

# FMEA THROUGH THE PROJECT LIFECYCLE

PREPARED FOR RAMS TRAINING SUMMIT XII

NOVEMBER 13<sup>TH</sup>, 2019

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# UNDERSTAND THE FMEA PROCESS

WHO? -> Reliability, Design, SME, Testing, Quality, Manufacturing, Maintenance, Service

WHAT? -> Bottom-up (inductive) study of a design / process's failure modes, and their effects

WHEN? -> From absolute beginning of the design process, and continuing through project lifetime

WHY? -> Improve safety and reliability, Identify and remove single point failures, decrease cost. *Changes throughout the project lifecycle.*

# NOTIONAL FMEA

Hardware Item, Process, or Service under study	Failure Modes	Failure Causes	Failure Effects (Integrated)	Severity (Criticality)	Detection Methods	System Response / Action	Controls / Mitigation	(RPN)
Sensor	Erroneous Output (on scale)	Component failures, loss of power, physical stress, etc	Depends on integration - effect from loss of (reliable) information	Depends on scale and vehicle effects	None	None	Tests or inspections, other	*
	Erroneous Output (off scale)				Sense off-scale reading	Disqualify Sensor		
	Individual Pin Failures				Depending on effects	Depending on effects		
...								

NOTIONAL, DOES NOT REPRESENT REAL HARDWARE OR FAILURE EFFECTS

# *Outcomes by Project Phase*

- Concept -> Influence the design architecture
- Preliminary Design -> Influence the design at a functional level  
Train engineers on systems, for integration @ later stage
- Detail Design -> Influence the design at a detailed level  
Create test + inspection plans  
Prepare for Troubleshooting & RCA
- Produce + Operate -> Generate 'lessons learned' for design  
Add data for Troubleshooting & RCA

# *Outcome $\propto$ Resources Invested*

And we need 100% of the outcome! Often, 1 failure is too many!

- Analyze lower levels of assembly  
get more design influences,  
get more safety improvement,  
price -> more work
- Don't under-analyze!  
FMEA only protects from  
failures when it is comprehensive



# LEVEL OF ANALYSIS : VEHICLE EXAMPLE (E.ENG)

System broken out into increasing levels of detail, exploring one of many paths.

The FMEA is a “Bottom-Up” Analysis – where is the bottom?

Need to identify the lowest level to perform analysis, to create useful work.

Rule of Thumb: Seek to ‘analyze out’ uncertainty.

VEHICLE	
(Subsystem)	Controls
Assembly 1 Assembly 2 ...	Sensors Processors Connectors
Propulsion	Structure
Engines Tanks Valves	Tanks Supports Skins
...	...

Vehicle  
Controls System  
Sensor  
Circuit  
Component  
Terminal

# Summary

- Concept, Preliminary -> Analyze available data (system to hardware)  
Influences Architecture, Functional Design, and prepares RE's to integrate analysis in later phase
- Detail Design -> Analyze from bottom up ("hardware level")  
Influences Detailed Design, Test/Inspection Plan and prepares for maintenance & RCA
- Produce + Operate -> Further analysis generates lessons learned (variable)  
Influences Future Design, R&M Models