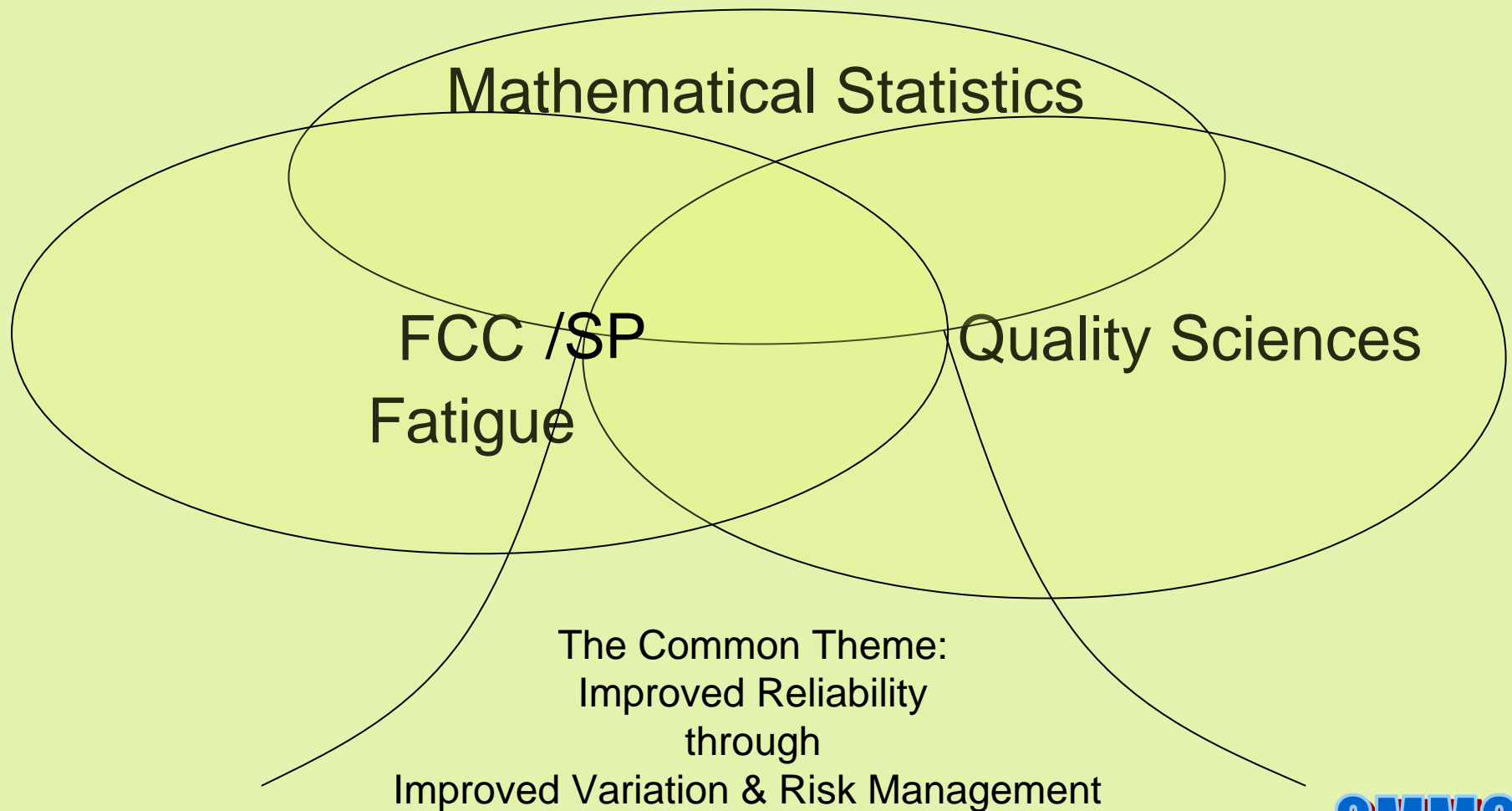


# GMMC: The Reliability Group



# GMMC: The Reliability Group

What we want\* :

## High Reliability

- From a customer point of view
- Created in the Product Development
- Proactively
- Organisationally supported

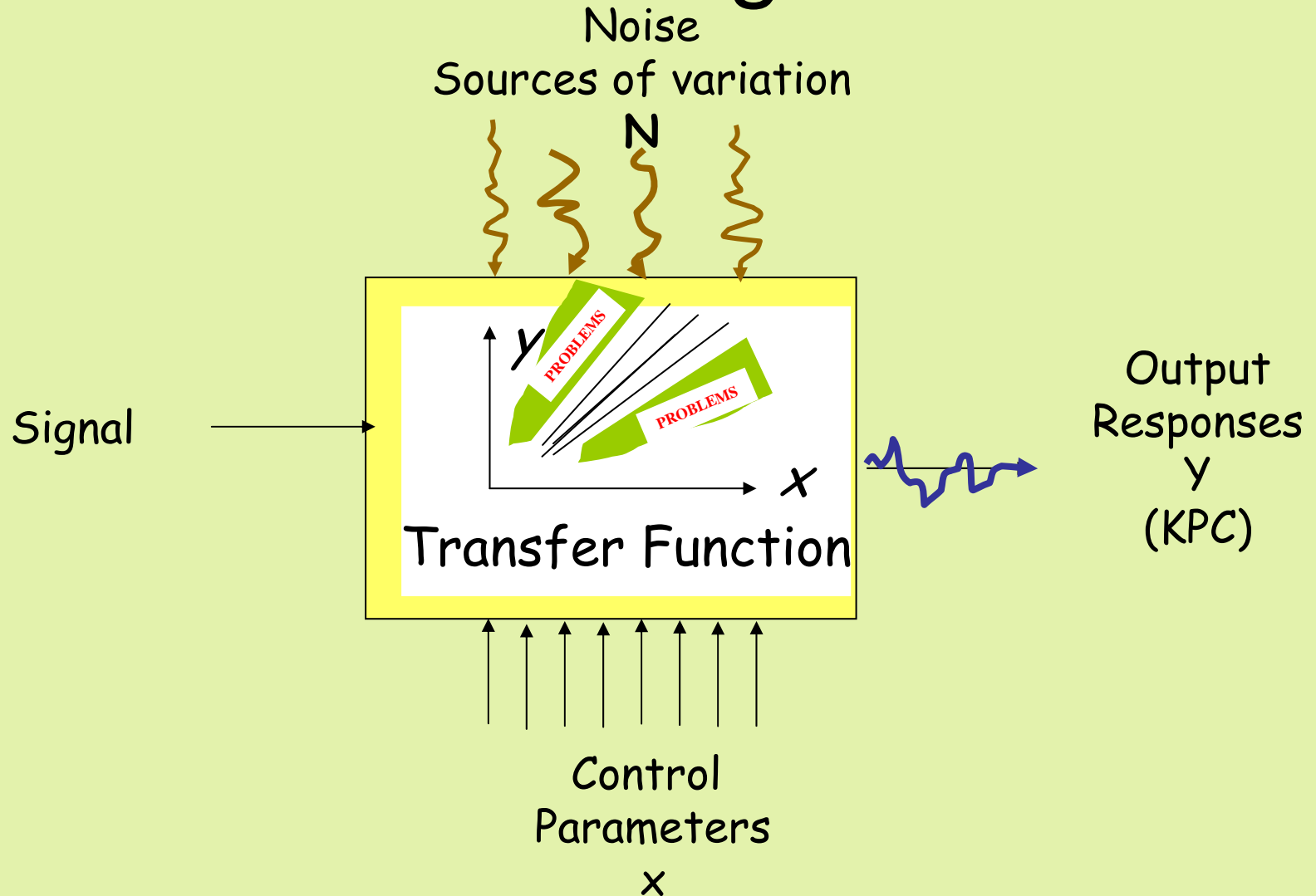
We  
Want  
To  
Make  
A  
Difference

\*companies to create

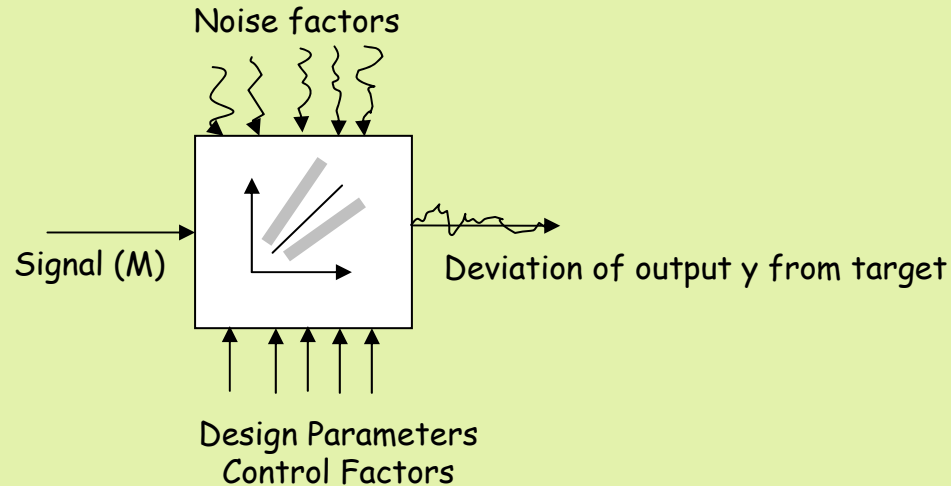
# Reliability

- From a customer point of view
  - All (negatively perceived) deviations from the expectations of the customer
- In the product development process
  - Design criteria
  - Model based or engineering simulations
- Proactively
  - Not based essentially on feedback from field usage or testing
  - Failure mode avoidance
- Organizationally Supported
  - Robust Design Methodology (Japanese Quality Engineering)
  - Design for Six Sigma

# The P-Diagram

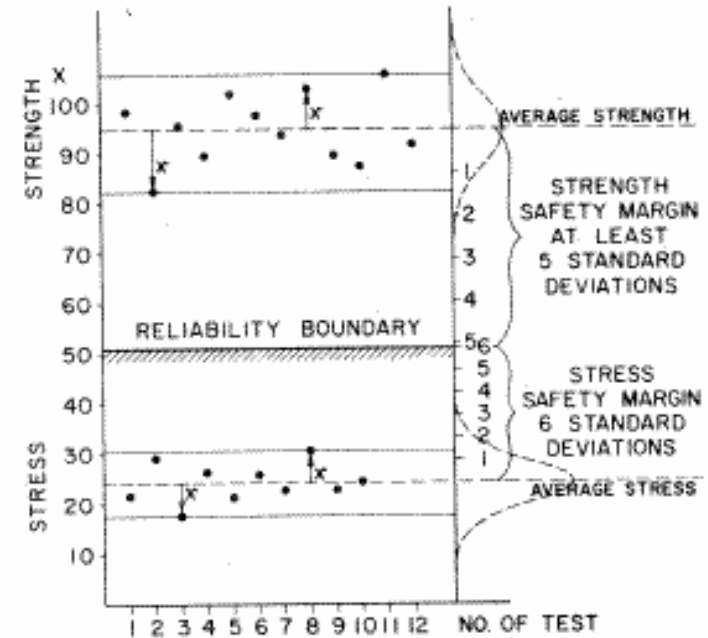
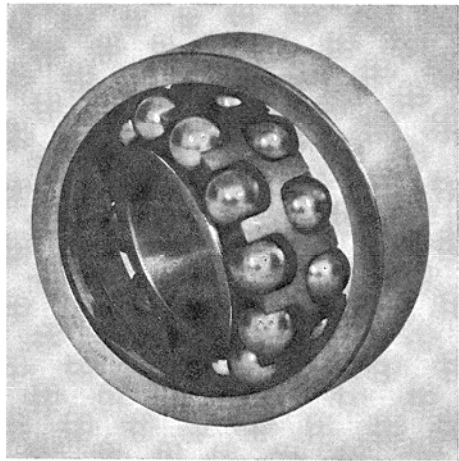


# Robust Design Methodology

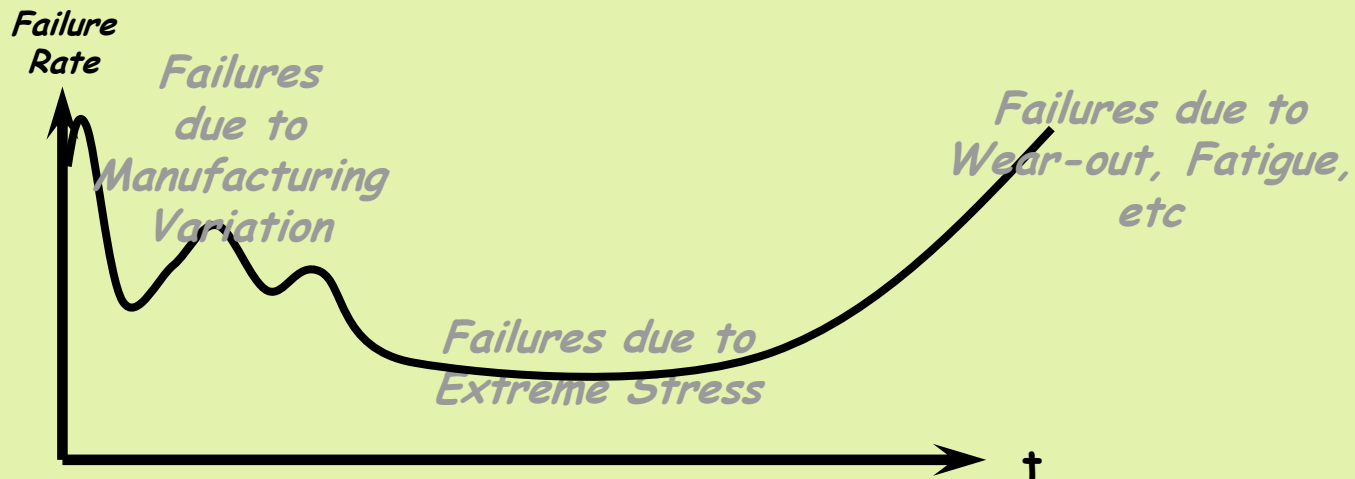


**Insensitivity to Variation**  
or  
**Robustness against Variation**  
or  
**Failure Mode Avoidance**

# Reliability Improvement - old ideas rephrased



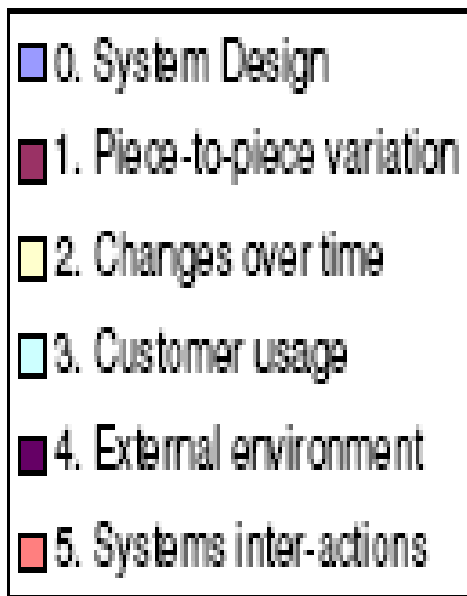
# Failure rate: The Bath-Tub Curve



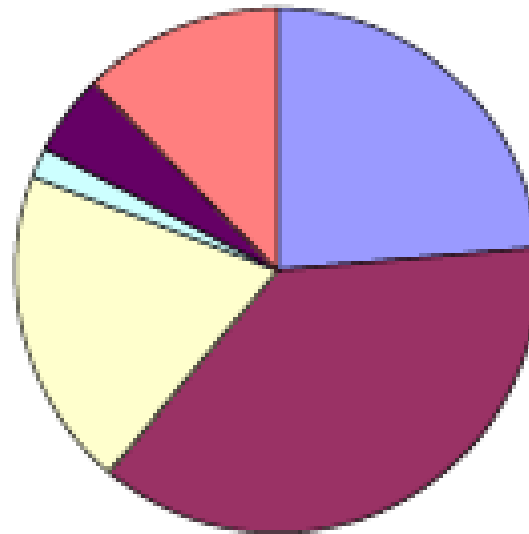
Improve Reliability through  
Variation Insensitivity

# Volvo Cars - project

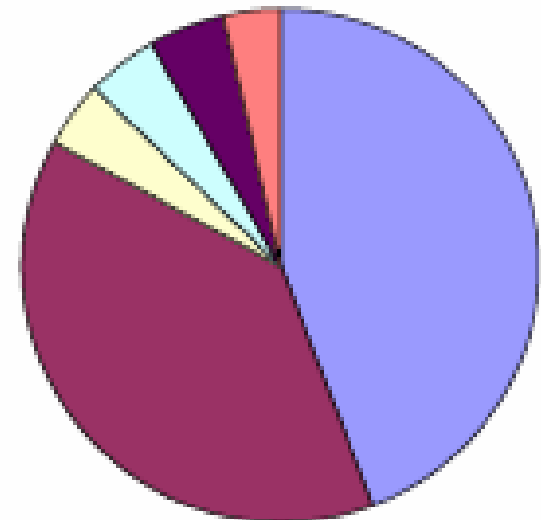
- Reconsider Design FMEAs
- Find underlying causes to failure modes
- Often down to noise factors/sources of variation



D-FMEA In-house



D-FMEA supplier





# Variation Mode and Effects Analysis VMEA

A Systematic Process for KPC(/CTQ)\*  
breakdown, noise factor impact  
identification, and selection of important  
improvement areas for parameter  
design or tolerance design

***Ask questions concerning variation!***  
***Select important areas for further variation management!***

- \* KPC – Key Product Characteristic
- CTQ – Critical to Quality Characteristic

# Current activities

- Robust Design Methodology and Reliability
  - The RDM concept
  - Modelling for RDM
  - "Implementation" of RDM
    - DfSS at SKF
    - VRES – Volvo Robust Engineering System
- Fatigue Applications
- Ocean Engineering
- Industrial Seminars
- The Book Project

# The Book Project

## Exploring unreliability and its countermeasures

Contract offer from Wiley

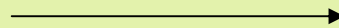
New Title ?:

"Robust Design Methodology for Reliability"

### CONTENT

Part I. Methodology  
Part II. Methods  
Part III. Modelling  
Part IV. Conclusions

?



Part I. Principles  
Part II. Methodology  
Part III. Tools  
Part IV. Models  
Part V. Conclusions

# The Book Project

## Content - preliminary

### CONTENT

#### Part I. Methodology

1. Introduction - Reliability, variation and the use of robust design methodology.

*Bo Bergman and Martin Arvidsson*

2. Evolution of Reliability thinking – countermeasures for some technical issues.

*Åke Lönnqvist.*

3. Principles of robust design methodology.

*Martin Arvidsson and Ida Gremyr.*

A review; Accepted for publication in *Quality and Reliability Engineering International*.

4. An operationalization of Robust Design.

*Martin Arvidsson, Ida Gremyr, and Torben Hasenkamp.*

# The Book Project

## Content - preliminary

### CONTENT

#### Part II. Methods

1. Variation Mode and Effect Analysis: a Practical Tool for Quality Improvement.  
*Per Johansson, Alexander Chakhunashvili, Stefano Barone and Bo Bergman.*  
*Quality and Reliability Engineering International, Vol. 22, pp.865-876, 2006.*
2. Including noise factors in design FMEA. *Åke Lönnqvist.*
3. Probabilistic Variation Mode and Effect Analysis: A Case study of a jet engine component.  
*Pär Johannesson, Thomas Svensson, Leif Samuelsson*
4. Verification of Safety Critical Components.  
*Magnus Karlsson, Bengt Johannesson, Thomas Svensson, Jacques de Maré.*
5. Uncertainty in fatigue life prediction of structures subject to Gaussian Loads.  
*Igor Rychlik.*

# The Book Project

## Content - preliminary

### **CONTENT**

#### **Part III. Modelling**

1. Monte Carlo simulation vs. sensitivity analysis. *Sara Lorén, Pär Johannesson and Jacques de Maré.*
2. Model complexity versus scatter in fatigue. *Thomas Svensson.*  
*Fatigue and Fracture of Engineering Material and Structures, Vol. 27, pp. 981-990, 2004.*
3. Choice of complexity in constitutive modelling of fatigue mechanisms *Erland Johnson, Thomas Svensson*
4. Interpretation of dispersion effects in a Robust Design Context *Martin Arvidsson, Ida Gremyr, Bo Bergman* (Journal of Applied Statistics, 33:6, 623-627).

#### **Part IV. Conclusions**

1. Reflections for future development. *Bo Bergman and Jacques de Maré.*