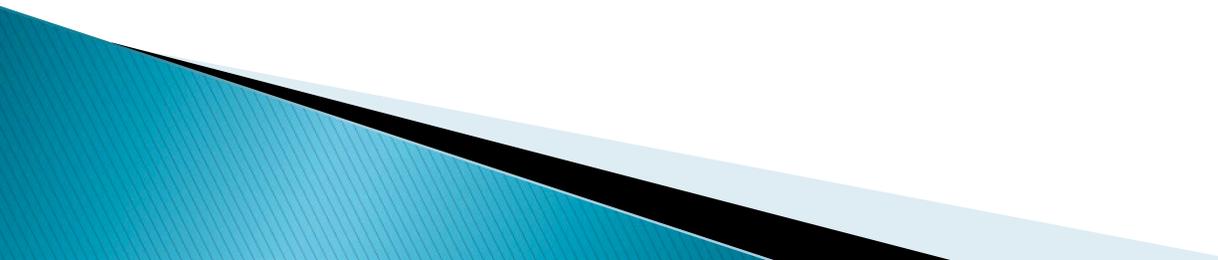


Creating an Effective Reliability Plan

Webinar hosted by Accendo
and presented by Carl Carlson

Webinar Overview

- ▶ What is a reliability plan?
 - ▶ What philosophy should drive a reliability plan?
 - ▶ Primary steps to achieving high reliability
 - ▶ Creating an effective reliability plan
 - ▶ How to avoid common pitfalls
- 

What is a reliability plan?

*“Good things only happen when planned;
bad things happen on their own.”*

Philip B. Crosby

Let's start with definition of “reliability”

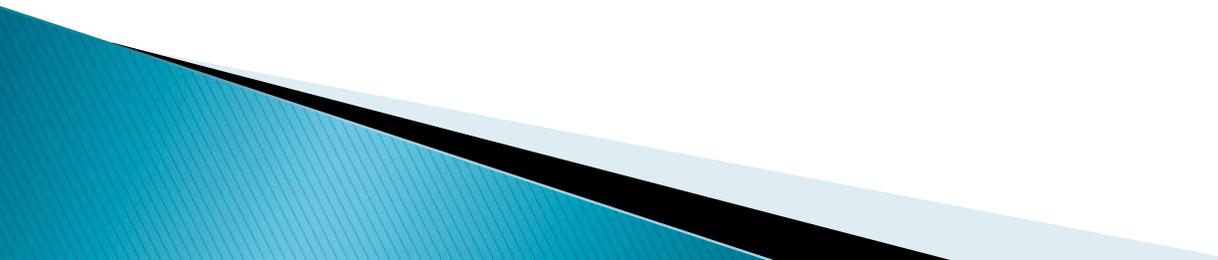
Reliability is the probability that an item will perform its intended function for a designated period of time without failure, under specified conditions.

- 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

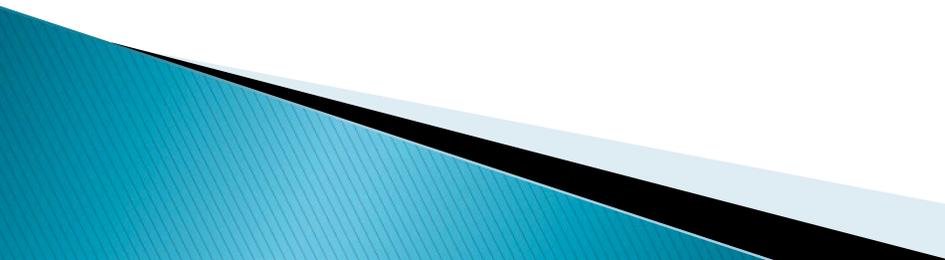


Definition of reliability plan

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.

Reliability plan is not merely . . .

- . . . a list of reliability tasks that are planned
 - . . . a test plan for the product
 - . . . a copy of a reliability plan template like MilStd 785
 - . . . a statement of intent to achieve reliability goals
 - . . . a bunch of general words about how the program plans to achieve reliability objectives
- 

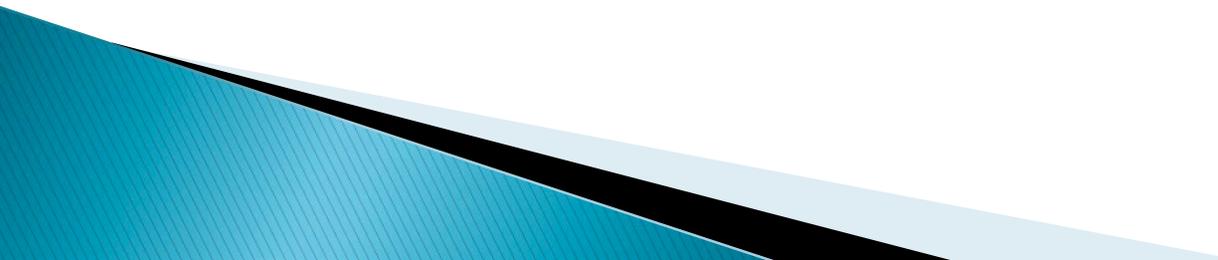
Reliability plan

a word about management

“Management’s attitude toward reliability, expressed through policy, is the most important single ingredient in making reliability engineering and reliability assurance a successful practice in any organization.”

*Handbook of Reliability Engineering and Management
by Ireson and Coombs*

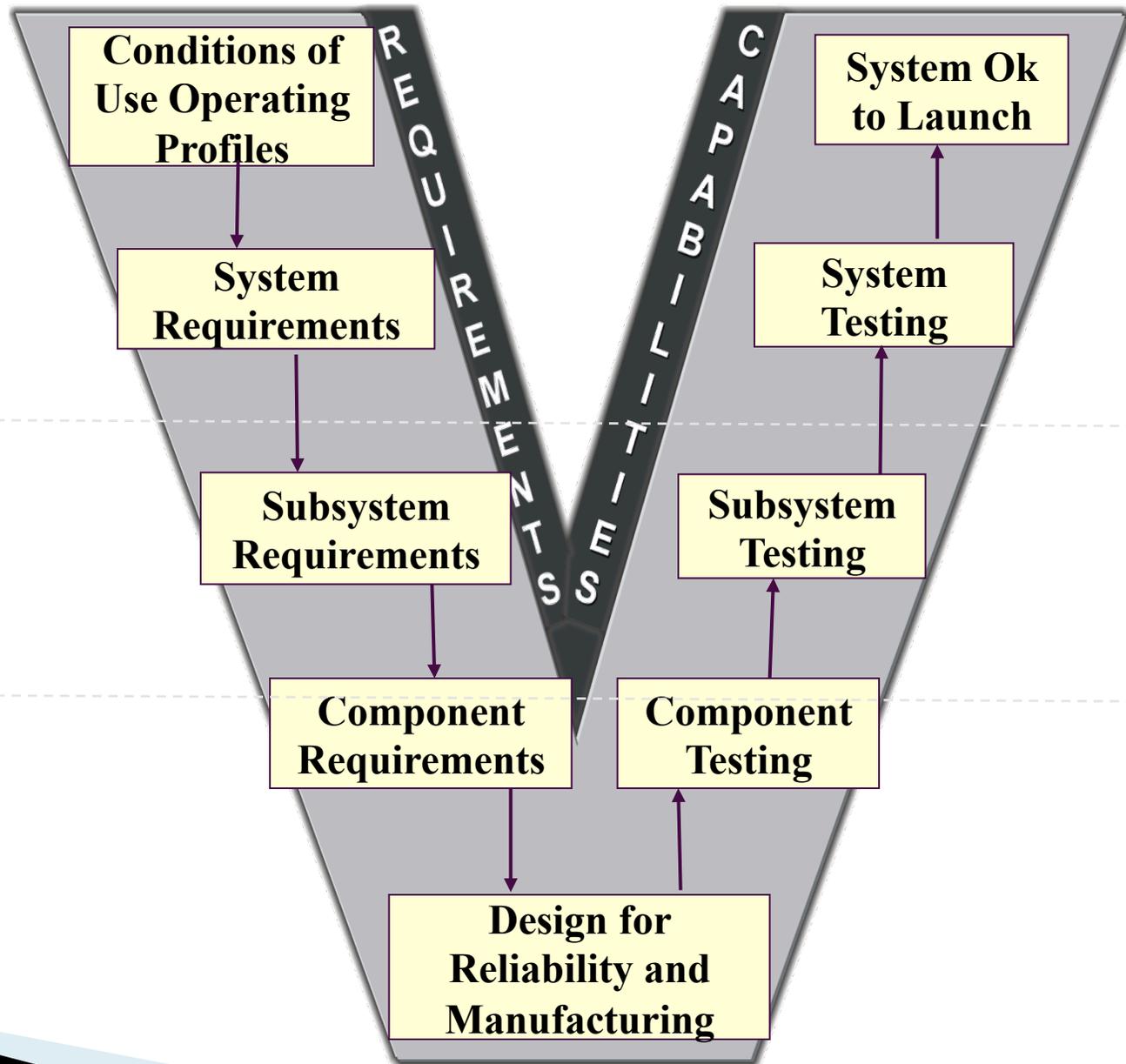
What philosophy should
drive a reliability plan?



*“Intellectuals solve problems,
geniuses prevent them.”*

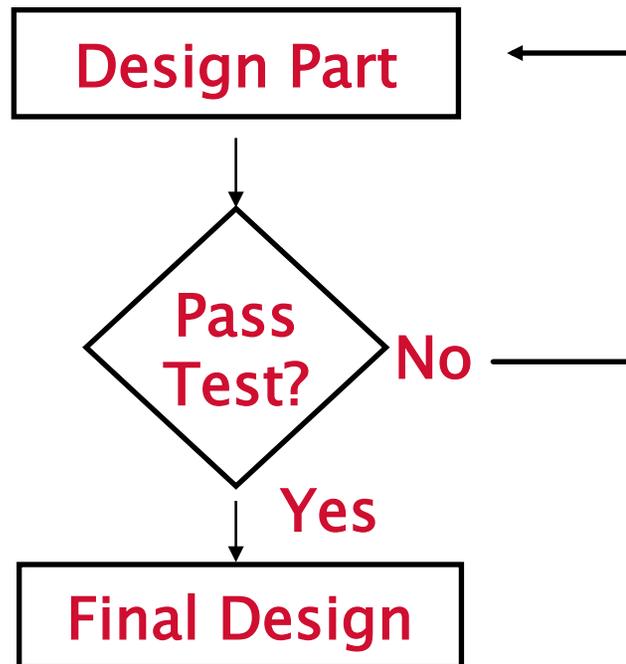
Albert Einstein

Use a systems engineering approach



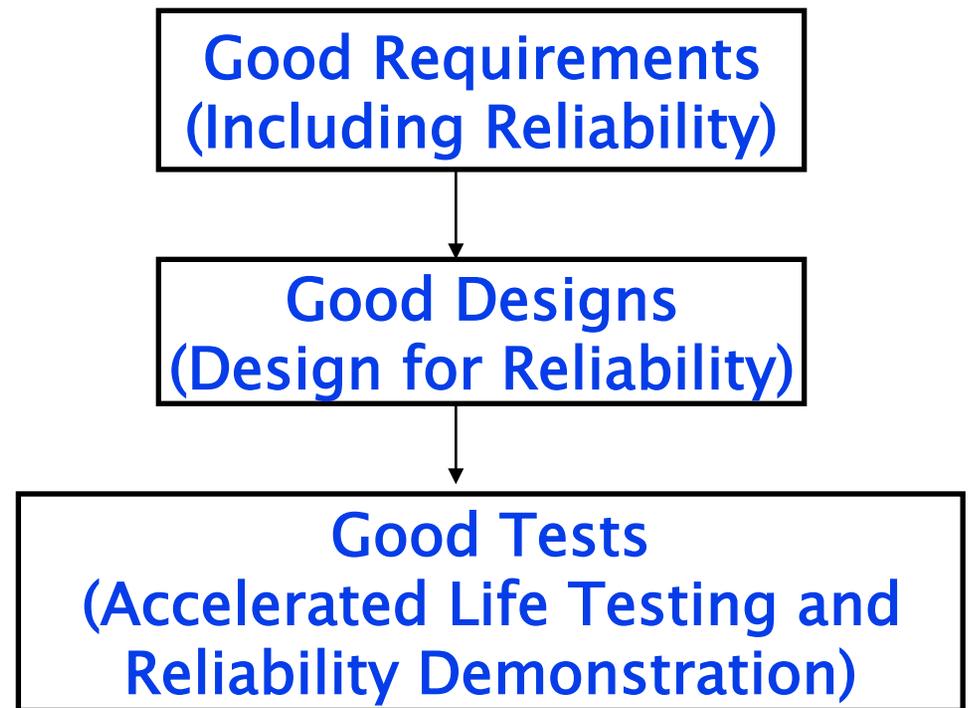
Vision: “Design In” Reliability

Shift Focus From . . .



Test & Fix

To This



Design It In

Consider the Reliability Equation

$$\text{Reliability} = f(\text{Stress, Parameters, Environment, Materials, Usage, ...})$$

Left Side

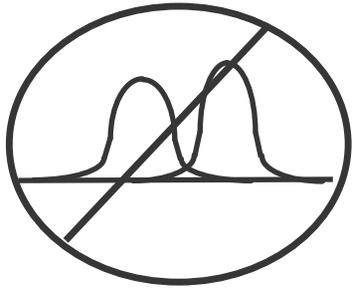
Measure
Reliability

Right Side

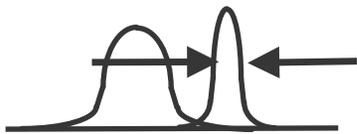
Manage Process Inputs,
Support Reliability in
Design

Where should the emphasis be?

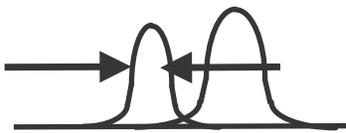
“Design for Reliability” Strategies



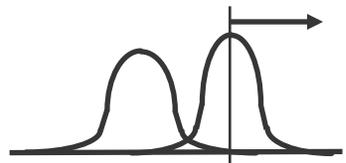
1. Design–Out Failure Mechanisms



2. Reduce Variation in Product Strength



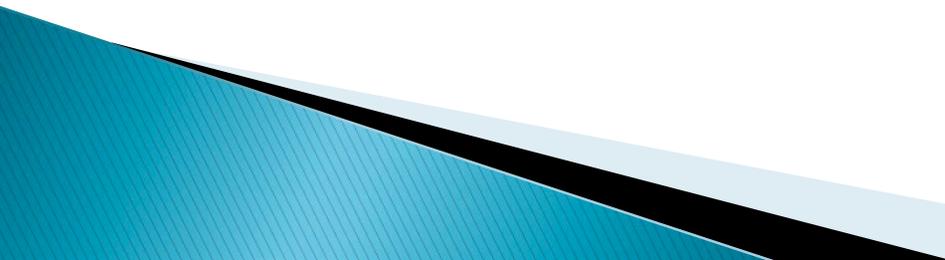
3. Reduce Effect of Usage/
Environment



4. Increase Design Margins

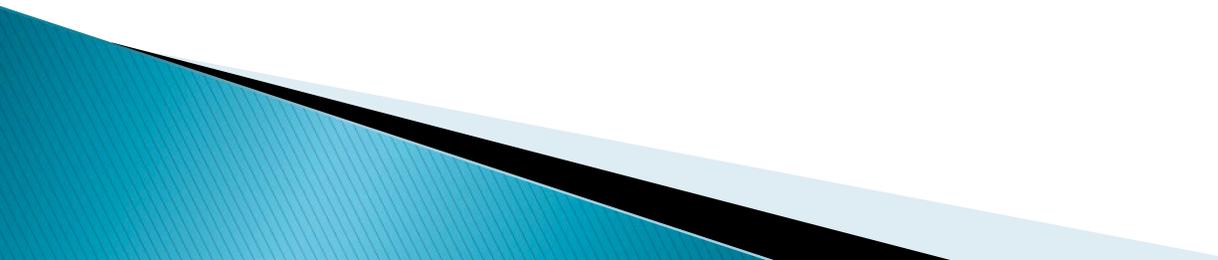
DFR requires knowledge of product and processes,
and understanding of failure mechanisms

Summarizing the philosophy that drives excellent reliability plans

- Requires organization-wide effort
 - Management driven
 - Focus on **prevention**
 - Selection of effective reliability tasks
 - Executed through comprehensive reliability plan
- 

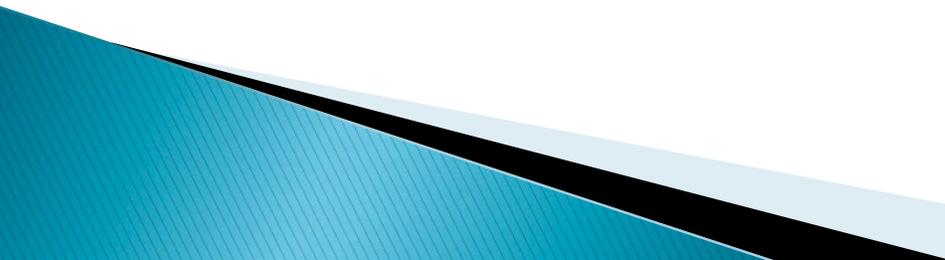
Quiz 1: Which of the following statements are true regarding reliability plans?

Reliability plans . . .

1. are developed and approved by reliability engineer
 2. are driven from bottom up
 3. are written after reliability gap analysis is completed
 4. should focus on fixing problems
 5. incorporate design-for-reliability methods
- 

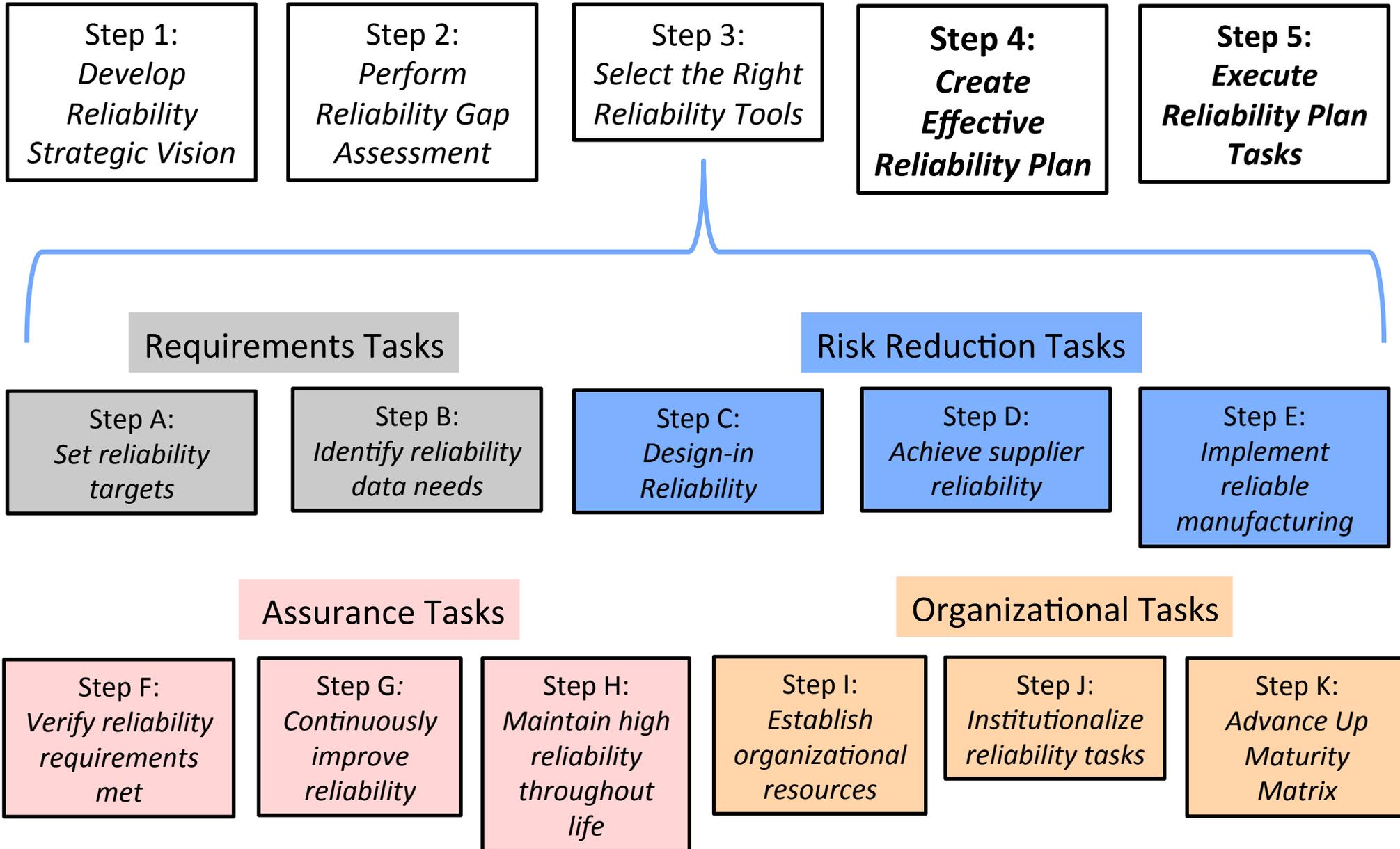
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- 

Primary Steps to Achieving High Reliability

(High Level)



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 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

Step Three:

Select the right reliability tools

- Use reliability strategic vision to set reliability objectives
- Use reliability gap assessment to select the tools that will close the gaps.
- Use pareto principle to identify the vital few tools



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



Transitions from list of reliability tools to specific tasks (what, who, when, where, how)

Step Four:

Create effective reliability plan

Steps to creating an effective reliability plan:

1. Gather the inputs

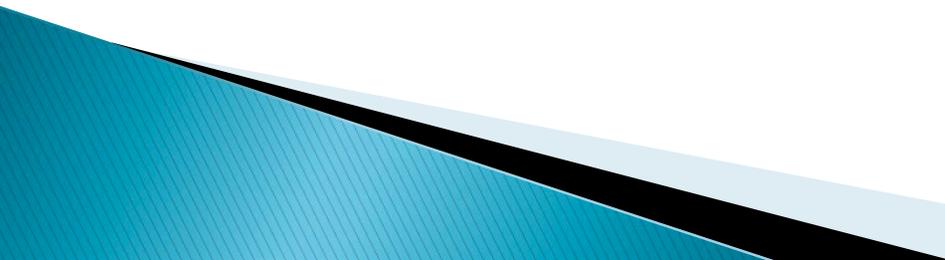
- Reliability strategic vision
- Reliability gap assessment
- List of selected reliability tools

2. Determine the scope of plan

- Program vs project
- Design, manufacturing, service, field

Step Four:

Create effective reliability plan

3. Write the tasks at the correct level of detail
 - Move from tools to tasks and subtasks
 4. Include organizational and method tasks
 5. Put it all together
 6. Get approved by management
 - Interact with management to ensure execution
- 

Reliability Plan

Table of Contents (1st of 3 slides)

1. Summary

(Summarizes purpose and content of reliability plan)

2. Reliability strategic vision

(Outlines overall vision for reliability for the organization or program)

3. Summary reliability gap analysis

(Summarizes gaps between reliability strategic vision and current reliability capability)

4. Reliability philosophy

(Brief statement of philosophy behind reliability task selection)

Reliability Plan

Table of Contents (2nd of 3 slides)

5. Reliability plan tasks

(Provides specific reliability tasks that must be done to close gaps and achieve reliability strategic vision. Tasks need to be well defined (what, who, when, where, how)

- a. Concept stage
- b. Design stage
- c. Assurance stage
- d. Manufacturing stage
- e. Field stage

Reliability Plan

Table of Contents (3rd of 3 slides)

6. Resources and training plan

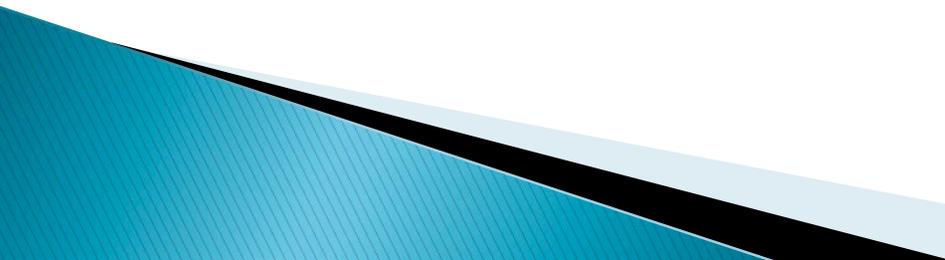
(Outlines specific reliability plan tasks that support resources and training)

7. Business process support

(Outlines specific reliability plan tasks that support business process and institutionalize reliability)

8. Reliability tools reference section

(Appendix section providing specific references for tools in reliability plan)



Reliability Plan

example of one task (1st of 3 slides)

Introduce the task with explanation and context . . .

Develop and use a system reliability model for system ABC

Definition: A System Reliability Model (SRM) is a graphical and mathematical representation of the reliability-wise relationship of the subsystems and components of the system. The SRM is typically expressed as a Reliability Block Diagram, or a Fault Tree.

Application: Early in the product development process the SRM will be used to flow down subsystem and component reliability requirements. It can then be used to make early predictions of system reliability. Later, during reliability testing stages, the model will be updated as the basis for subsequent system reliability predictions and support reliability growth analysis.

Reliability Plan

example of one task (2nd of 3 slides)

Break down the task into executable subtasks, including what, who, when, where, how.

ACTION STEPS *(Overall Responsible: name)*

1. Ensure at least one person is trained in procedure for system reliability analysis (SRM). Assign person and provide training and software.
(Responsibility, Date, Resource)
2. Determine exact system configuration that will be used in the SRM.
(Responsibility, Date, Resource)
3. Develop SRM and use it to analyze system, subsystem and component reliability requirements. *(Responsibility, Date, Resource)*
 - a. Enter the current reliability requirements into SRM at system, subsystem and critical component levels.
 - b. Using SRM, verify reliability requirements flow down is feasible.
 - c. Modify as needed to ensure model reflects system reliability requirements.

Reliability Plan

example of one task (3rd of 3 slides)

ACTION STEPS *(continued)*

4. Use SRM to analyze and predict system reliability as data becomes available. *(Responsibility, Date, Resource)*
 - a. When available, modify SRM with FMEA failure mode frequency information.
 - b. As soon as test data is available, update model with actual test results. The model can then be used to predict impact of component test results on system reliability.
5. Continue updating SRM on ongoing basis, as new test data becomes available.” *(Responsibility, Date, Resource)*

REFERENCES

Technical Guideline “Generate a System Reliability Model”

Quiz 2: You want to include FMEAs in your Widget Reliability Plan. Why is “B” better than “A”?

A. Perform required FMEAs

or

B. Perform required System, Design and Process FMEAs

[Person responsible, target date, resources]

- a. Identify needed FMEAs, based on selection criteria (ref SOP XYZ)
- b. Get list of FMEAs approved by project team
- c. Train FMEA teams, based on training material (ref SOP ABC)
- d. Conduct FMEAs, according to FMEA procedure (ref SOP 123)
- e. Review quality of FMEAs against quality objectives (ref SOP 456)
- f. Set up ongoing reviews of high-risk issues from FMEAs in management reviews

Align reliability plan tasks to product development process

Concept Stage	ex: <i>Generate System Reliability Model</i>
Design Stage	ex: <i>Perform Design Margin Analysis</i>
Assurance Stage	ex: <i>Develop accelerated life test methods</i>
Mfg Stage	ex: <i>Implement screening/monitoring plans</i>
Field Stage	ex: <i>Implement ongoing FRACAS process</i>
Organization	ex: <i>Hire two reliability engineers</i>

Keep in mind that each task must be described in sufficient detail to enable execution

What is management's role?

Best stated by Dr. W. Edwards Deming:

“Support of top management is not sufficient. It is not enough that top management commit themselves for life to quality and productivity. They must know what it is that they are committed to — that is, what they must do. These obligations cannot be delegated. Support is not enough: action is required.”



Step Five:

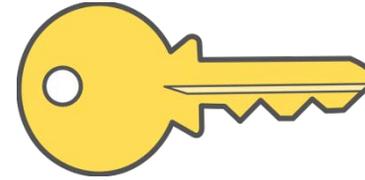
Execute the plan

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



Step Five:

Execute the plan – the key



- Reliability plan is developed with management support and approved by management
- Assignment of person responsible for individual tasks is across organization (not only reliability)
- Tasks are written in sufficient detail (what, who, when, where, how)
- Tasks close known gaps and achieve reliability objectives

Reliability Plan

Case Study

Reliability project tier one supplier developing new transmission system for unique application

Observations company had no reliability plan; two months until first prototype; no agreed-upon system requirements; improper FMEAs; no design margin on critical subassembly

Actions met with management to discuss shortcomings; developed reliability plan including system requirements, proper system FMEA, design margin analysis

Lesson learned one of the first steps in reliability planning is good system requirements

Creating Reliability Plans

lessons learned (1st of 2 slides)

1. Understand role of management
 - Reliability engineering is different subject than reliability management
 - Management must be involved throughout development and implementation of reliability plan
2. Create structured mechanism for execution
 - Include management buy-in of initial plan
 - Provide necessary resources and review progress
 - Remove roadblocks to on-time execution

Creating Reliability Plans

lessons learned (2nd of 2 slides)

3. Clearly define roles and responsibilities
 - Reliability cannot be executed from bottom-up, it must be supported from top-down
 - Incorporate into employee job descriptions
4. Reliability subject matter expertise is required
 - Assigned reliability person has training in reliability methods
5. Understand the importance of “people” skills
 - Reliability is a team-based effort
 - Develop “people” skills: working on teams, effective meetings, presentation, facilitation skills

Conclusions

- Developing and executing an effective Reliability Plan is essential to achieving high reliability for products and processes
- By following the information in this tutorial, companies can develop effective Reliability Plans that achieve reliability objectives, while staying within budget and timing constraints

Where to get more information

- ▶ Questions about this presentation or any other reliability topic: Carl@CarlsonReliability.com
- ▶ Websites: 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)
- ▶ Tutorials: ARS tutorial: “How to Develop an Effective Reliability Plan”, by Carl Carlson (2013); RAMS tutorial: “Introduction to R&M Management,” by Fred Schenkelberg and Carl Carlson (ongoing)