THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

RELIABILITY AND FAILURE ANALYSIS LABORATORY

How does the FMECA Support Reliability Engineering?

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Objective

- **Understanding a FMECA**
- **How FMECAs support Reliability Engineering**

Why does reliability matter?

Mission Reliability

- **The probability that a part will perform its designed function without failure for a specified mission duration under stated conditions of use.**

- **The essential factor of reliability is part failure.**

Elements of a FMECA

- **Specification of Part Nomenclature and Identification Code**
- **Definition of sources of failure mechanisms that act on the part**
- **Definition of failure mechanisms that act on the part to include metrics (tensile load, psi) – causes of failure**
- **Definition of failure modes caused by the failure mechanism – damage to the part – to include metrics (strain, in)**
- **Definition of the failure effects resulting from the failure modes – symptoms of the failure mode**
- **Definition of the failure effects on the assembly (next higher design configuration) – consequences of the failure mode**

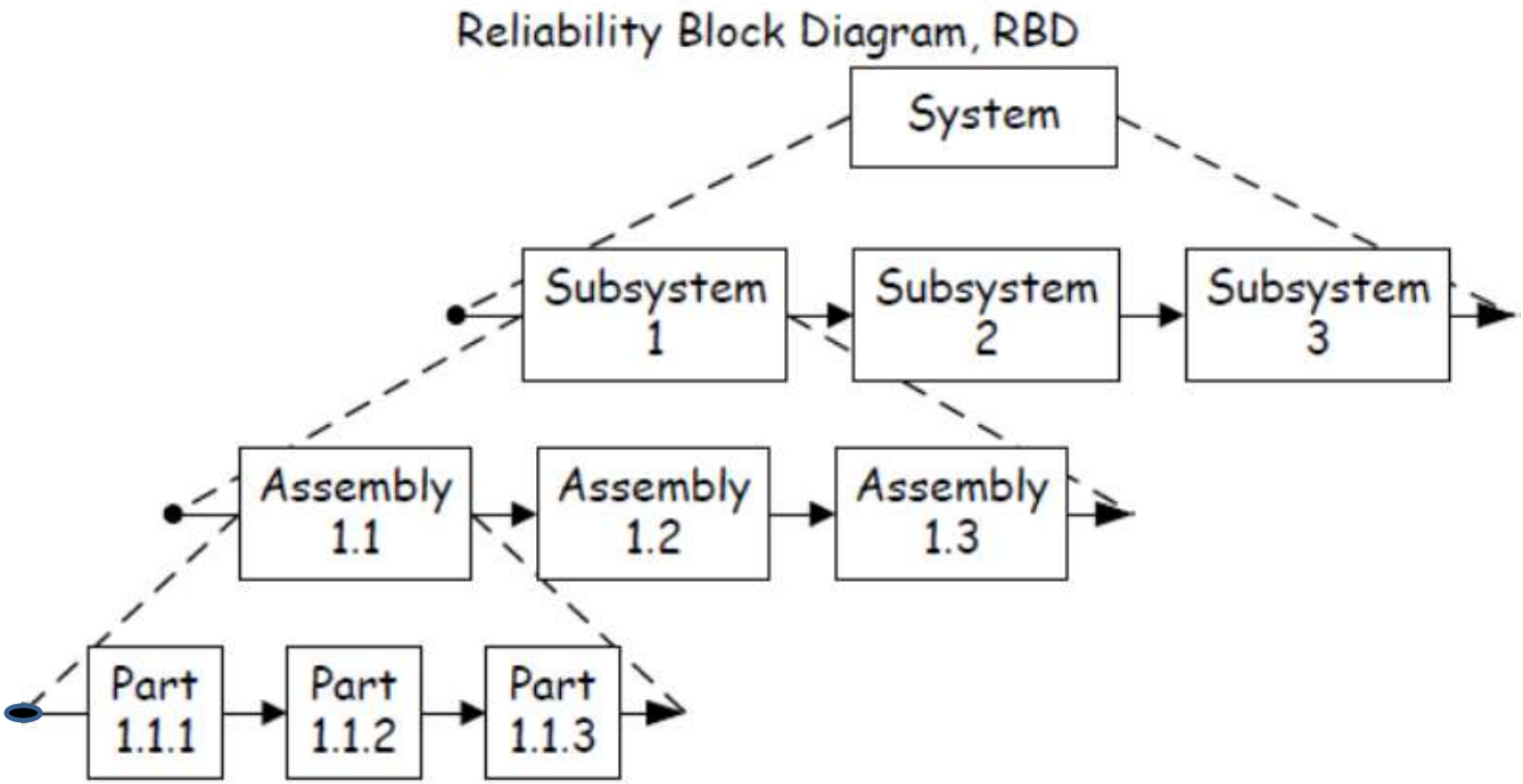
Notional FMEA

SYSTEM: Automobile						
SUBSYSTEM: Starter				Failure Effects		
Part Number	Part Nomenclature	Failure Mechanism	Failure Mode	Local (Part)	Next Higher (Assembly)	End (System)
ABC-01-123	Starter Motor	Vibration	Loosens wire connector	Short circuit	Starter subsystem fails to function	System does not start
			Mounting bracket fractures	Starter motor fasteners fail	Wiring stressed by displacement of starter motor	None
		Corrosion	Wire connections lose connectivity	Intermittent loss of circuit	Starter subsystem erratic	Intermittant system starts
		Low temperature	Mechanism locks up	Start fails to function	Starter subsystem fails to function	System does not start
		Moisture				

The Role of the FMECA in Reliability Engineering

- **The FMECA enables the design engineer to:**
  - **Understand part failure**
  - **Determine fault detection and fault isolation**
  - **Develop a critical items list**
  - **Design reliability experiments for critical parts**
  - **Develop a reliability block diagram**

Reliability Block Diagram Example



How FMECAs influence design?

- Part Selection
- Assembly design configuration
  - Serial LRU design
  - Active Parallel
    - Parallel-in-series
    - Series-in-parallel
    - n-Provided, r-Required
  - Standby parallel
  - Shared load
- Testability Requirements

How FMECA Supports System Engineering and Integration

- **System reliability, maintainability, and availability allocation to the LRU (top-down)**
- **LRU reliability, maintainability, and availability integration to the system (FMECA-bottoms up)**

How FMECAs Support Sustainability

- **Determines critical part maintenance requirements**
- **Learning curve for maintenance practices**
- **Key input to implementation of reliability centered maintenance**

Summary

- **FMECAs provide an understanding of part failure:**
  - **Influences design**
  - **Integral to systems engineering and integration**
  - **Provides understanding of maintenance requirements**

Questions?