

# Design FMEA as input for the Reliability Test Plan

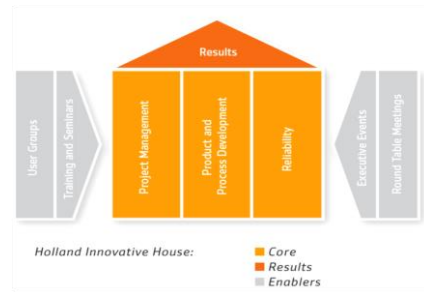
## PLOT Showcase

Eindhoven, November 21, 2017  
Ronald Schop  
Sr. Director Reliability

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# Holland Innovative House



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- Results
- Enablers

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# HI Market Segments

HighTech Energy Automotive Health Agro&Food



Business Drivers:

- Reduction of Complexity – Sustainable solutions
- Short Time To Market – Right Product with Right Design
- Cost control – Cost of Non Quality reduction



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# Reliability Validation Testing

## Testing according to Standards / Guidelines

- Relation test – Customer usage?
- How many samples to test?
- What Reliability can be expected after test completion?

## Is a "standard test" valid for New Concepts... ?

- New functions
- New failure modes
- How to prove a Minimal Reliability?
- Is the "Standard Environmental Testing" sufficient?

## Alternative: Test Plan Creation using

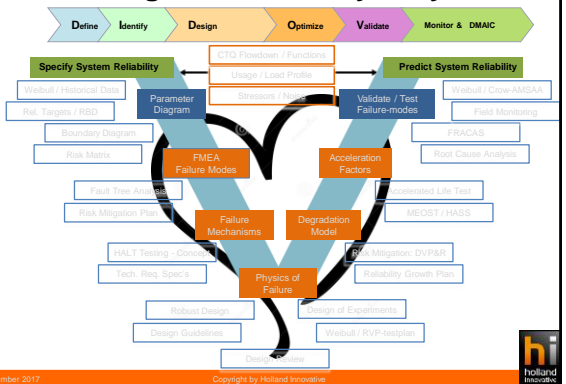
Design - FMEA & Test Substantiation



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# Design for Reliability V-Cycle



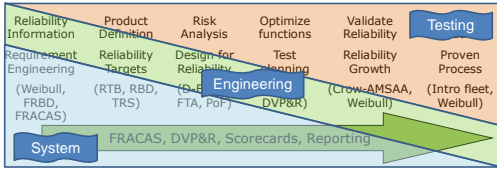
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## Design of the Reliability Test Plan

Team effort in all Engineering disciplines  
Applies to hardware & software



Includes co-designing with key suppliers AND to all supply chain manufacturing processes



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## Test Plan Creation Process

### 1 - Requirements Engineering

- Functional decomposition
- Determine the CTQ's
- Measurability

### 2 - Risk Analysis

- Design FMEA
- Risk Mitigation Plan

### 3 - Test Engineering

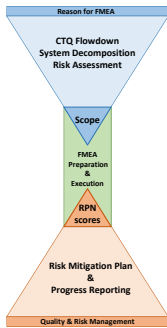
- Customer Usage Profile
- Physics of Failure
- Accelerated Life Testing (ALT)
- Type of testing
  - Zero-failure testing
  - Test to failure



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## FMEA: The Drill Down ...



Requirements Engineering  
Scope & Prioritization

Risk Analysis: FMEA  
Preparation & Execution

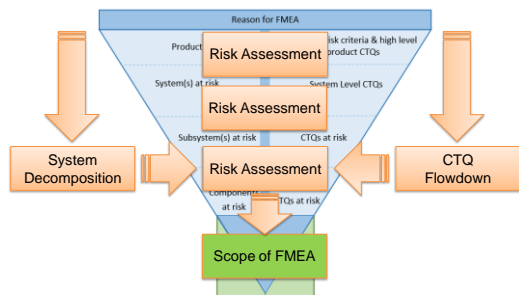
Risk Mitigation  
Design Validation Plan



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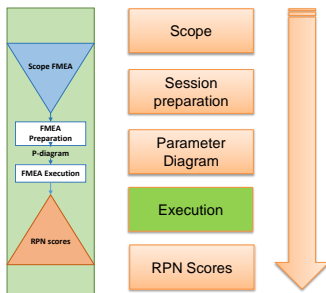
## Scope Preparation & Prioritization



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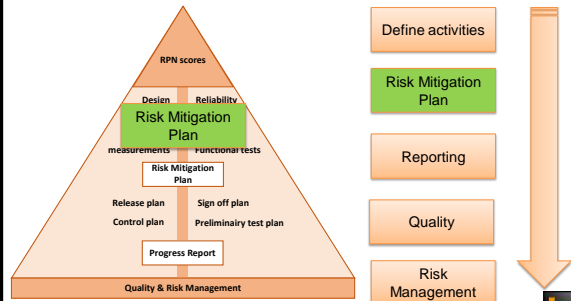
## Risk Analysis: FMEA Session



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## Risk Mitigation



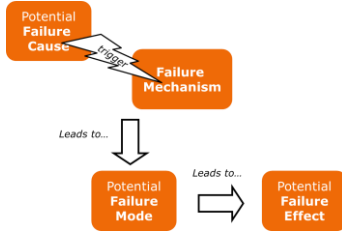
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## Physics of Failure (PoF)

### What can cause the Failure Mode?

- Design weakness which may result in the Failure Mode
- Cause = Initiator - Stressor and Failure Mechanism



## Effect – Mode – Mechanism - Initiator

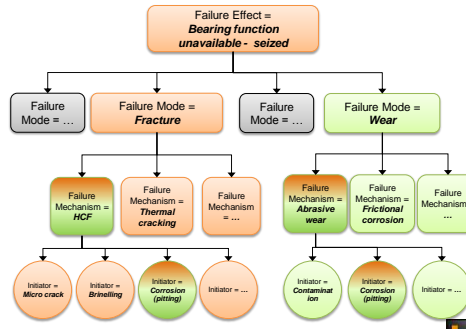
FAILURE EFFECT

FAILURE MODE

FAILURE MECHANISM

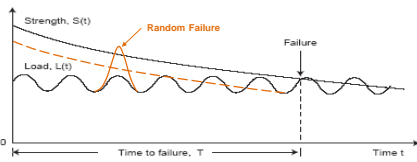
AND

INITIATOR

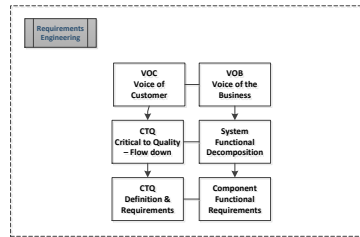


## Failure is a Time dependent process

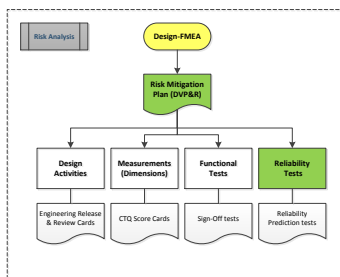
The probability of failure is increasing in time.  
Last part of the Bath Tub curve



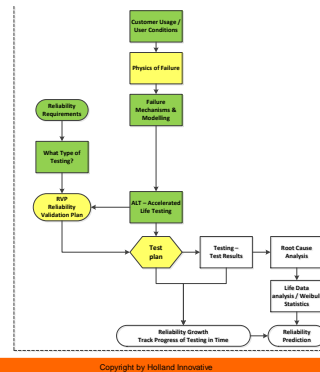
## 1 - Requirements Engineering

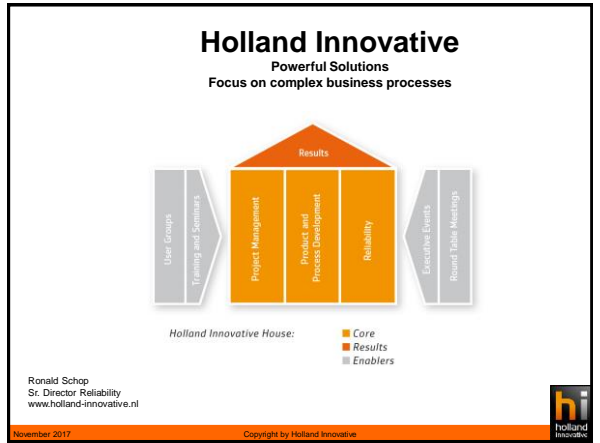
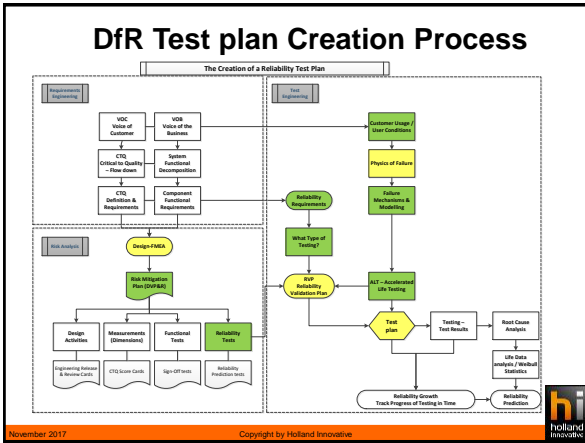


## 2 - Risk Analysis - FMEA



## 3 – Test Engineering





# Questions?

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