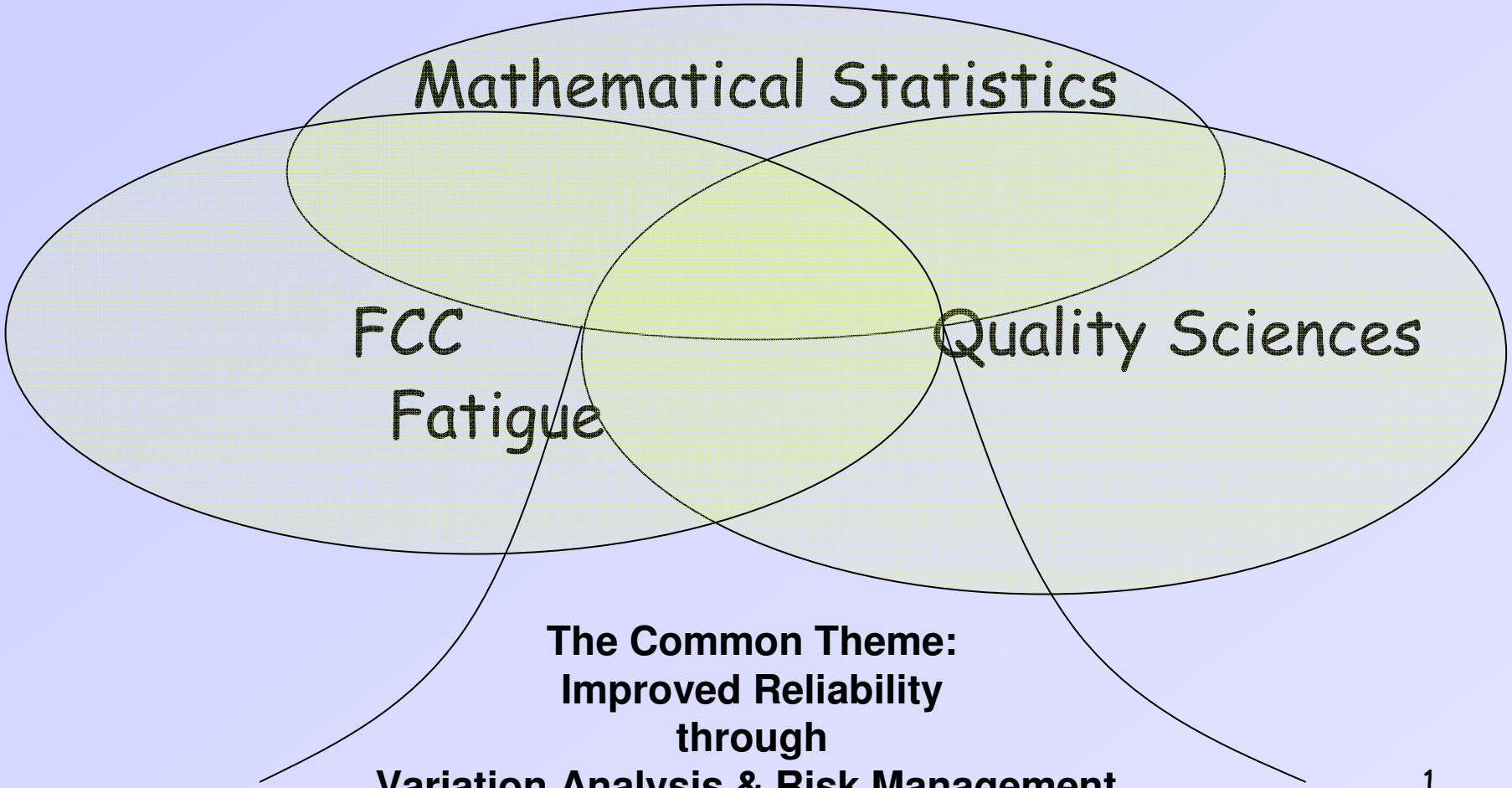
GMMC: The Reliability Group



The Common Theme:
Improved Reliability
through
Variation Analysis & Risk Management

FMEA
Failure Mode and Effects Analysis

VMEA
Variation Mode and Effects Analysis

Ask questions concerning variation!

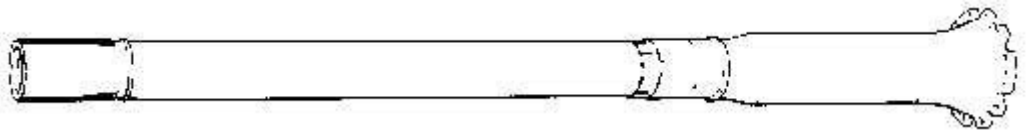
Select important areas for further variation management!

VMEA in practice

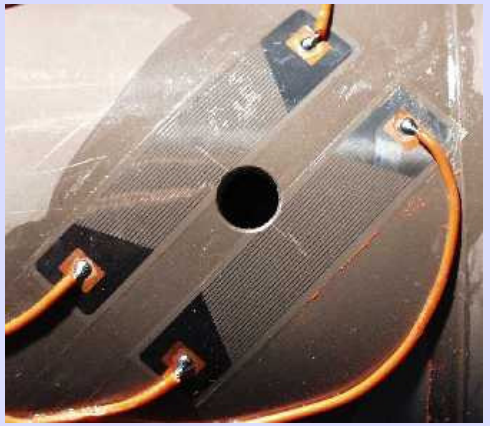
Life prediction	**logarithmic life, ln(N)**		
Type of scatter & uncertainty	**scatter**	**uncertainty**	**total**
Strength scatter			
- Material, within			
- Material, between			
- Geometry			
Statistical uncertainty			
- Life-curve			
Model uncertainty			
- Life-curve			
- Mean stress model			
- Multi- to uni-axial			
- Plasticity			
- Stress analysis			
- Temperature			
Load scatter & uncertainty			
- Service load, scatter			
- Service load, uncertainty			
Total			

VMEA in practice at Volvo Aero

Low pressure turbine shaft



Life prediction	logarithmic life, ln(N)		
Type of scatter & uncertainty	**scatter**	**uncertainty**	**total**
Strength scatter			**0.38**
- Material, within shaft	0.15		
- Material, between shafts	0.29		
- Geometry	0.20		
Statistical uncertainty			**0.07**
- LCF-curve		0.07	
Model uncertainty			**0.84**
- LCF-curve		0.05	
- Mean stress model		0.30	
- Multi- to uni-axial		0.20	
- Plasticity		0.72	
- Stress analysis		0.24	
- Temperature		0	
Load scatter & uncertainty			**0.50**
- Service load, scatter	0.40		
- Service load, uncertainty		0.30	
Total	**0.55**	**0.90**	**1.05**



Monitoring of crack propagation during fatigue testing. The crack starts at an oil hole on the shaft.

EXPECTATIONS

Publications

Courses

Conferences