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Quality Management 444
Gehaltebestuur 444

Week 1: Introduction to Quality Management and Reliability Engineering and -Methods

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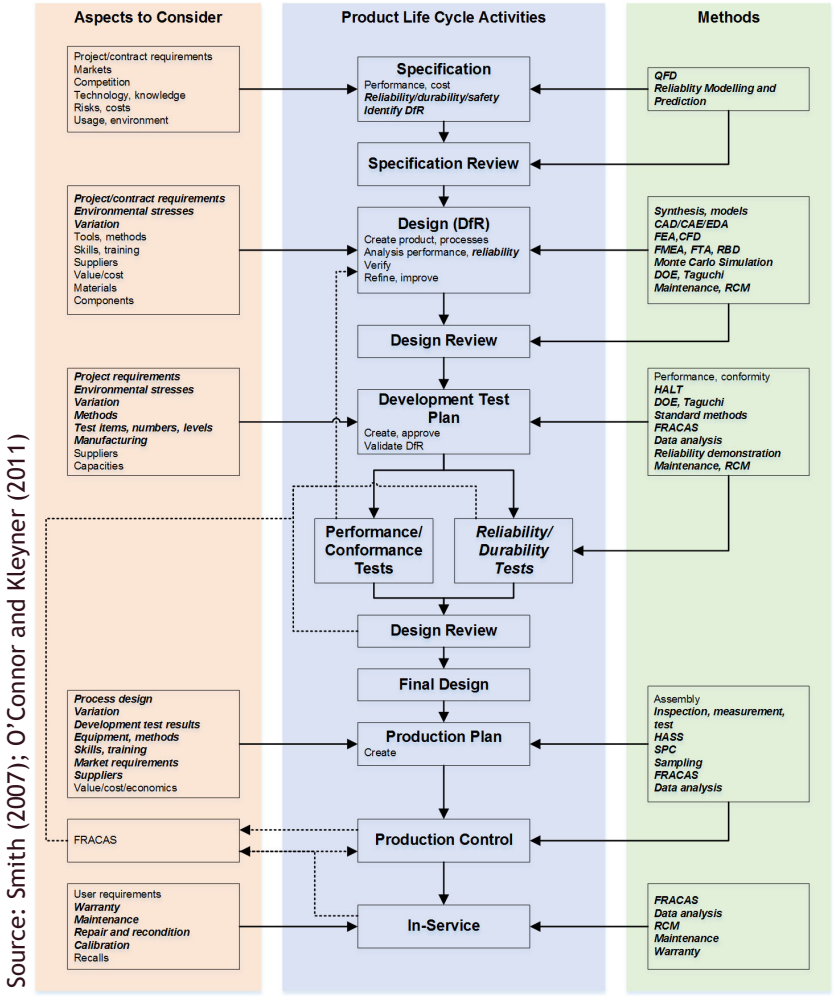
Agenda

- Introduction to Reliability Engineering
- Reliability Modelling
- Component Importance
- Data Analysis:
  - Functions and terminology
  - Failure data
  - Failure timelines
    - Importance of chronological data
  - Selecting an appropriate model
  - Laplace trend test
  - Non-repairable systems - Weibull
  - Repairable systems – NHPP
- Availability

Product Life Cycle

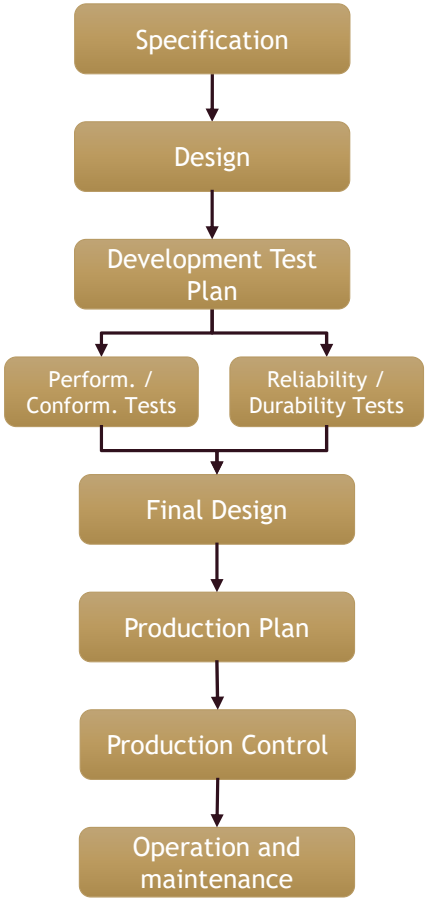


Design for Reliability (DfR)

Quality Assurance

Reliability

Quality vs. Reliability



Quality Assurance

Reliability

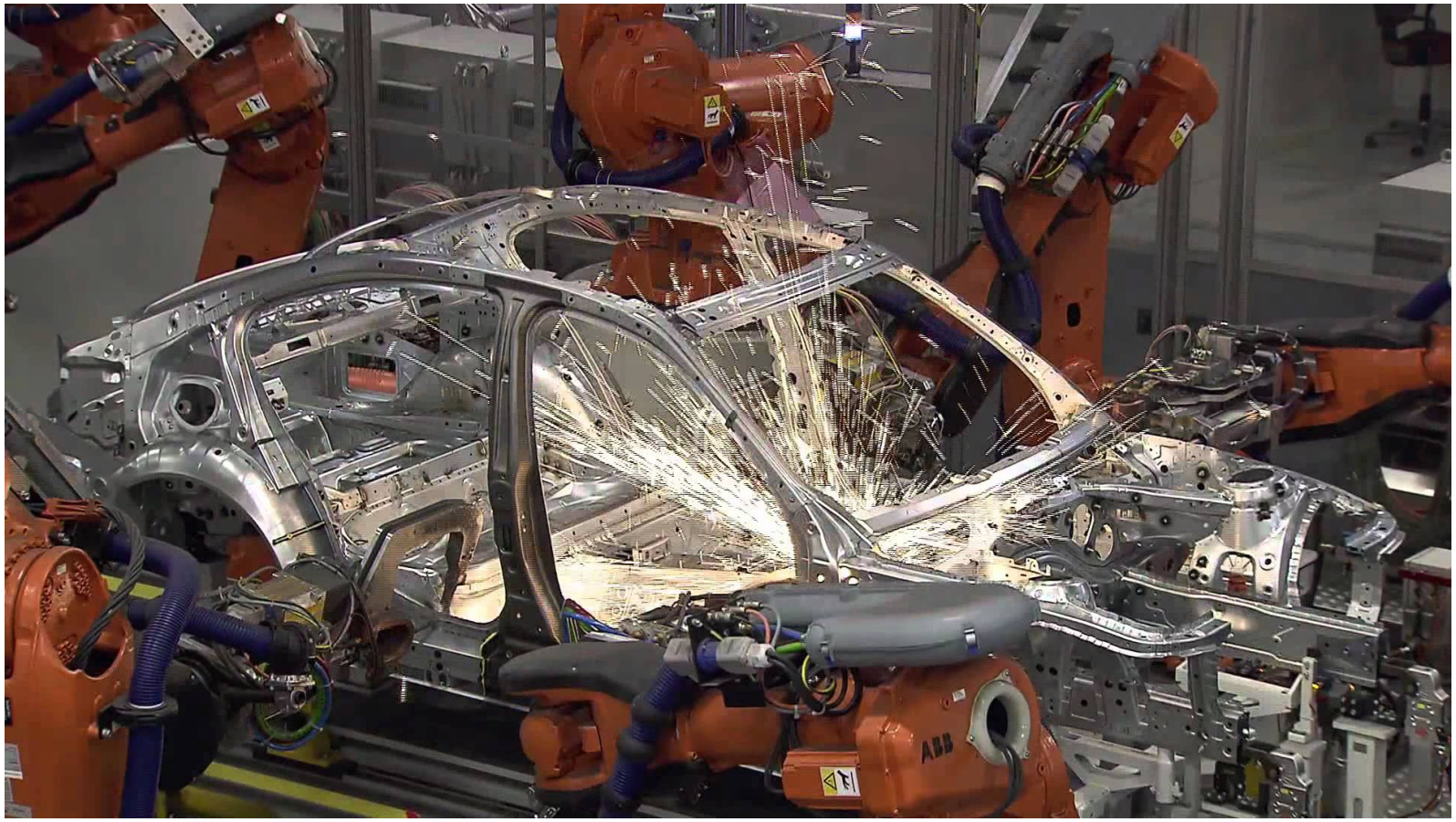
Quality is:

- the conformance to requirements at the start of use

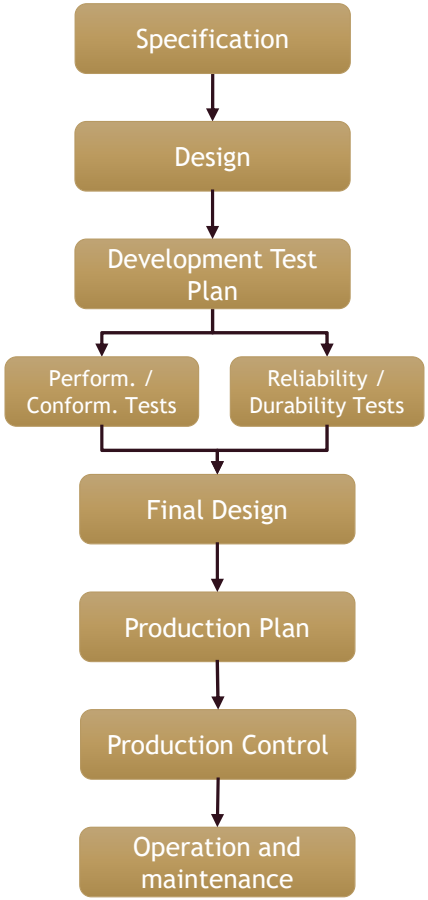
Reliability is:

- a time-based concept for quality
- Probability that something will perform its required function without failure under stated conditions for a specified period of time

What quality related observations can you make?



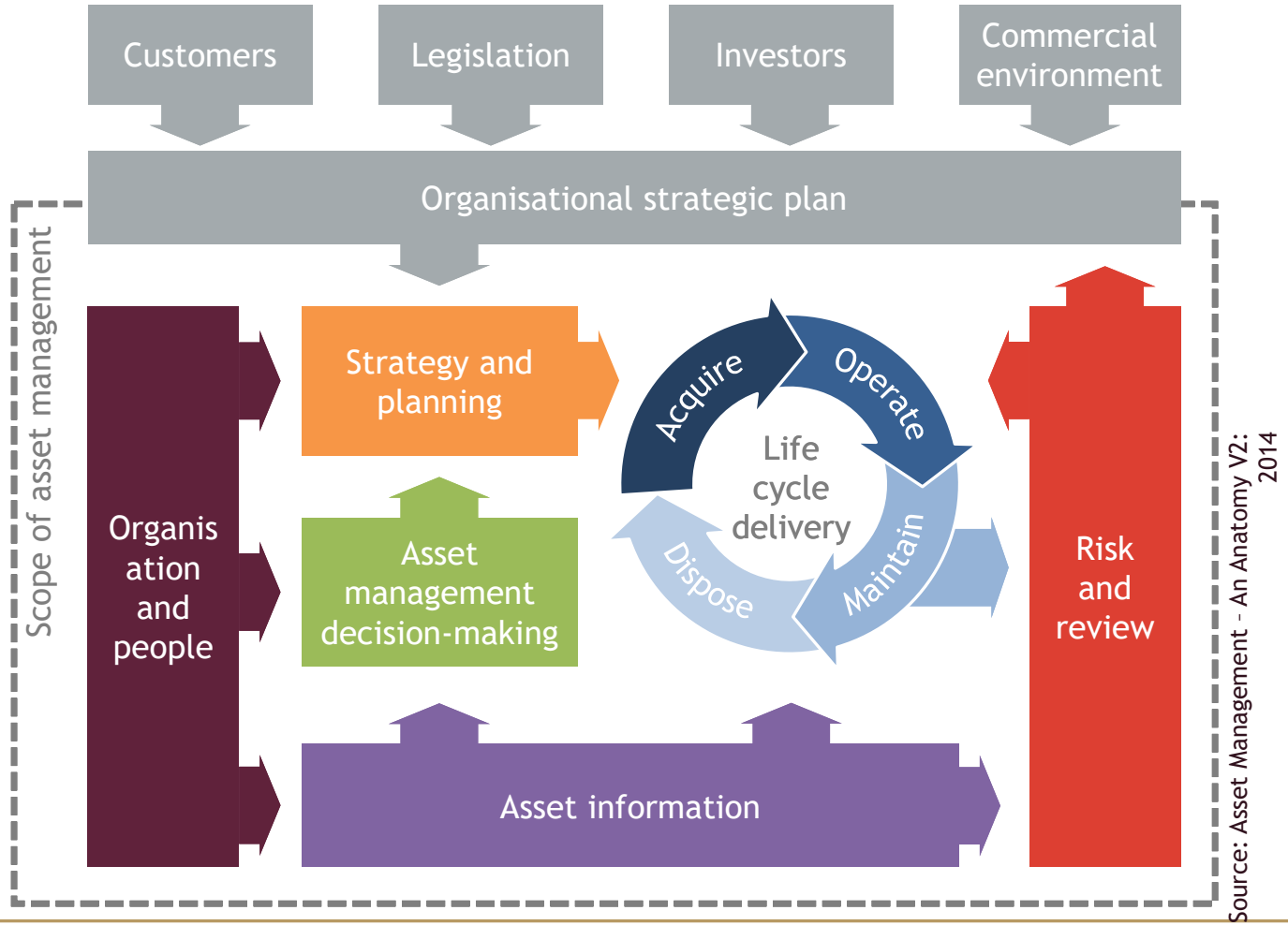
Product Life Cycle Perspective



Quality Assurance

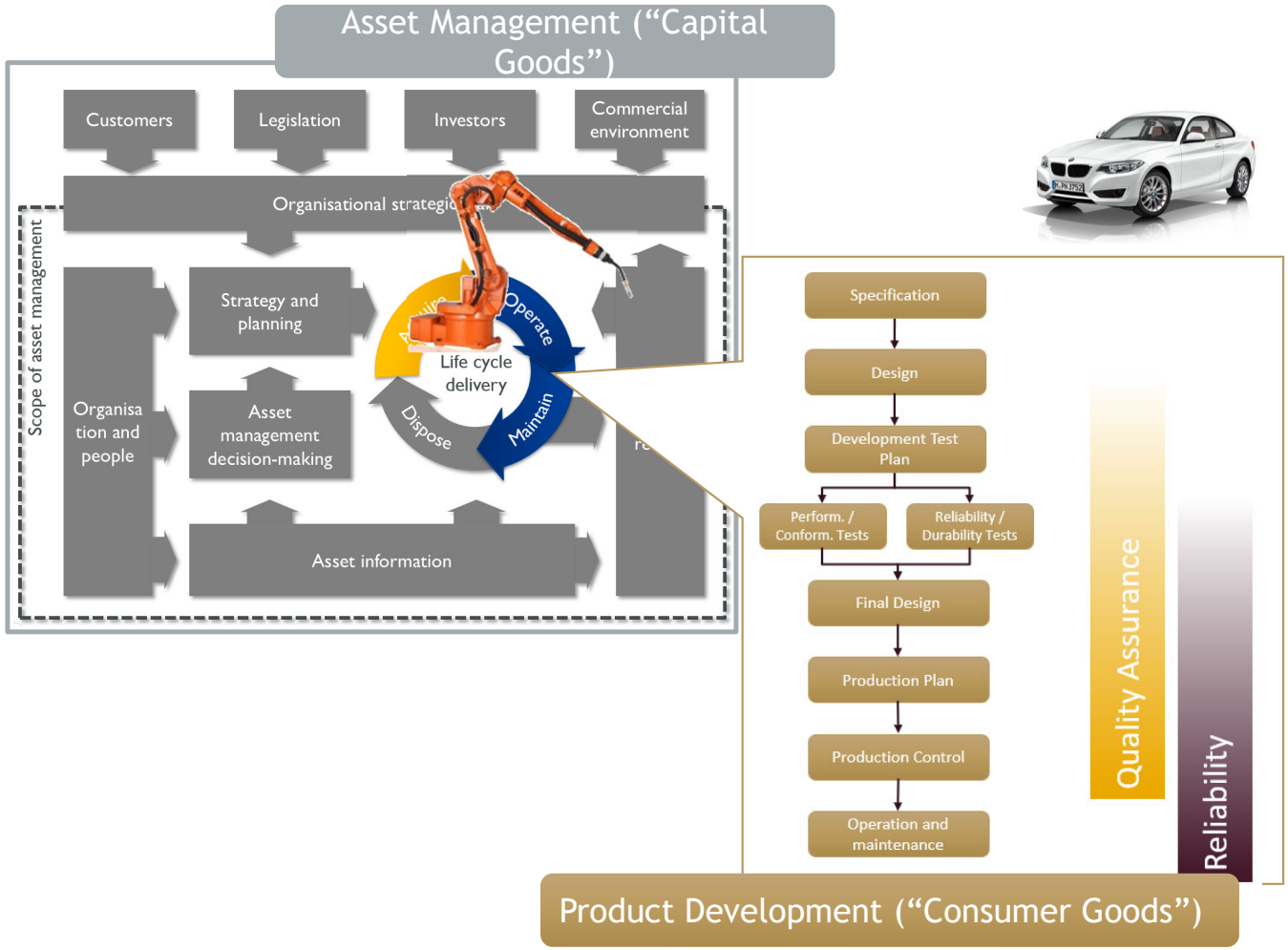
Reliability

Asset Management Perspective



Source: Asset Management – An Anatomy V2: 2014

Tiers of Reliability and Quality Management



What is reliability engineering?

Time Domain

Uncertainty

Definition

Maths & Stats

Management & Integration

The probability that an item will perform a required function without failure under state conditions for a stated period of time

Objectives

- Apply knowledge/techniques to prevent failures
- Identify and correct causes of failures
- Find ways to cope with failure
- Estimate and analyse reliability

Why do engineering products fail?

- Incapable design

(too weak, too much power)

- Overstress

(applied stress, exceeds strength)

- Variation
- Sneaks

(system fails, parts working)

- Errors

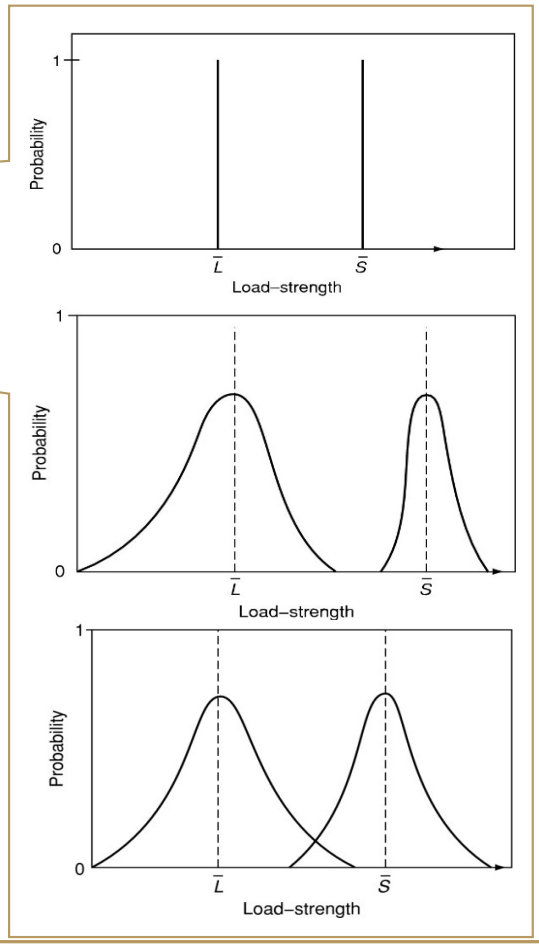
(Incorrect spec, design, coding)

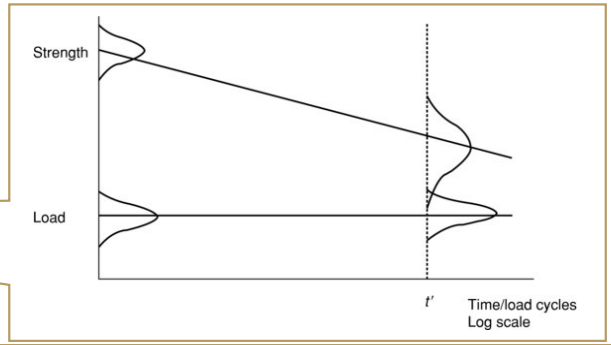
- Time-dependent mechanisms

(i.e. battery run-down)

- Wear-out

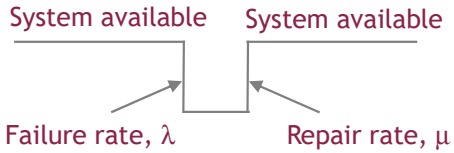
(weaker with time)





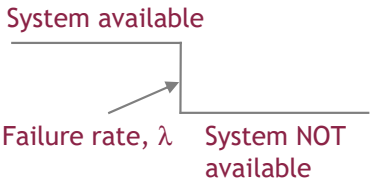
Repairable Systems

- Systems which are repaired when they fail
- R = survival probability over life with more than one failure
- Failure rate, λ known as:
  - Rate of occurrence of failures (ROCOF)
- Mean time between failures (MTBF) = $\frac{T}{k}$
  - T = Total cumulative time
  - k = number of failure
- Availability and Maintainability important
  - Maintainability: MTTR = $\frac{1}{\mu}$, where μ = repair rate
  - Availability = $\frac{MTBF}{MTBF+MTTR} = \frac{\lambda}{\lambda+\mu}$

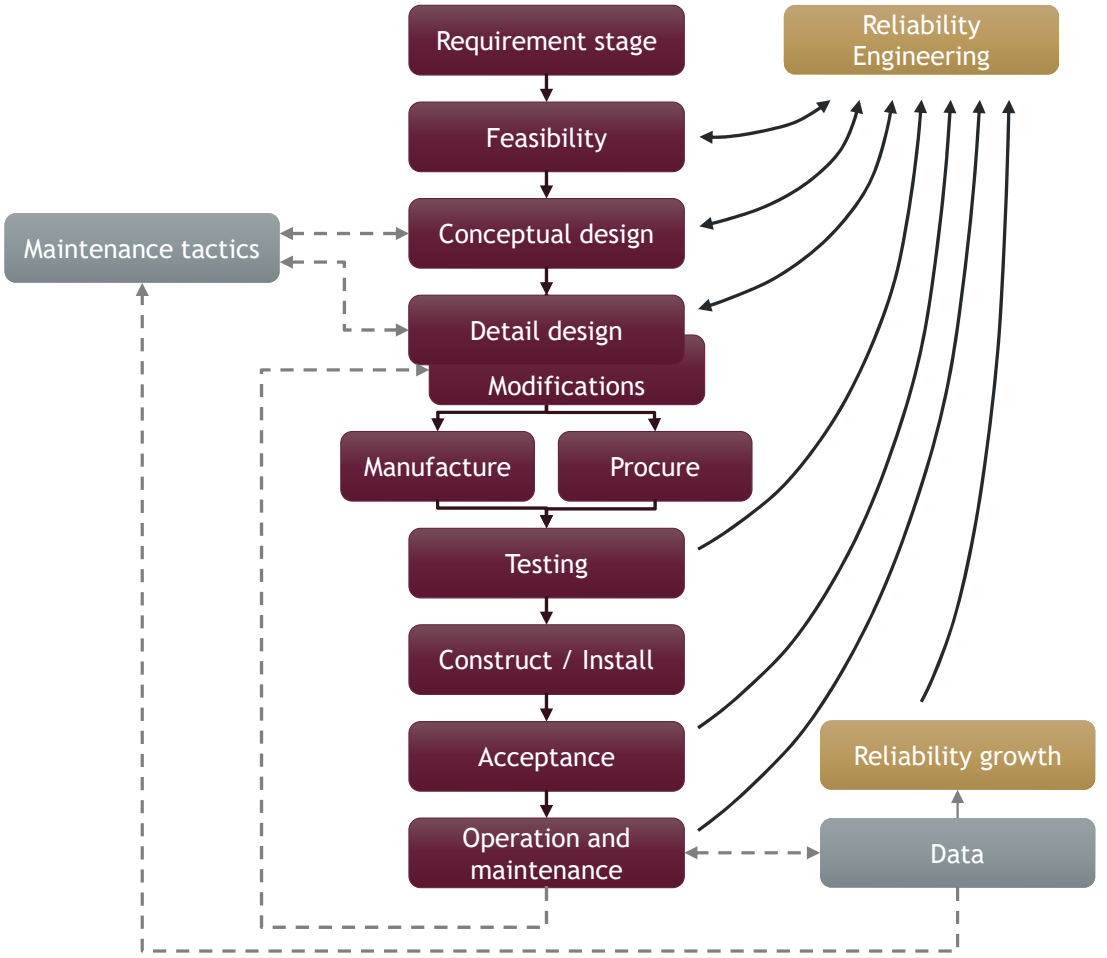


Non-Repairable Systems

- Systems which are not repaired when they fail
- R = survival probability over life with <u>one failure</u>
- Failure rate, λ known as:
  - Hazard rate, h(t)
  - Instant. probability of first and only failure
- Mean time to failure (MTTF) = $\frac{T}{k}$
  - T = Total cumulative time
  - k = number of test failures
- Examples:

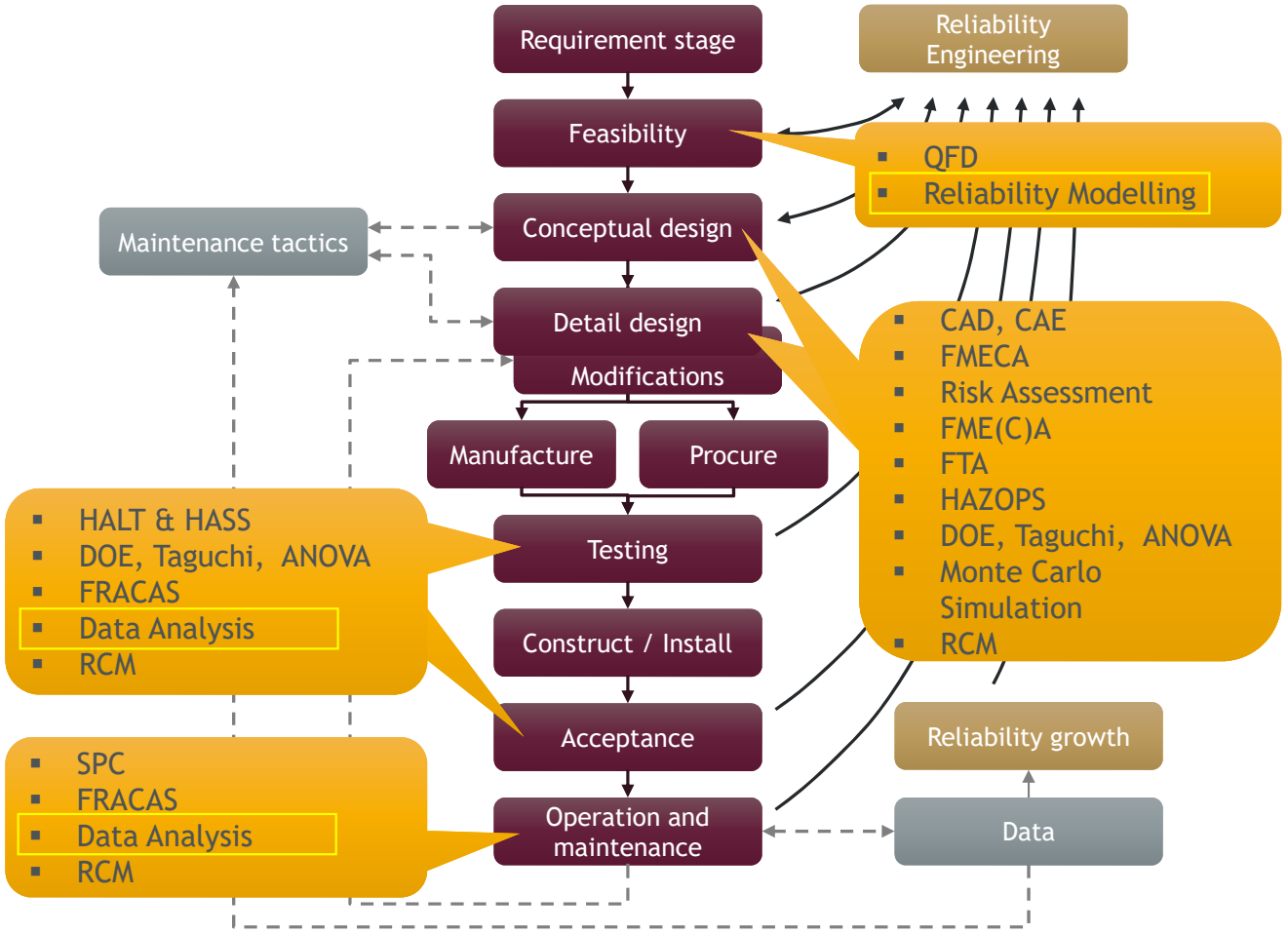


Integrated Reliability Programme



Source: Smith (2007); O'Connor and Kleyner (2011)

Reliability Engineering Methods



Source: Smith (2007); O'Connor and Kleyner (2011)

Must-have Reliability References

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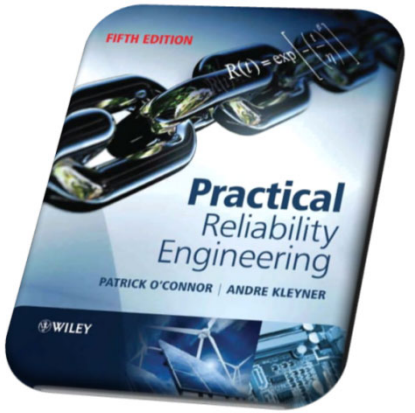
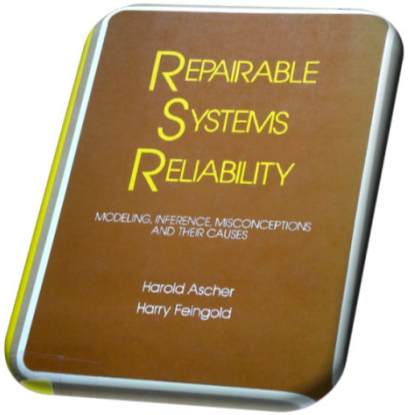
- O'Connor, P.D.T. and Kleyner, A. *Practical Reliability Engineering*. John Wiley & Sons Ltd, Chichester, UK, fifth edition, 2012.

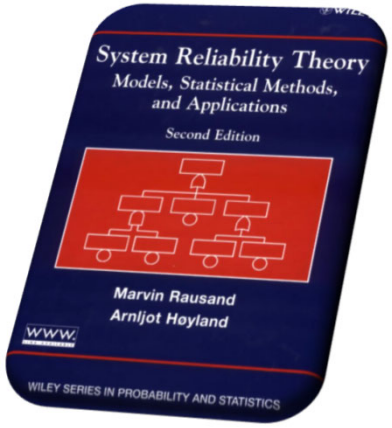


- Ascher, H. and Feingold, H. *Repairable Systems Reliability*. Marcel Dekker, Inc., 1984.



Must-have Reliability References

- Rausand, M. and Hoyland, A. *System reliability theory: Models, statistical methods, and applications*. John Wiley & Sons, New Jersey, 2004.



Must-have Reliability References

- http://reliawiki.org/

- http://www.itl.nist.gov/div898/handbook/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Thank you
Enkosi
Dankie
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