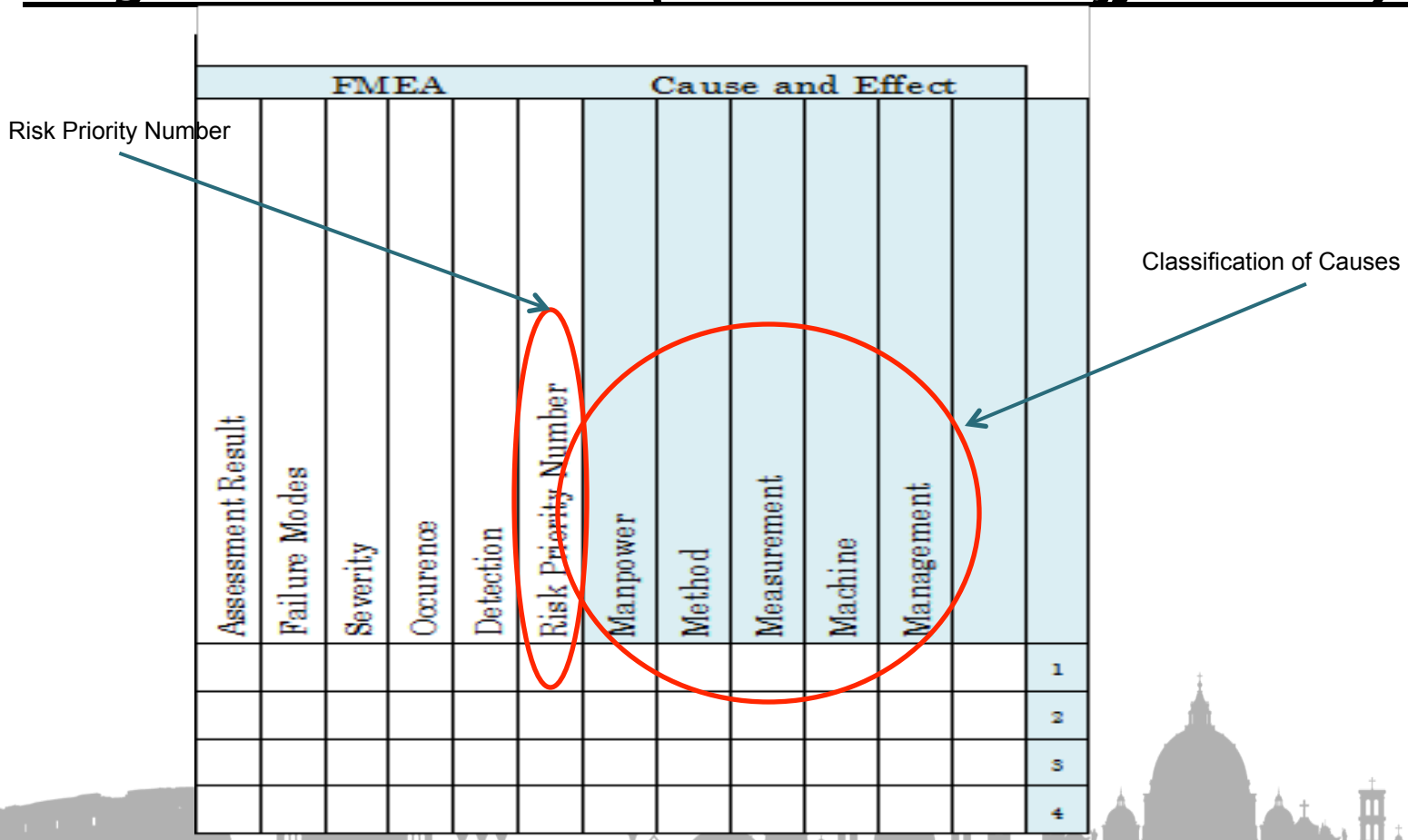
Stage 2: Characterize

- Assess each requirement against the quality attributes (expert judgments)
- Build the correlation matrix.
- Risk Analysis
  - Perform Failure Mode and Effect Analysis
  - Calculate Risk Priority Number (RPN)
- Identify low quality requirements
- Identify causes for each potential defects
- Identify process capability and sigma level

Technical Approach

Requirements Engineering Process Design for Six Sigma

Stage 2: Characterize (Risk & Cause-Effect Analysis)



Technical Approach

Requirements Engineering Process Design for Six Sigma

Stage 3: Optimize

- Eliminate potential defects identified at the earlier stages
- Root Causes are analyzed
- Optimize requirements identified as low quality to change their quality level.

Technical Approach

Requirements Engineering Process Design for Six Sigma

Stage 3: Optimize-Cause and Effect Analysis

- ☐ Effect: 10 Requirements are not understood.
- ☐ Ask Why! Why does this occur?
  - ◘ Because a level of uncertainty is high
- ☐ Ask Why! Why is the level of uncertainty high?
  - ◘ Because there is lack of domain knowledge
- ☐ Ask Why! Why is there lack of domain knowledge?
  - ◘ Because there is no expertise in the area of domain.
- ☐ Ask Why! Why is there no expertise?
  - ◘ Because there is no training
- ☐ Ask Why! Why is there no training?
  - ◘ **It is a company policy!** **ROOT CAUSE** of the problem of requirements not being understood)

Technical Approach

Requirements Engineering Process Design for Six Sigma

Stage 4: Verify/Validate

- Requirements will be validated with stakeholders
- Process capability modeling
- Reliability testing
- Process control plan
- Training

Conclusions

- REDFSS will
  - propose the requirement engineering process model based on the Design for Six Sigma.
  - help the Requirements Engineer to capture the defects in the RE process, measure and eliminate them
  - provide the engineer a way of thinking from the defects and quality of the requirements perspective.
  - analyze the relationship the between process and the quality of the requirements

Questions

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THANK YOU!

Back up Slides

Requirements Engineering Process Design for Six Sigma

Hypothesis

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- Hypothesis 1: “Subject Matter Experts (SMEs) will be able to predict the low quality requirements using REDFSS”
- Hypothesis 2: “There will be a positive correlation between the specific quality attributes determined by REDFSS and the quality of the requirements. The specific quality attributes offered by REDFSS have a direct effect on the requirements quality”
- Hypothesis 3: “There will a positive correlation between the process offered by REDFSS and quality of the requirements.”
- Hypothesis 4: There will be a positive correlation between the quality of requirements and identification and elimination of the root causes

Experimental Investigation

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- 3 organizations with different CMMI Levels will be selected for the experiment. The organizations will include CMMI level 2, 3, and 4 organizations.
- One project with baseline requirements from each organization will be selected. (CMMI Level 2, 3, and 4 projects). The number of requirements and changes to the requirements for each project will be basis for the analysis
- One Subject Matter Expert from each organization whose expertise is in Requirements Engineering will be selected
- Each Subject Matter Expert will evaluate the set of requirements for all of the three projects using the proposed methodology
- All nine evaluations (3 projects * 3 SMEs) will be compared and analyzed against the baseline requirements data (number of changed/modified requirements) . In terms of analysis,
  - Results will be compared to see if the proposed process achieves the intended goals.
  - The hypothesis will be tested