TRAINING IS THE KEY TO SUCCESS

COPE *Capture Opportunities for Performance Excellence*

Failure Mode Effects

Analysis (FMEA)

What is it?

Who needs it?

LEARNING

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- **Baldrige Factors for evaluating processes:**
  - **Approach**
  - **Deployment**
  - **Learning**
  - **Integration**
- **Focus on the Learning factor**
  - **To capture Performance Excellence**
- **Be dedicated to (CPI)**
  - **Continuous Performance Improvement**

Learning & Success

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- The best process will fail when:

The workforce is not trained.

- The best trained workforce will fail when:

The process is flawed.

A Little Bit of History

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- **FMEA previously documented in**

  MIL-STD-1629 (1974),

  PROCEDURES FOR PERFORMING A FAILURE MODE, EFFECTS AND CRITICALLITY ANALYSIS (FMEAC)

A Little Bit of History

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- **FMEA is an established tool for risk management employed by:**
  - **Manufacturers**
  - **Builders**
  - **Six Sigma and other quality management methodologies.**

FMEA and PFA

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- **Could be compared with Feigenbaum's Cost of Quality (COQ) concept (PFA)**
  - **Prevention - Quality planning**
  - **Appraisal - Inspection and testing**
  - **Failure - External and internal**
- **Cost of Poor Quality:**
  - **$1.00 to prevent a problem**
  - **$10.00 to find it**
  - **$100.00 or more to fix it**

Types of FMEAs

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- **FMEAC**
  - **Failure Mode Effects Analysis & Criticality**
- **FMEAD**
  - **Failure Mode Effects Analysis in Design**
- **FMEAP**
  - **Failure Mode Effects Analysis for Processes**

Project Planning

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- ✓ **FMEA is a planning tool to:**
  - – **Identify potential causes of risks.**
  - – **Analyze the impact of those risks.**
- ✓ **A mitigation plan ensures that identified risks are addressed:**
  - – **During the project-planning phase.**
  - – **As the project progresses.**

What is a Failure Mode?

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- **Something that could occur, and might:**
  - **Inhibit the progress of the project.**
  - **Affect the end result (quality).**

  ➢ ***"that could occur"***
  - **The probability of occurrence is less than 100%.**

- **NASA: Flight Assurance Procedure (P-302-720)**
  - **A particular way in which an item fails, independent of the reason for failure.**

Risk Categories

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- **Budget:** Uncertainties related to funding.
- **Indefinite Requirements:** Uncertainties related to customer's/end user's requirements.
- **Technical Challenges:** Uncertainties related to capability of available technology to satisfy requirements.
- **Resources:** Uncertainties related to:
  - Workforce availability.
  - Equipment availability.
  - Facility issues.

A Risk Analysis Tool

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- **The FMEA addresses these questions:**
  - **What event might occur that will affect performance, cost or schedule?**
  - **If it occurs what will be the impact?**
  - **What is the likelihood of it occurring?**
  - **What can be done about it?**

A Risk Mitigation Tool

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- **Identifies actions that might be employed to avoid or mitigate the risk.**
  - **Directed at potential cause and effect.**

The FMEA Worksheet

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Failure Mode and Effects Analysis (FMEA) Worksheet

Project:				Project Lead:					Date:	
TASK	POTENTIAL FAILURE MODE	POTENTIAL FAILURE EFFECTS	SEVERITY	POTENTIAL CAUSES	OCCURRENCE	CURRENT PROCESS CONTROLS	DETECTION	RPN	PLANNED ACTION	ACTION DUE DATE
Funding								0		
								0		
								0		
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								0		
								0		
								0		
								0		
								Project Average RPN		
Enter brief statement of tasks	What is the mode of the failure? Technology? Resource? Time?	What will be the effect of the failure caused by the risk? Rate the severity of the effect in the next column.	1 = Low, 10 = Very High	What are the potential causes of the failure? Rate the likelihood of occurrence of the cause in the next column.	1 = Low, 10 = Very High	What controls are in place to detect the occurrence? Rate the possibility of detection in the next column.	1 = Detectable; 10 = Not	RPN = Risk Priority Number	What actions are planned to mitigate the risk?	When will these actions be taken?

May be for a task, design, part or process

May be for the over-all project funding

FMEA Chart Entries

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- **Entries are made typically by the Project Team Leader.**
  - **Subjective: Based on Team Member's expertise and knowledge.**
    - **Technology**
    - **Work load**
    - **Application**
    - **User**

FMEA Chart Entries

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- **Entries are brief summaries:**
  - **Supported by descriptive statements.**
  - **Included in overall Project Plan.**
  - **Should be reviewed as project progresses.**
    - **Revised as necessary.**

The FMEA Worksheet

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Failure Mode and Effects Analysis (FMEA) Worksheet

Project:				Project Lead:					Date:	
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Tasks: From Work Breakdown Structure (WBS) or Gantt Chart

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Event, or **M**ode of a possible failure. What could happen?

The FMEA Worksheet

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Failure Mode and Effects Analysis (FMEA) Worksheet

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The result(s) of the event:
- ✓ Cost
- ✓ Schedule
- ✓ Quality

The FMEA Worksheet

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Failure Mode and Effects Analysis (FMEA) Worksheet										
Project:				**Project Lead:**					**Date:**	
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Severity of the effect: 1 - 10

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Failure Mode and Effects Analysis (FMEA) Worksheet

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Potential cause(s) of the event, or failure mode.
The Xs?
X_1, X_2, etc.

The FMEA Worksheet

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Failure Mode and Effects Analysis (FMEA) Worksheet

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Funding										
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Likelihood of occurrence: 1 - 10

The FMEA Worksheet

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Funding								0		
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What processes are in place to detect the occurrence, or the cause?

The FMEA Worksheet

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Failure Mode and Effects Analysis (FMEA) Worksheet

Project:				Project Lead:					Date:	
TASK	POTENTIAL FAILURE MODE	POTENTIAL FAILURE EFFECTS	SEVERITY	POTENTIAL CAUSES	OCCURRENCE	CURRENT PROCESS CONTROLS	DETECTION	RPN	PLANNED ACTION	ACTION DUE DATE
Funding								0		
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What is the possibility of detection?
1 = High
10 = Low

The FMEA Worksheet

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Failure Mode and Effects Analysis (FMEA) Worksheet

Project:				Project Lead:				Date:		
TASK	POTENT FAILURE MODE				OCCU	CURRENT PROCESS CONTROLS	DETECTION	RPN	PLANNED ACTION	ACTION DUE DATE
Funding								0		
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								0		
								0		
								0		
								0		
								0		
								0		
						Project Average RPN				
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Identify the "lemons"

Prioritize the risks.
RPN =
Severity X
Occurrence X
Detection
Range = 1 – 1,000

Risk Priority Number (RPN)

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- No standard score level for the RPN.
- Actions are typically based on the top three.
- Coordinated effort with Team Lead, and Team Members.

The FMEA Worksheet

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Failure Mode and Effects Analysis (FMEA) Worksheet

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Funding								0		
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Action plans to mitigate the risk. Should be preventive and aimed at the potential causes and effects.

The FMEA Worksheet

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Failure Mode and Effects Analysis (FMEA) Worksheet

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Schedule the action, when possible (especially for preventive actions). May only be if and when the event occurs.

The FMEA Worksheet

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Failure Mode and Effects Analysis (FMEA) Worksheet

Project:				Project Lead:					Date:		Action Tracking
TASK	POTENTIAL FAILURE MODE	POTENTIAL FAILURE EFFECTS	SEVERITY	POTENTIAL	ENCE		ON		PLANNED ACTION	ACTION DUE DATE	Actionee, status, issues, etc.
Funding											
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								0			
								0			
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								0			
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May be added to track progress on the actions

Action Tracking

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Actions	Actionee	Due Date	Actual Date	Actions Taken	S	O	D	RPN

- Can be added to the FMEA worksheet or as a separate file.

FMEA & DMAIC

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- **How does *F*ailure *M*ode and *E*ffects *A*nalysis (*FMEA*) relate to Six Sigma, *D*efine *M*easure *A*nalyze *I*mprove and *C*ontrol (*DMAIC*)?**

FMEA & Define

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TASK	POTENTIAL FAILURE MODE	POTENTIAL FAILURE EFFECTS	SEVERITY	POTENTIAL CAUSES	OCCURRENCE	CURRENT PROCESS CONTROLS	DETECTION	RPN	PLANNED ACTION	ACTION DUE DATE
Funding								0		
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Define

FMEA & Measure

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Funding								0		
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Measure

FMEA and Analyze

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Funding								0		
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Analyze

FMEA and Improve

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Funding								0		
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Implement/Improve

Opportunities For Improvement (OFI)

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Actions	Actionee	Due Date	Actual Date	Actions Taken	S	O	D	RPN

Due date for Preventive Action

Establish targets for improvements in S, O, D & RPN

Identify and document Preventive Actions
Directed at Causes, Detection, and mitigation of Effects

FMEA and Control

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Funding								0		
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Control

Improve & Control

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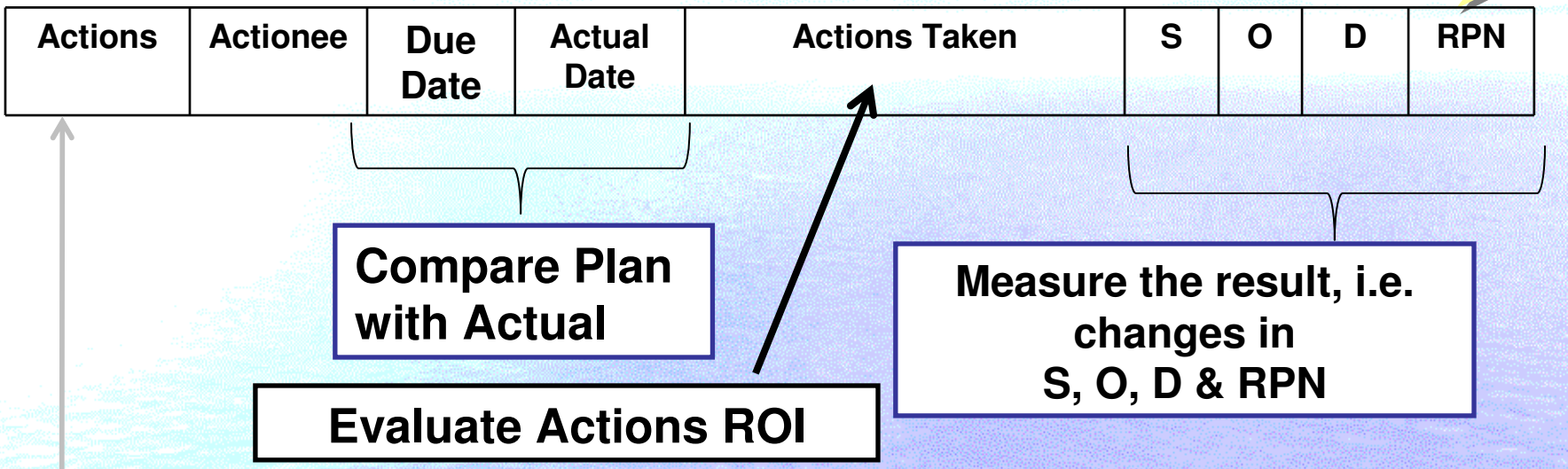

Identify and document Preventive Actions

Failure Modes of FMEA

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1. We've never done it that way.
2. We tried that once and it didn't work.
3. We're not ready for something so sophisticated.
4. We're doing OK the way we are.
5. It will cost too much.
6. We don't have time for that right now.

Success Modes of FMEA

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- ✓ **Team work!**
  - **Team training**
- ✓ **Training on FMEA tools.**
- ✓ **Problem Solving:**
  - **Problem Statements.**
  - **Measures definitions.**
  - **Action Planning.**
- ✓ **Follow-up and analysis.**

Who needs FMEA?

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- **Project managers**
  - **Avoid schedule slippages**
  - **Avoid over-runs**
  - **Avoid injuries**
- **Anyone with an important objective**
  - **Getting the house remodeled**
  - **Getting that degree**

Use with other tools

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- Ishikawa Diagram
- Pareto
- Histogram

Ishikawa Diagram

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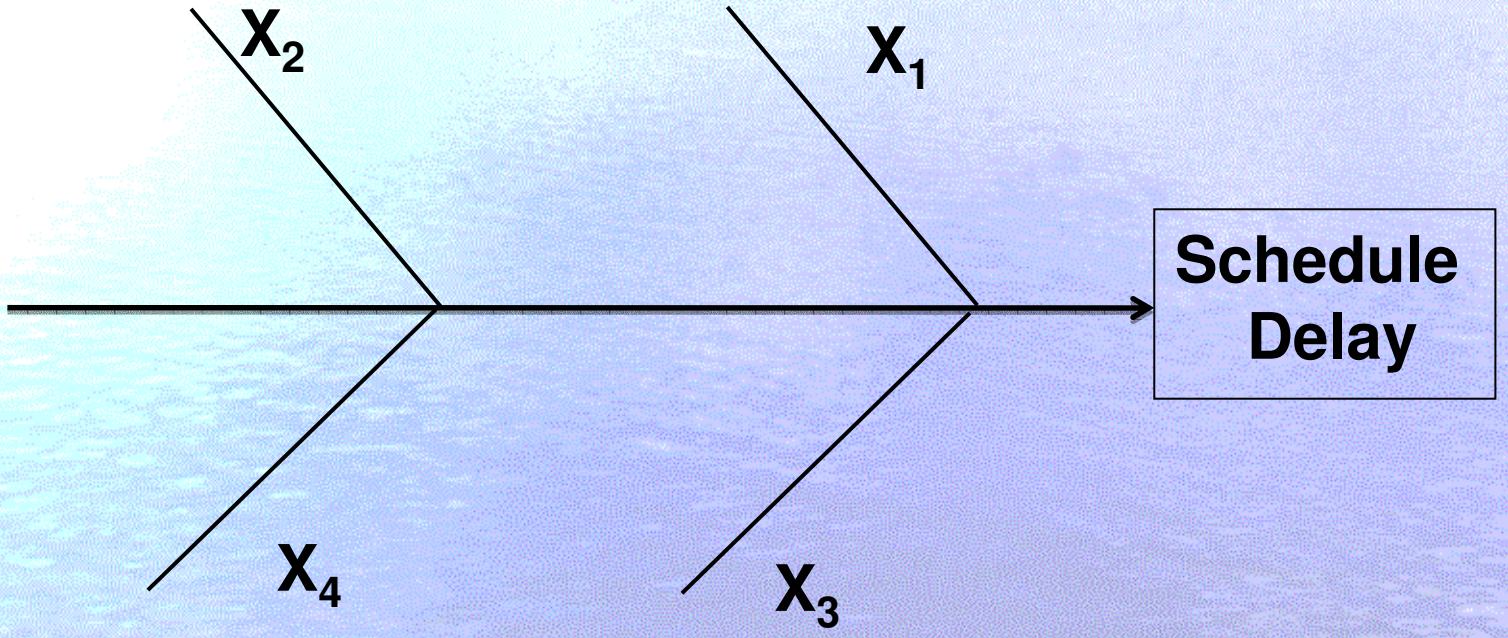

X_2 and X_4 may have low RPNs but both may contribute to schedule delays

Schedule Delay Pareto

All Projects

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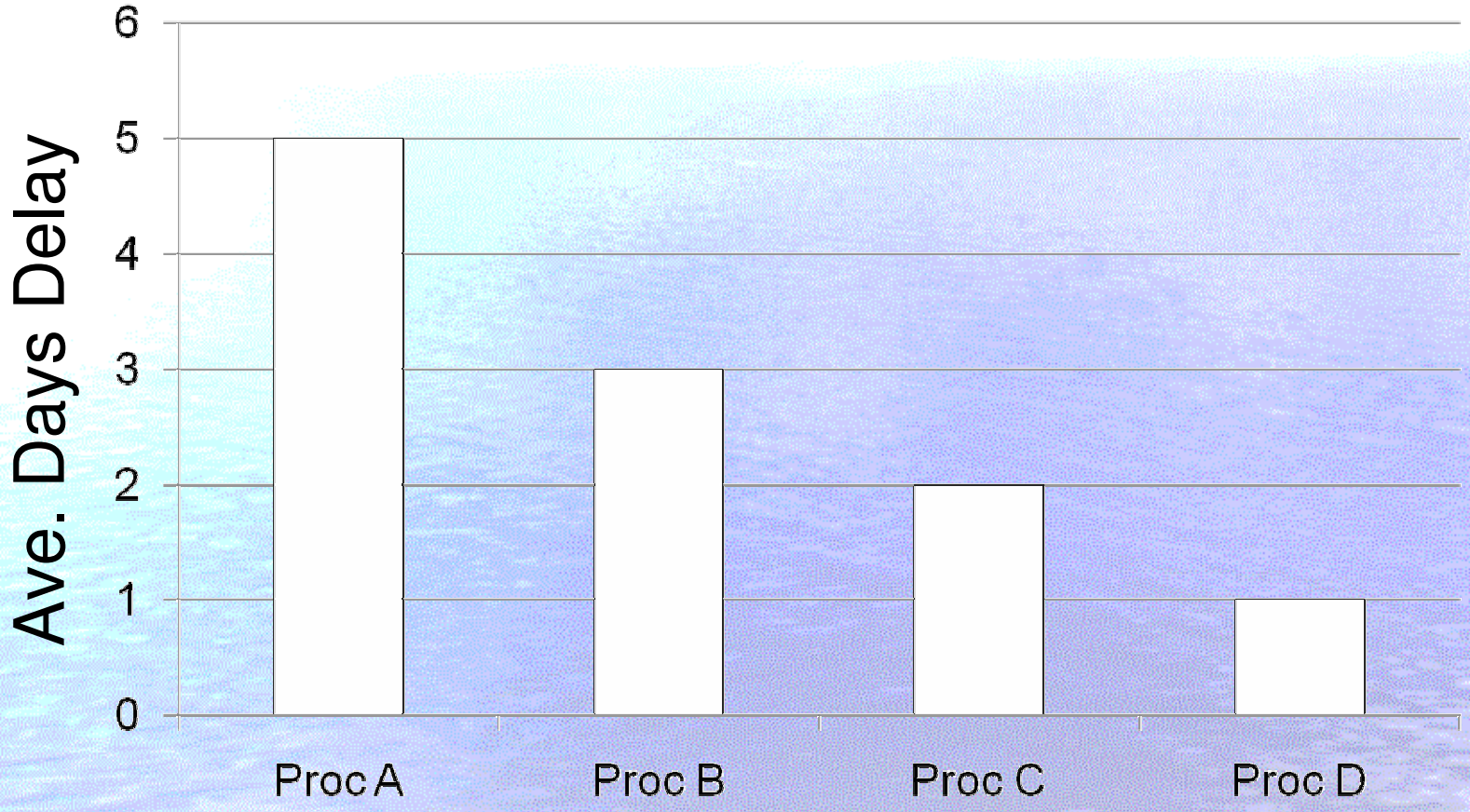

Information Sources

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- **Websites on FMEA**
- **ANSI Webstore (risk management)**
- **ISO Guide 73, *Risk management vocabulary***
- **ISO 31000, *Risk management – Principles and guidelines on implementation***

ISO 31000

Risk Management – Principles and guidelines on implementation

4 Risk management:

a) **Creates value**

b) **Is an integral part of organizational processes.**

c) **Is part of decision making.**

d) **Explicitly addresses uncertainty**

ISO 31000

Risk management(contd.)

e) Is systematic, structured and timely.

f) Is based on available information.

g) Is tailored.

h) Takes human and cultural factors into account.

i) Is transparent and inclusive.

j) Is dynamic

k) Facilitates continual improvement

A New Tool Emerges

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- **Success Mode Effects Analysis (SMEA)**
  - **What worked well?**
    - **Mode**
  - **What does "worked well" mean?**
    - **Effect**
  - **What caused it?**
    - **Analysis**
  - **Can it (the process) be replicated?**
- **A Benchmarking Tool**

Quality is meeting or exceeding stakeholder expectations

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QUESTIONS?

COMMENTS?

FAILURE MODES?

AREAS FOR IMPROVEMENT?