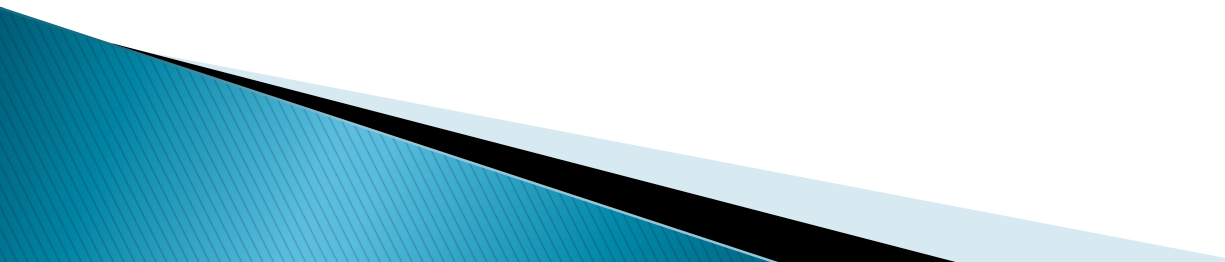


Selecting the Right Reliability Tools

Webinar hosted by Accendo
and presented by Carl Carlson

Webinar Overview

- ▶ What is a “reliability plan”?
 - ▶ Overview of the steps to achieving high reliability
 - ▶ What are the specific steps to selecting the right reliability tools?
 - ▶ How to avoid common pitfalls to reliability tool selection
- 

What is a Reliability Plan?

Let's start with definition of “reliability”

Reliability is the probability that an item will perform its intended function for a designated period of time without failure, under specified conditions.

- Statistical measure
- Intended function
- Designated time.
- Specified operating and environmental conditions.

Let's add definition of “plan”

“A ‘plan’ is a written account of intended future course of action aimed at achieving specific goal(s) or objective(s) within a specific timeframe. It explains in detail what needs to be done, when, how, and by whom.”

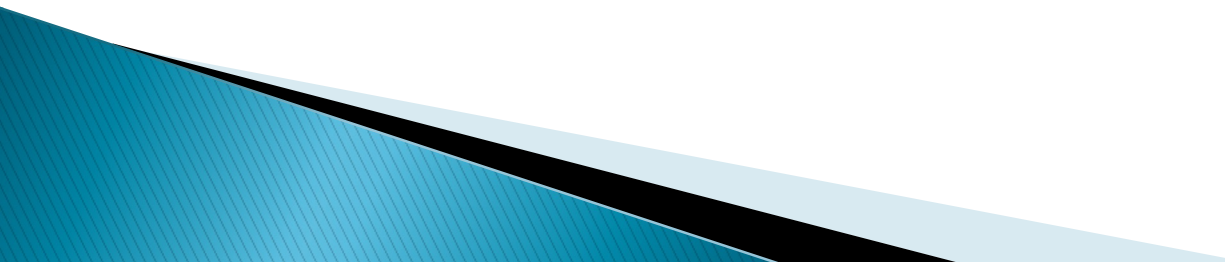
Reference: BusinessDictionary.com



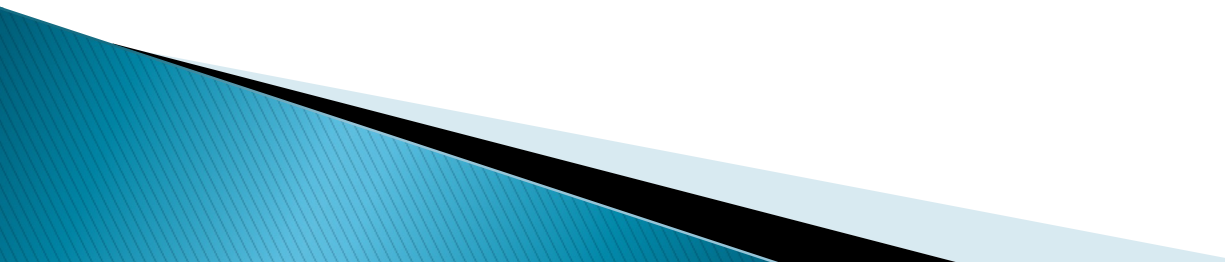
Definition of reliability plan

A reliability plan includes the entire set of tasks that need to be accomplished, including responsibility for execution, timing and resources, in order to achieve reliability objectives.

The objective is to design and manufacture a highly reliable product, on time, and in a cost effective manner.



Description of Reliability Plan

- Reliability plans can be written at generic level (which can be tailored to specific projects), or at project level.
 - It's a roadmap to move project or company from where it is today to where it needs to be from a reliability standpoint.
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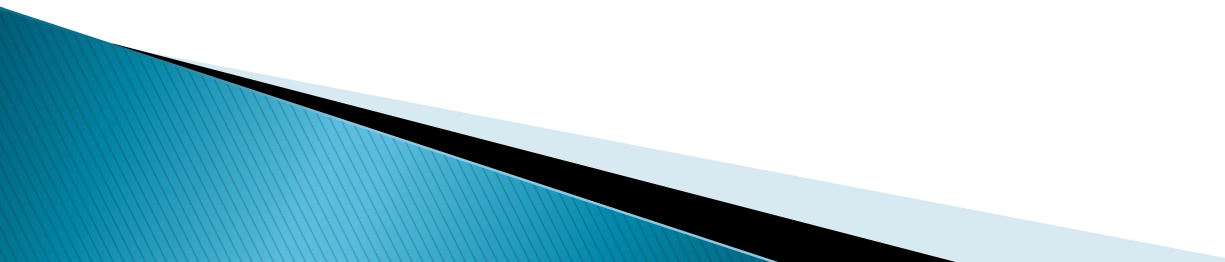
Description of Reliability Plan (cont'd)

- Includes summarized version of reliability strategic vision, reliability “gap” analysis, and full set of tasks, both technical and business, to achieve reliability objectives.
- Each of the tasks should include timing and responsibility, with enough detail to ensure the task is well defined.

The reliability plan specifically avoids a long list of tasks that may exceed resources and capabilities.

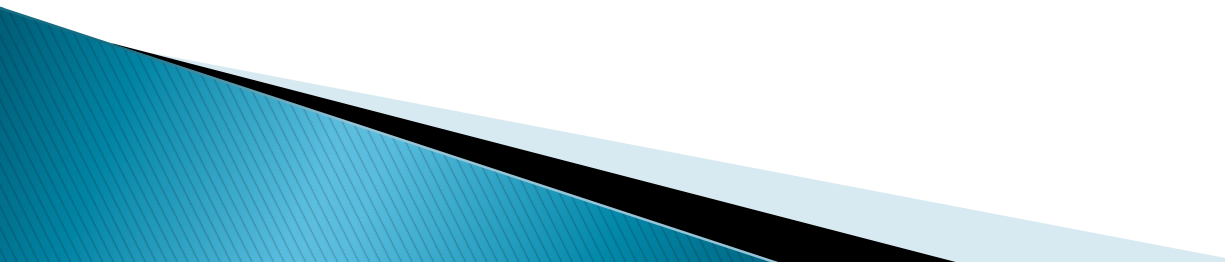
QUIZ 1: Answer the following question about reliability plans

Which of the following best describes a reliability plan? (select one)

1. a list of reliability tools that will be used
 2. a test plan for the product
 3. the entire set of tasks that need to be accomplished to achieve reliability objectives.
 4. a template, like MilStd 785
 5. a statement of intent to achieve reliability goals
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QUIZ 1: Answer the following question about reliability plans

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Reliability engineering versus reliability management

There are two primary disciplines in the field of reliability:

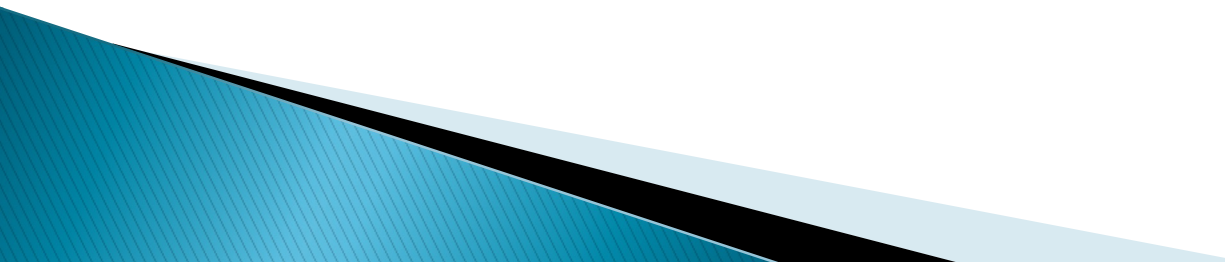
- Reliability engineering is concerned with knowledge and application of specific tasks and methods that achieve high reliability
- Reliability management is concerned with how to establish and successfully execute reliability programs

Developing effective Reliability Plans uses both disciplines



Best practice philosophy

Three important statements summarize the reliability philosophy of successful companies:

- Reliability must be designed into products and processes.
 - Knowing how to calculate reliability is important, but knowing how to achieve reliability is more important.
 - Reliability practices must be integrated into overall product development and design processes.
- 

Which methods best achieve reliability?

Accelerated Testing	Pugh Selection
Block Diagram Development	Quality Function Deployment (QFD)
Design for Manufacturing/Assembly (DFM/A)	Quality Loss Function
Design of Experiments (DoE)	Real World Usage Profiles
Design Review	Regression Analysis/Prediction Modeling
Environmental Characterization	Reliability Allocation
Environmental Stress Screening	Reliability Benchmarking
Error/Mistake Proofing	Reliability Centered Maintenance
Failure Analysis	Reliability Demonstration Testing Rome
Failure Modes and Effects Analysis (FMEA)	Reliability Growth Testing (Modeling)
Failure Reporting & Corrective Action System (FRACAS)	Reliability Modeling and Prediction
Fault Tolerance Analysis (Markov Modeling)	Risk Assessment Draft
Fault Tree Analysis (FTA)	Robust Design
Finite Element Method (FEM)	Root Cause Analysis
Gage Repeatability and Reproducibility	Sampling Procedures
Mission Profile Generation (Product Usage Profile)	Sneak Circuit Analysis (SCA)
Pareto Analysis	Statistical Process Control (SPC)
Part Derating	Variation Simulation Modeling (VSM)
Parts, Materials, Process Review / Control	Warranty Tracking and Information Collection
Probabilistic Design - Stress & Strength Interference	Weibull Analysis
Production Process Capability Study	Worst Case Analysis

So many tools . . . so little time

The

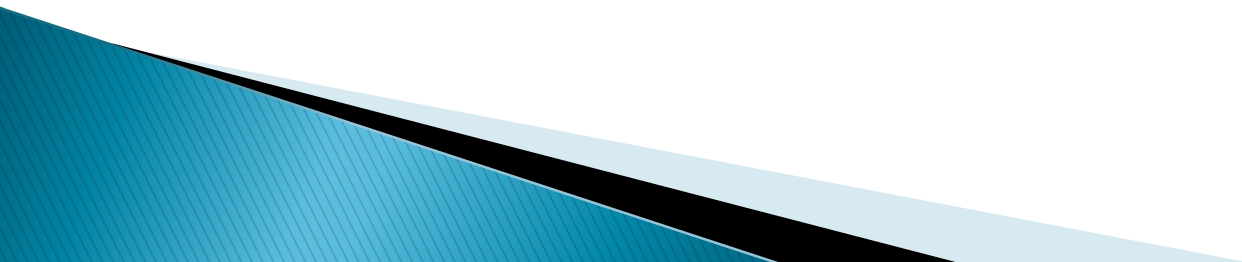
- Select the vital few (effective) reliability tools to drive high quality and reliability based on the circumstances of the program being supported.
- The reliability plan identifies and deploys the right tools for the program.

Selecting reliability tools

common mistake

It is a mistake to copy a list of reliability tasks from some guidebook or template and think you have a reliability plan.

It is essential to identify the appropriate tasks, based on unique circumstances of a project or program, and ensure the tasks are approved by program management, and effectively executed.



Primary Steps to Achieving High Reliability

(High Level)

Step 1:
*Develop
Reliability
Strategic Vision*

Step 2:
*Perform
Reliability Gap
Assessment*

Step 3:
***Select the Right
Reliability
Tools***

Step 4:
*Create
Effective
Reliability Plan*

Step 5:
*Execute
Reliability Plan
Tasks*

Requirements Tasks

Step A:
*Set reliability
targets*

Step B:
*Identify reliability
data needs*

Step C:
*Design-in
Reliability*

Risk Reduction Tasks

Step D:
*Achieve supplier
reliability*

Step E:
*Implement
reliable
manufacturing*

Assurance Tasks

Step F:
*Verify reliability
requirements
met*

Step G:
*Continuously
improve
reliability*

Step H:
*Maintain high
reliability
throughout
life*

Organizational Tasks

Step I:
*Establish
organizational
resources*

Step J:
*Institutionalize
reliability tasks*

Step K:
*Advance Up
Maturity
Matrix*

Step One:

Develop Reliability Strategic Vision


- Begin with the end in mind
- The *envisioned future* from reliability viewpoint
 - Infrastructure
 - Resources
 - Skills
 - Methods capability
 - Reliability of products and processes
- Developed with full management support
- Understood by all employees



Step One:

Develop reliability strategic vision

The following are randomly excerpted lines from reliability strategic vision statements:

- System reliability requirements must exceed benchmark of targeted competition, converted into design parameters, and flowed down to components
 - Reliability represents opportunity to increase credibility with OEMs and business partners
 - Increase focus on design reliability tasks
 - The program will not go forward unless tests demonstrate reliability goals
 - Reliability tasks must be implemented at a rate of change that can be sustained long term (not “program of the month”)
 - Correctly determine contribution of components to overall system reliability
 - Reduce warranty costs by 30% over 5 years
 - Reliability tasks must support shorter development time goals
- 

Step Two:

Perform reliability gap assessment

- Begins with understanding reliability vision, and analyzes shortcomings (gaps*) to achieving the vision
- Identifies capability of current products and processes
- Assesses effectiveness of current reliability methods
- Identifies high-risk areas

* Gaps include both organizational capability and application of reliability methods



Reliability gap assessment *outputs*

- Document outlining shortcomings or “gaps” between reliability vision and current reliability capability, from business and technical standpoint.
 - Lists each “gap” found and summarizes into useable form.
 - Identifies strengths, as these can be leveraged to close the gaps.
- Input to development of effective reliability plan.

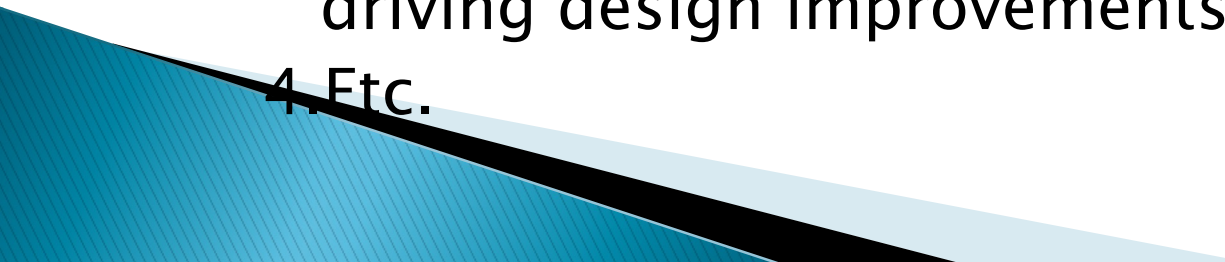
Reliability gap assessment

Partial example of results

Reliability Requirements

- 1.lack of agreed upon definition of “failure” in specs and in use
- 2.System Reliability requirements are not converted into design parameters and flowed down to components
- 3.lack of understanding and use of System Reliability Analysis
- 4.Etc.

FMEAs

- 1.lack of consistent approach to FMEA RPN handling
 - 2.FMEA is not used to ensure field problems are not repeated
 - 3.FMEAs are not achieving the primary objective of driving design improvements
 - 4.Etc.
- 

Reliability gap assessment

Partial example of results (continued)

Reliability Testing & Analysis

- 1.lack of analysis of variable data, such as strength or performance
- 2.there is a limited understanding of reliability statistics and methodology
- 3.most Design Verification testing is “test to bogey” rather than “test to failure”
- 4.Etc.

Other Gaps with Methods/Tools

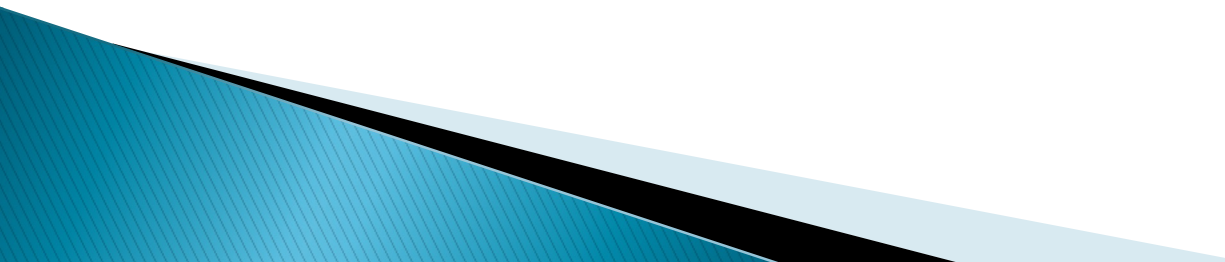
Gaps in Reliability Organization

Gaps in Reliability Process



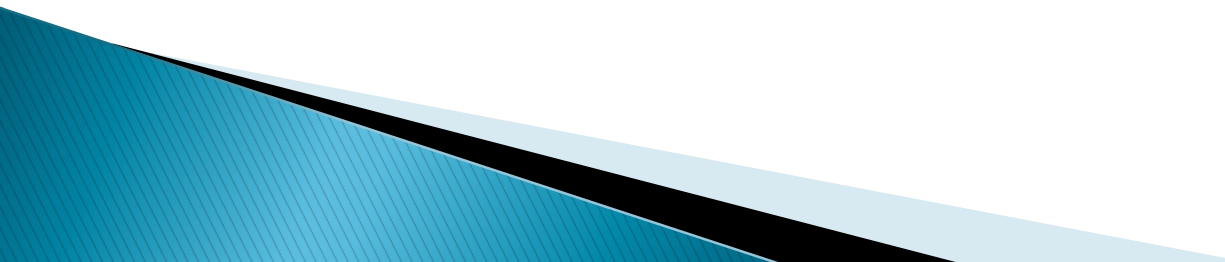
QUIZ 2: Answer the following question about reliability gap assessment?

Which of the following are true statements about a reliability gap assessment?

- A. Gaps include organizational capability
 - B. Includes a list of tasks that will be done to achieve the reliability objectives
 - C. Assesses the effectiveness of current reliability methods
 - D. Includes the completed System and Design FMEAs
 - E. Begins with an understanding of the vision for reliability
- 

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- 

Step Three:

Select the right reliability tools

- Use the reliability strategic vision to set reliability objectives
- Use the reliability gap assessment to select the tools that will close the gaps.



Step Three:

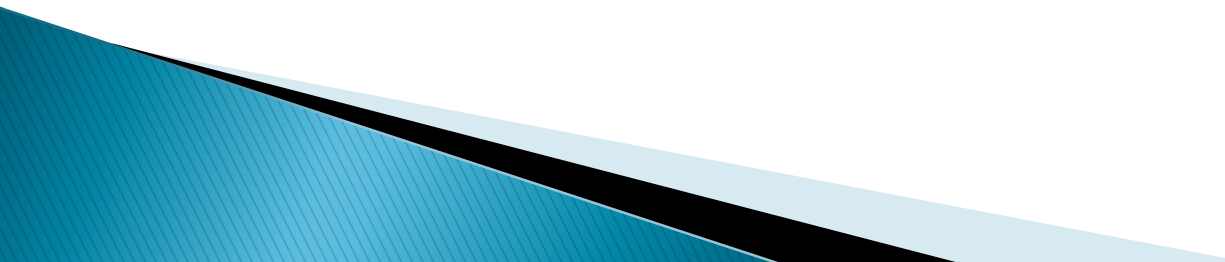
Select the right reliability tools

- Be specific on the tool description.
 - Don't just say "FMEA", say "Design FMEA on Subsystem X"
 - Don't just say "DOE", say "DOE on decal application process"
- If a tool is needed that is beyond current organizational capability, there are two choices. Either:
 - Increase organizational capability
 - Or select alternative tool

Step Three:

Select the right reliability tools

Referring to reliability strategic vision and reliability gap assessment, select vital few tools that close gaps and achieve reliability objectives:

- Requirements tasks
 - Risk reduction tasks
 - Assurance tasks
 - Organizational tasks
- 

Step Three:

Select the right reliability tools

Using one of the examples from gap assessment:

“Reliability Requirements

- 1.lack of agreed upon definition of “failure” in specs and in use
- 2.System reliability requirements are not converted into design parameters and flowed down to components
- 3.lack of understanding and use of system reliability analysis”

QUIZ 3: What tools can be used to close this gap?



Step Three:

Select the Right Reliability Tools

“Reliability Requirements

1. lack of agreed upon definition of “failure” in specs and in use
2. System reliability requirements are not converted into design parameters and flowed down to components
3. lack of understanding and use of system reliability analysis”

What tools can close this gap?

- Reliability requirements definition (using correct definition of reliability and flowing down to design parameters)
- System reliability analysis (including proper training)

Step Four:

Create effective reliability plan

- Establishes the strategy and actions that will achieve reliability strategic vision
- Develops the specific tasks that close the “gaps”
- Pulls together all necessary resources
- Addresses high-risk areas
- Strengthens organizational shortfalls
- What, who, when, where, how



Subject of webinar “Creating Effective Reliability Plans
5/2/2017 at 9 am PT

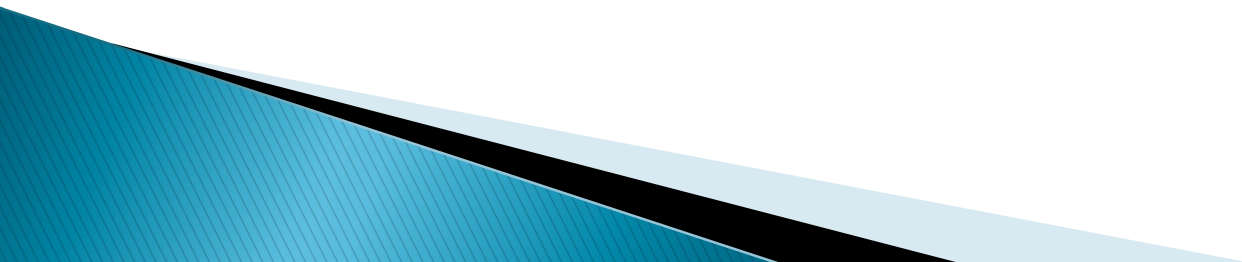
Step Five:

Execute the plan

- Leverage management support to ensure each task is completed
- All gaps are closed
- Reliability objectives are achieved



Case Studies



Reliability Plan

Case Study 1

Reliability project military defense company wanted to ensure missile system met reliability and availability objectives

Observations initial reliability plan was copy/paste of MilStd785, put together by one person with little management support

Actions met with management to discuss their roles in reliability planning; developed comprehensive reliability plan with management input and support

Lesson learned always begin reliability planning with management input and support; don't copy MilStd 785



Reliability Plan

Case Study 2

[Note, this was author's first "reliability plan"]

Reliability project automotive OEM needed plan to achieve reliability goals on new vehicle program


Observations new reliability manager; first time developing reliability plan

Actions identified long list of reliability tools and presented them to project team as reliability plan

Lesson learned a reliability plan is more than a list of tools; it should identify the vital few tools along with execution strategies

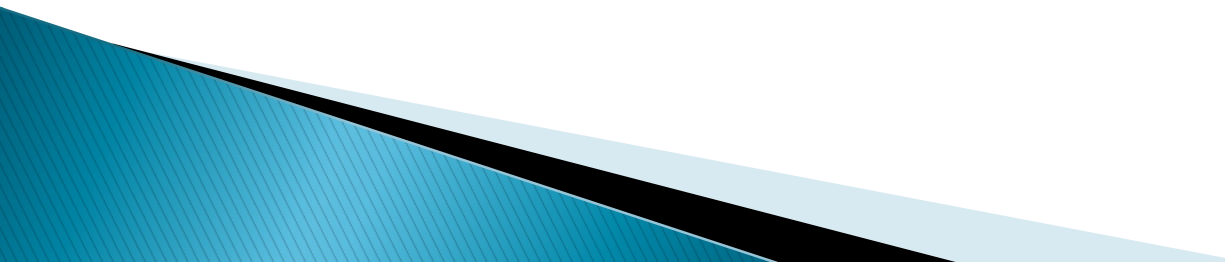
Reliability tool selection

lessons learned

1. Focus on “vital few” reliability tools
 - Avoid inclusion of too many reliability tools in reliability plan
 2. Use the “factor of ten” rule
 - The earlier changes are made to designs or processes the less costly
 3. Emphasize DFR strategies
 - Assure desired reliability is designed into the product
 4. Safety comes first!
 - Treat safety objectives with highest priority
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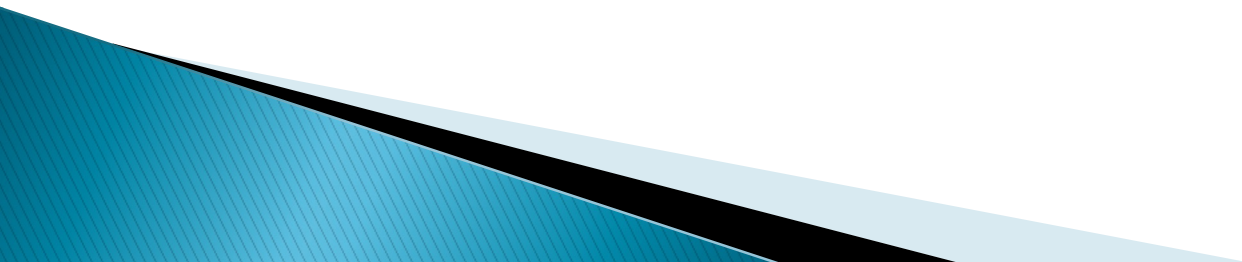
Reliability tool selection

lessons learned

5. Do a reliability gap assessment when developing new reliability plans
 - Important for new technology or new applications
 - Companies have varying abilities to implement reliability tasks
 - Consider tailoring reliability plan tasks to the organization's reliability maturity level (reference Quality Management Maturity Grid, from *Quality is Free*, by Philip Crosby, 1979)
- 

Conclusions

- Developing and executing an effective reliability plan is essential to achieving high reliability for products and processes.
- By following information in this tutorial, the right tools can be selected that support effective reliability plans, achieve reliability objectives, while staying within budget and timing constraints.



Where to get more information

- ▶ Author can be reached at carl@carlsonreliability.com
 - ▶ Website: www.effectivefmeas.com
 - ▶ Standards: SAE JA1000/1 Reliability Program
Standard Implementation Guide (SAE International)
 - ▶ Books: *Design for Reliability*, by Dev Raheja and Louis Gullo; *Practical Reliability Engineering*, by Patrick O'Connor and Andre Kleyner; *Effective FMEAs*, by Carl S. Carlson (John Wiley & Sons)
 - ▶ RAMS tutorial: "Introduction to R&M Management," by Fred Schenkelberg and Carl Carlson
- 