Mystery of Magic Mouse

From Use case to Failure Mechanism based Reliability Test Plan

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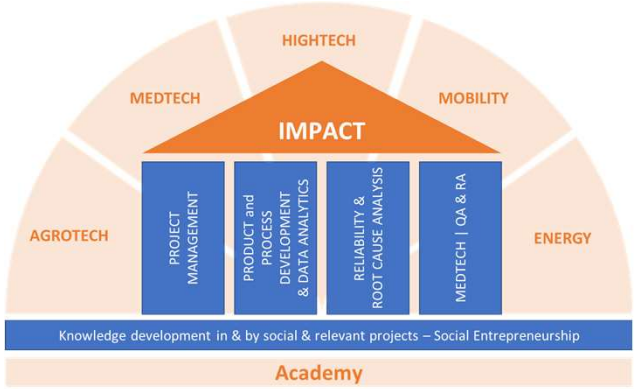
POWERFUL SOLUTIONS

Introduction



Elly van den Bliek

Competence Lead Reliability & Root Cause Analysis & Safety

- Reliability, DfR, Functional Safety, RCA, also DfSS, Six Sigma
- HighTech, Automotive, Energy – Smart Meters, Aerospace, Process Industry
- Over 25 years of experiences in Reliability and Functional Safety
- HI – DfR Reliability Academy – Trainings, workshops, seminars

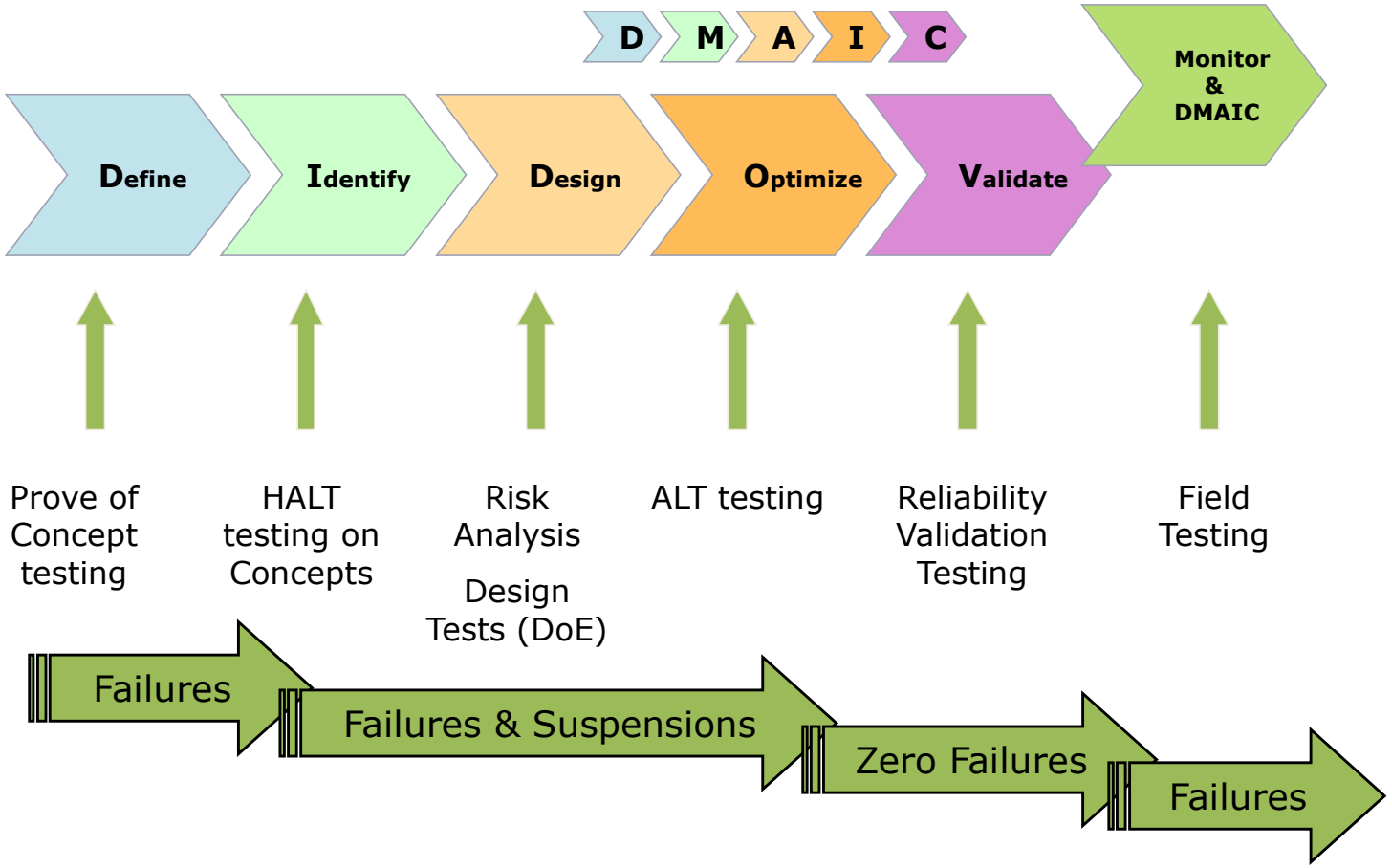
Today's Stuff

- ~~Reliability Testing in Product Development~~
  - ~~Some starting points~~
  - ~~Drivers~~
  - ~~How to~~

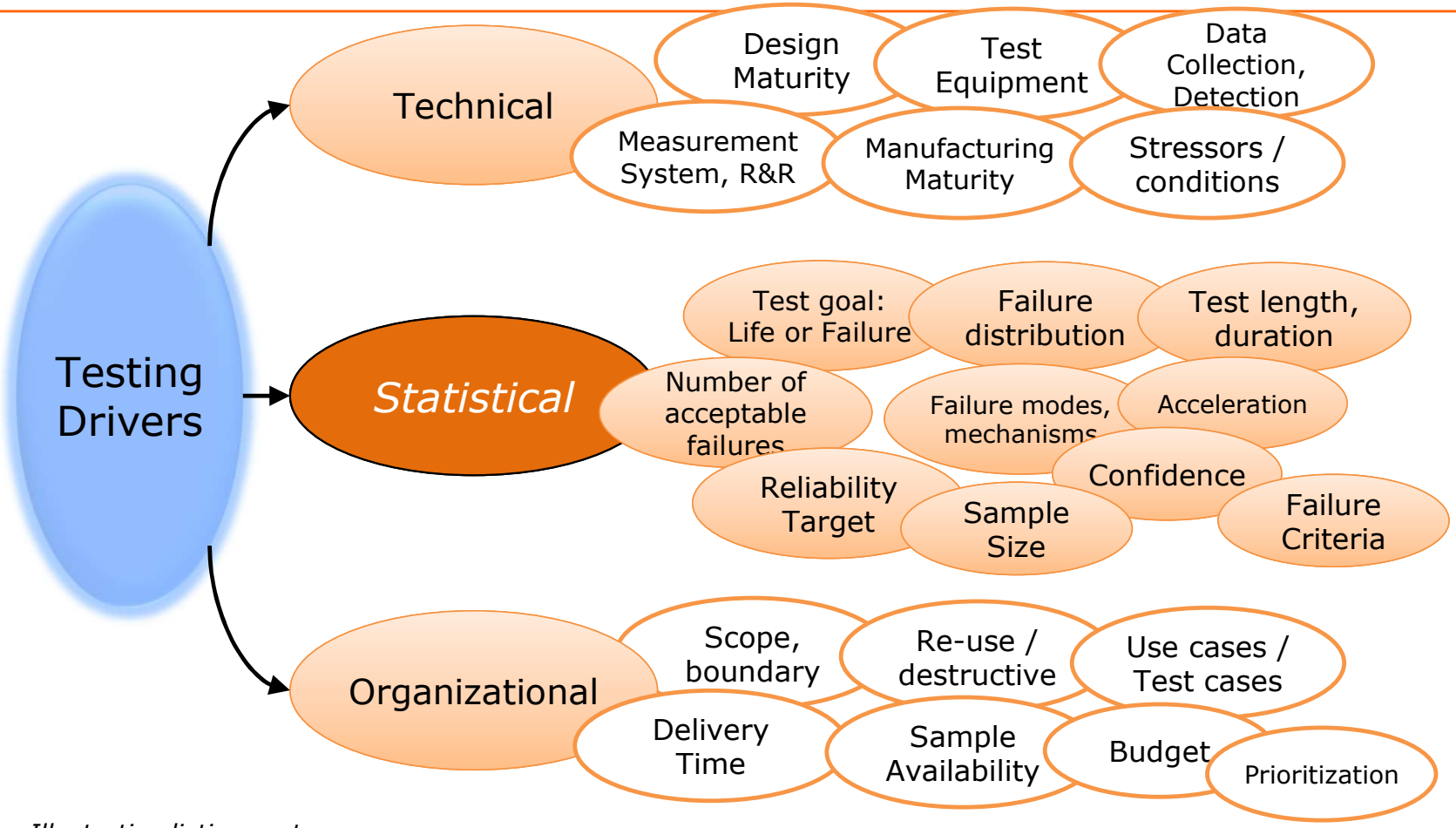
- Creating a Reliability Test Plan
  - Product & Functions
  - Use case
  - Failure mechanisms
  - Some statistics ?
  - Test Plan

- Using consumer product as Case

Test for Reliability in Product Development



Drivers in Reliability Testing



Illustrative listing, not intended to be complete

How-to ?

CTQ's – FMEA – Test plan flowchart

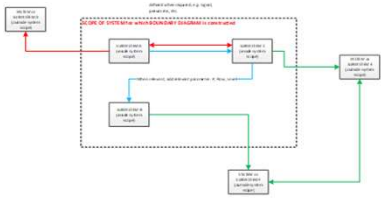
Test Plan Flowchart…a rigid version so let’s do it together

a rigid version
so let’s do it
together

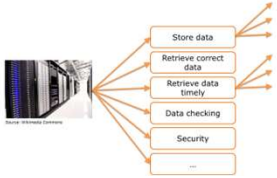
Product in question: Magic Mouse

- Let's go through the steps…or 'wing it' ?
- In-scope, Functions
  - out-of-scope
- Users – Market – Application
- Reliability ?
  - Requirements (Target)
  - Expectations

More details on ‘what’s it about’



Define Product *Boundaries, Structure*

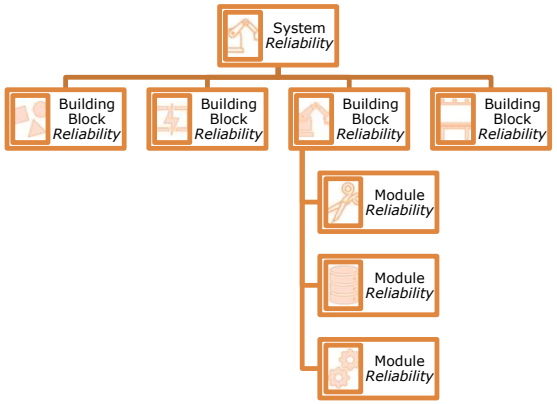


Product *Functions*…into Functional Breakdown

CTQ flowdown

Set *Priority* and Create *Focus*

95% ? 98% ?
99% ? 99.99% ?



Set Reliability/Availability *Requirement…*

Budgetting and Allocation

More details on ‘what’s it about’ Loads, Use, Failures

Determine Loads, Load profile

- Stressors, Levels
- Translate external into internal

Use Cases

- With worst-case, mis-use, use profile
- Operational conditions

Assess Failure Behavior - *PoF*

Failure Modes → Failure Mechanisms

Assess R & M – *Time, Parts, Diagnostics*

									CURRENT DESIGN				
No	Item	Function	Requirement	Potential Failure Mode	Failure Effect: on Item and Next Level	SEVERITY S	Failure Cause	Failure Mechanism	Prevention Controls	OCCURRENCE O	Detection Control	DETECTION D	RPN Risk Priority Number	Recommended Actions

Assess Risks – *FMEA*

Definition of a *product*

- Definition of product
  - Subsystems, Modules, Components
- Scope of Supply, responsibility, design
- Boundary Diagram – System Lay-Out
  - Including Interfaces
  - Interactions
- Breakdown
- Operational states

Definition Mouse

Product - Function

- What is a Function ?
  - **What** the product should do
  - **Not: How** the product should do it
- What is a system's Function ?
- Does a system have more than 1 Function ?
  - All equally important ?
  - All equally complex to engineer ?
  - All same reliability ?

Functions Mouse

- For User
- For Developer
- For Manufacturer
- For distributor, sales, warehouse, …

Reliability Target / Requirement

EXAMPLE Reliability requirement

For reference gear box, excluding interfaces, maximal 0.03% is allowed to fail catastrophically @ 50 kkm or 2,000 gear changes and maximal 1,5% is allowed to fail catastrophically @ 240 kkm or 10,000 gear changes (whichever comes first) for light-duty usage in city-traffic in low-end Asian market, proven with 90% confidence level using reliability tests & statistical data analysis.

Mouse ?

Reliability Target Mouse ?

- Depends on supplier ?
- Per Function ?
- What about use cases ?

Use Case(s)

- Design Life
- Users – Applications
- Use Case(s)

Design Life, Use Cases / Load Diagram

- The time that you expect the customer will use your product.
- For what Design Life is the product developed?
  - What is the average, 90 percentile, what distribution?
  - Where are we designing for?
  - What metrics… Years, Day's Operating hours, prints, cycles, …

- How will your customer use the product ?
  - Customer Use Cases
  - User conditions
  - Operating profiles
  - Load profiles
  - ….
  - Include; Specials (Transport, Installation, Service, Repair, ….)

Design Life Mouse ?

- In calendar time ? Or operational hours ? Or movements ?

Users – Applications Mouse ?

- Consumer
  - Home office
  - Gaming
  - …
- Professional
  - Office worker
  - Outside use
- User profile
  - Light – average / typical – heavy
  - Mis-use, foreseeable mis-use
  - 90%, 90% worst-case, …

Use Case Mouse

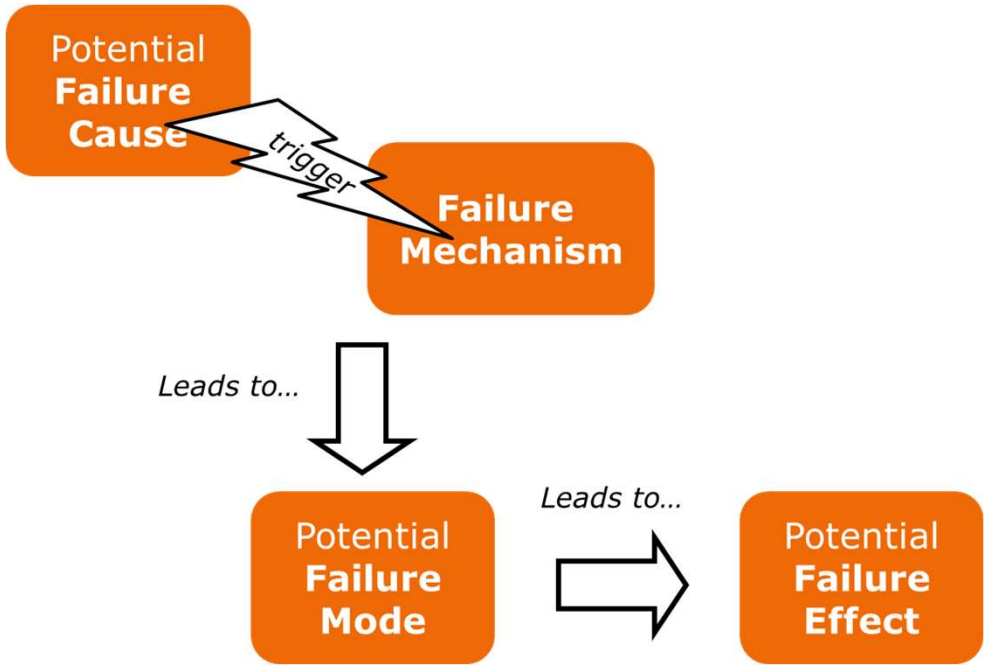
- For gaming…
  - Include Functions
  - Loads ? Load profiles ?
- For office worker…
  - Include Functions
  - Loads ? Load profiles ?
- Reliability target(s) ?

Failure modes & mechanisms

- From and in use case
- How can it fail ?
- Function → Failure Mode(s)
- Failure Mode ← Failure Mechanism(s)
- Causes ?

Physics of Failure --- Sequence of Events

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



Failures Mouse ?

- Physics of Failure ?

Reliability testing

- Which Function and Use Case ?
- Accelerated ?
- Zero-failure Testing or Test until all have failed ?
- Statistics or ‘wing it’ ?

RVP Reliability Validation Plan

- The Full Package
- Link

Microsoft Excel
ro-Enabled Works

Break !!!

Thank you !

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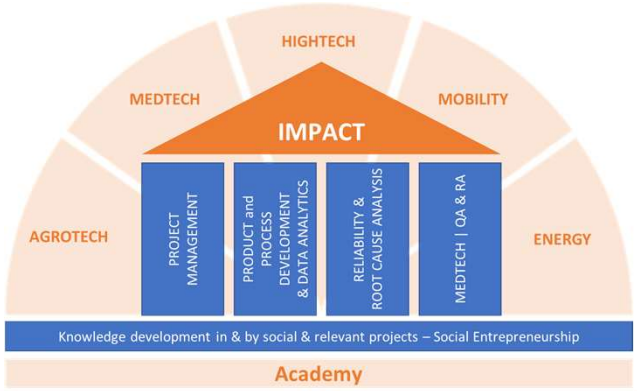

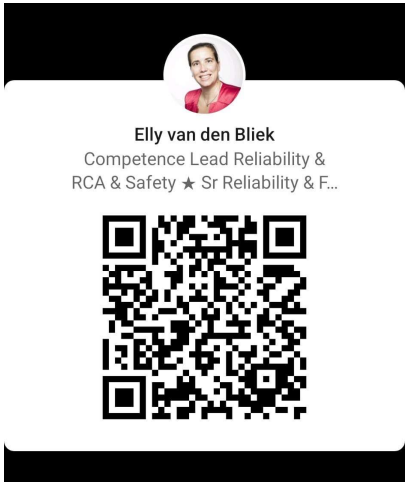

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