



INTERNATIONAL OPERATIONS & MAINTENANCE CONFERENCE  
IN THE ARAB COUNTRIES

UNDER THE THEME

**"MANAGING MAINTENANCE WITHIN INDUSTRY 4.0"**

CONICIDE WITH THE 16<sup>TH</sup> ARAB MAINTENANCE EXHIBITION

# Asset Management and Dependability

*"Supporting the Business"*

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CAMA**

A vertical photograph of a person in a blue uniform working on a piece of machinery. The image is partially obscured by a dark blue vertical bar on the right side.

# 4.0



# Coverage

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- The **burning platform** for change in **Dependability standards**
  - Technical Committee TC 56 – 13 Countries directly involved
- International Electrotechnical Commission (IEC) TC56 Dependability standards (60+ standards on RAMS)
  - The Swiss army knife for risk based decision making
- ISO 55000 - Balancing cost, risk and performance
  - Role of risk based tools for asset management
- Integrating an ISO Asset Management System and Dependability
  - Building a symbiotic relationship to **assure Business Outcomes**
- Summary
  - Why bother?

# IEC standards – Swiss Army knife of Asset Management



- FMEA
- RBD
- RCM
- FTA
- LCC
- RCA
- ILS
- HAZOP
- +50 more

ISO/IEC 15288 Processes	
IEC Dependability Standards	
60300-1	Dependability management
60300-2	Guidance for dependability management
60300-3-1	Dependability analysis techniques
60300-3-2	Collection of dependability data
60300-3-3	Life cycle costing
60300-3-4	Specification of dependability reqts
60300-3-5	Reliability test conditions and statistical data
60300-3-10	Maintainability and supportability
60300-3-11	Reliability centered maintenance
60300-3-12	Integrated logistic support
60300-3-14	Maintenance and maintenance support
60300-3-15	Engineering of system dependability
60300-3-16	Specifying maintenance support services
60319	Reliability data for electronic components
60410	Sampling plans and procedures
60605-2	Reliability testing - Design of test cycles
60605-4	Statistical procedures for exponential distributions
60605-6	Tests for constant failure rate and intensity
60706-2	Maintainability during design

ISO/IEC 15288 Processes	
IEC Dependability Standards	
60706-3	Verification of maintainability data
60706-5	Testability and diagnostic testing
60812	Failure mode and effects analysis
61014	Programs for reliability growth
61025	Fault tree analysis
61070	Compliance test procedures for steady state availability
61078	Reliability block diagrams and Boolean methods
61123	Compliance test plans for success ratio
61124	Compliance test for constant failure rate
61160	Design reviews
61163-1	Reliability stress screening Repairable assemblies
61163-2	Reliability stress screening Electronic components
61164	Reliability growth Statistical methods
61165	Application of Markov techniques
61649	Weibull analysis
61650	Comparison of two constant failure rates
61703	Mathematical expressions for RAMS
61709	Reliability prediction from failure rate data
61710	Power law model - goodness of fit

ISO/IEC/IEEE 15288:2015 System lifecycle processes (technical)	
IEC Dependability Standards	
61882	Hazard and operability studies - HAZOP
61907	Communication network dependability engineering
62198	Managing risk in projects
62308	Equipment reliability assessment methods
62309	Reused parts - Functional test requirements
62347	Guidance on system dependability specs.
62380	Reliability data handbook for electronics
62402	Obsolescence management
62429	Reliability growth - stress testing for early failures
62502	Event tree analysis
62506	Methods for accelerated stress testing
62508	Human aspects of dependability
62551	Petri net analysis techniques
62628	Software aspects of dependability
62673	Communication network dependability assurance
62740	Root Cause Analysis
62741	Demonstration of dependability requirements - Dependability case
62814	Software products with reusable components
31010	Risk management - Risk assessment techniques

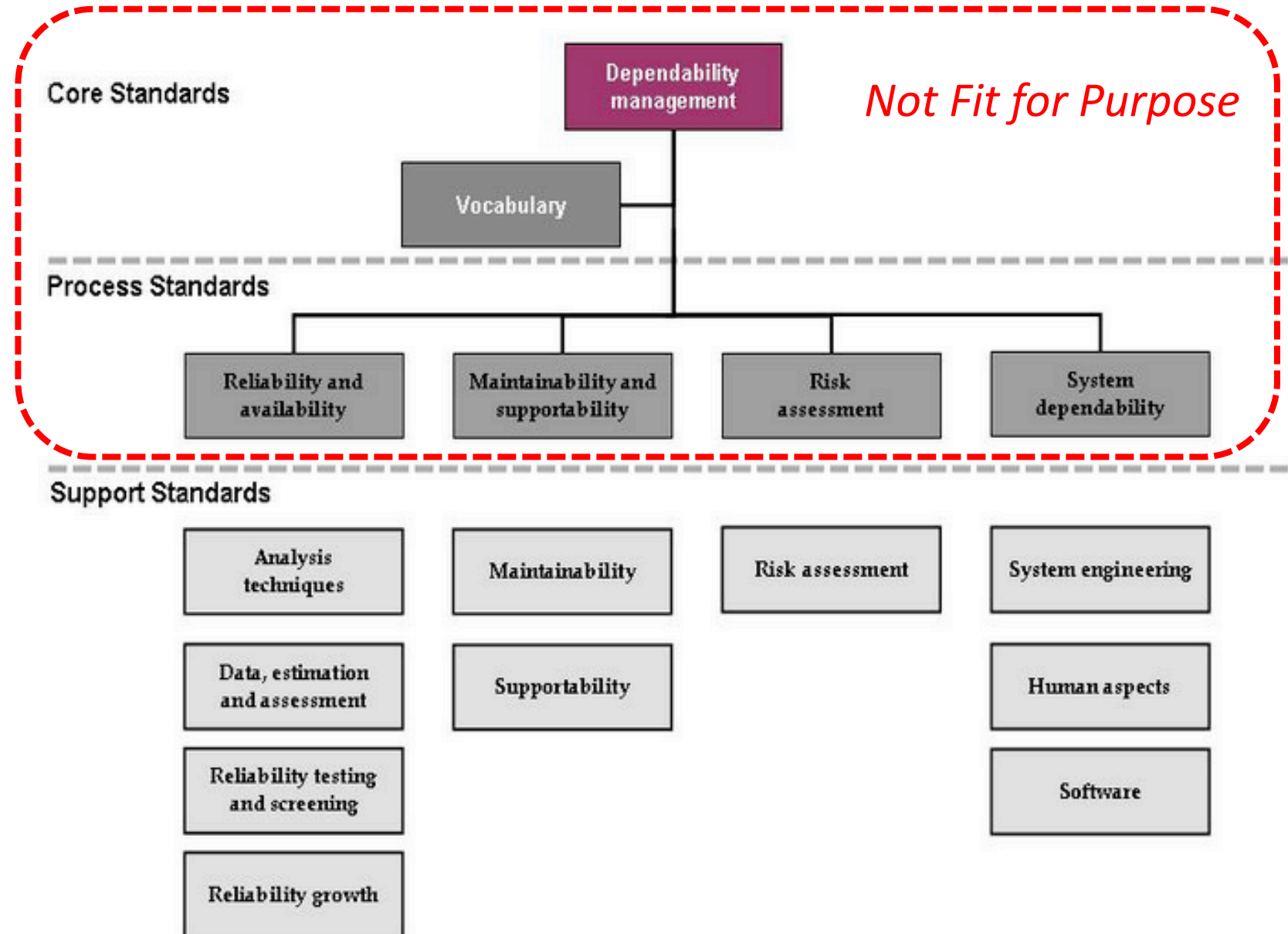
# IEC Dependability - A burning platform



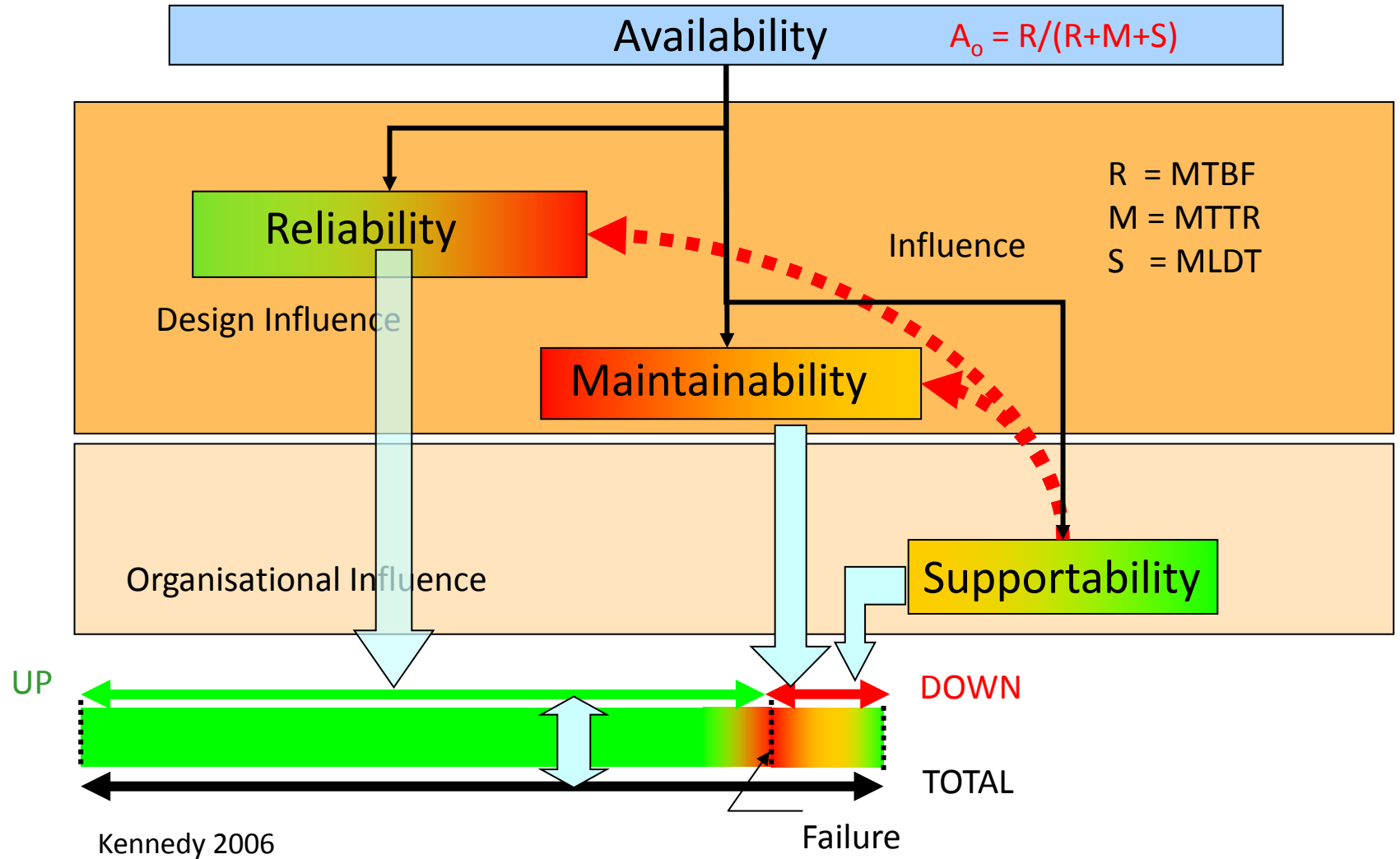
- “Dependability” - A new name to extend “reliability” focus and capture attention and knowledge (1980s) in new standards on RAMS
- RAMS = Reliability, Maintainability, Supportability = Availability
- Bottom up process of standards development had evolved over time
- Standards while individually sound, were fragmented and overlapping
- Standards now “not fit for purpose” at top levels
- IEC TC56 was now challenged on the relevance of those standards



# Dependability standards - Previous structure



# Lighting the fuse - TC56 Meeting Pau France 2012



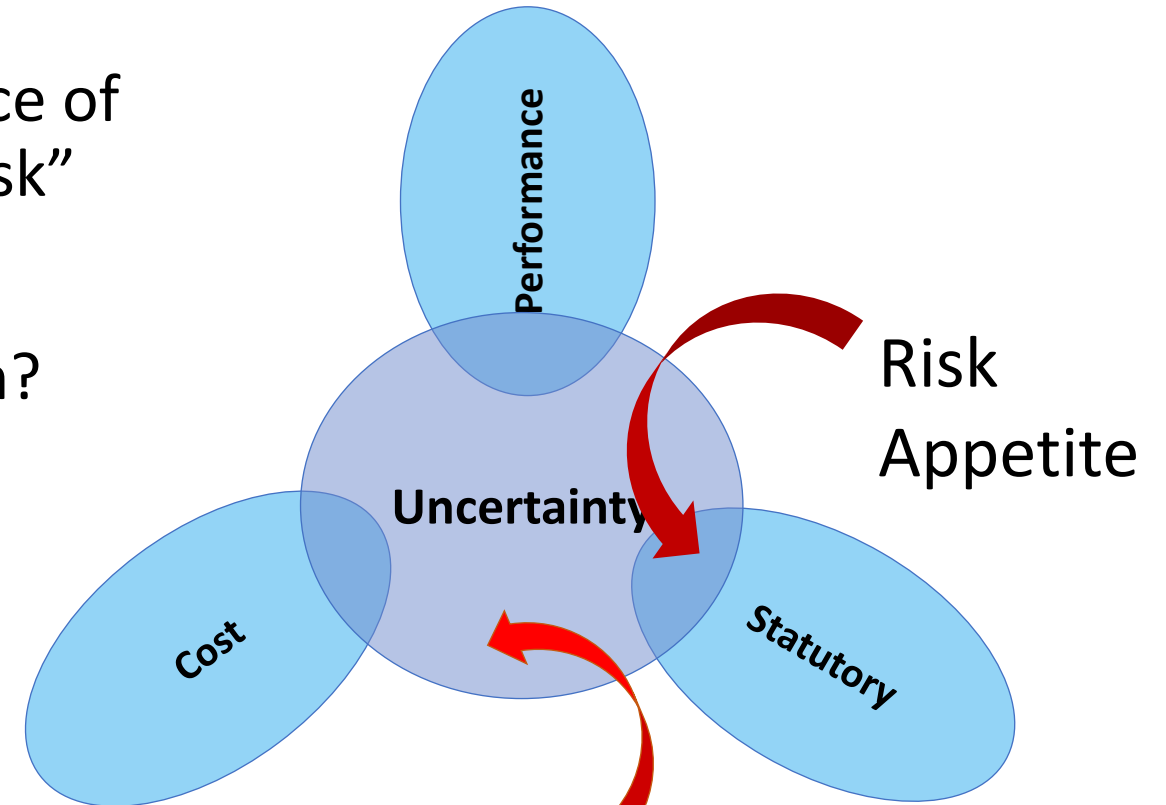
# ISO 55000 - Balancing performance, cost and risk



## ISO 55000:

“achieve a desired balance of performance, cost and risk”

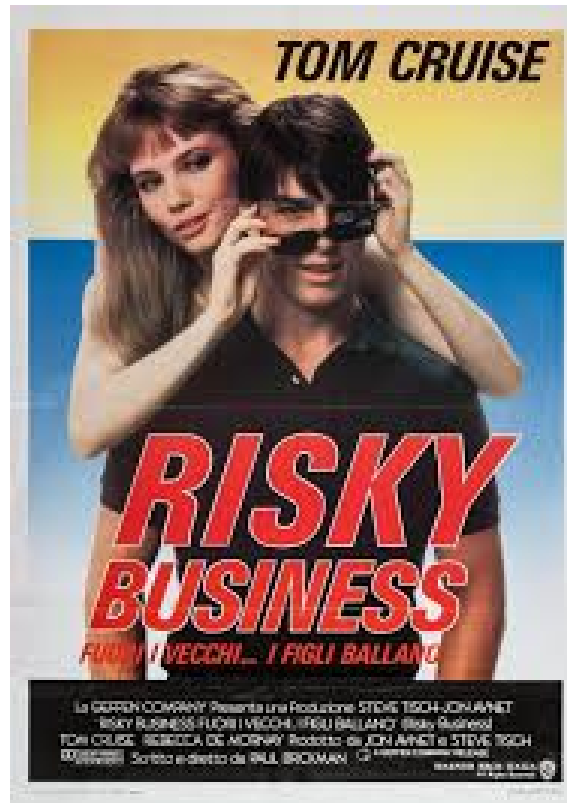
But what does that mean?



Capability of **Asset Management System** drives **size and placement** of “uncertainty”.

Kennedy 2015

# ISO/IEC 31010 - Risk assessment methods



- Event Tree Analysis
- Fault Tree Analysis
- Cause and Consequence
- Bow Tie Diagram
- Failure Modes and Effects Analysis (FMEA)
- Fault Mode, Effects and Criticality Analysis (FMECA)
- Reliability Block Diagram
- Human Reliability Analysis
- Consequence/Likelihood Matrix
- Cost Benefit Analysis
- Multi Criteria Decision
- Root Cause Analysis
- Layers Of Protection Analysis
- Hazard and Operability
- HACCP
- Preliminary Hazards Analysis

- Category Rating
- Common Mode Failure
- Consequence Models
- Delphi Technique
- Hazard Indices
- Monte-Carlo Simulation Technique
- Paired Comparisons
- Structured “What-if”
- Scenario Analysis
- Toxicological Assessment
- Markov Analysis
- Bayesian statistics and Nets
- F-N Curves
- Sneak Analysis
- Decision Tree Analysis



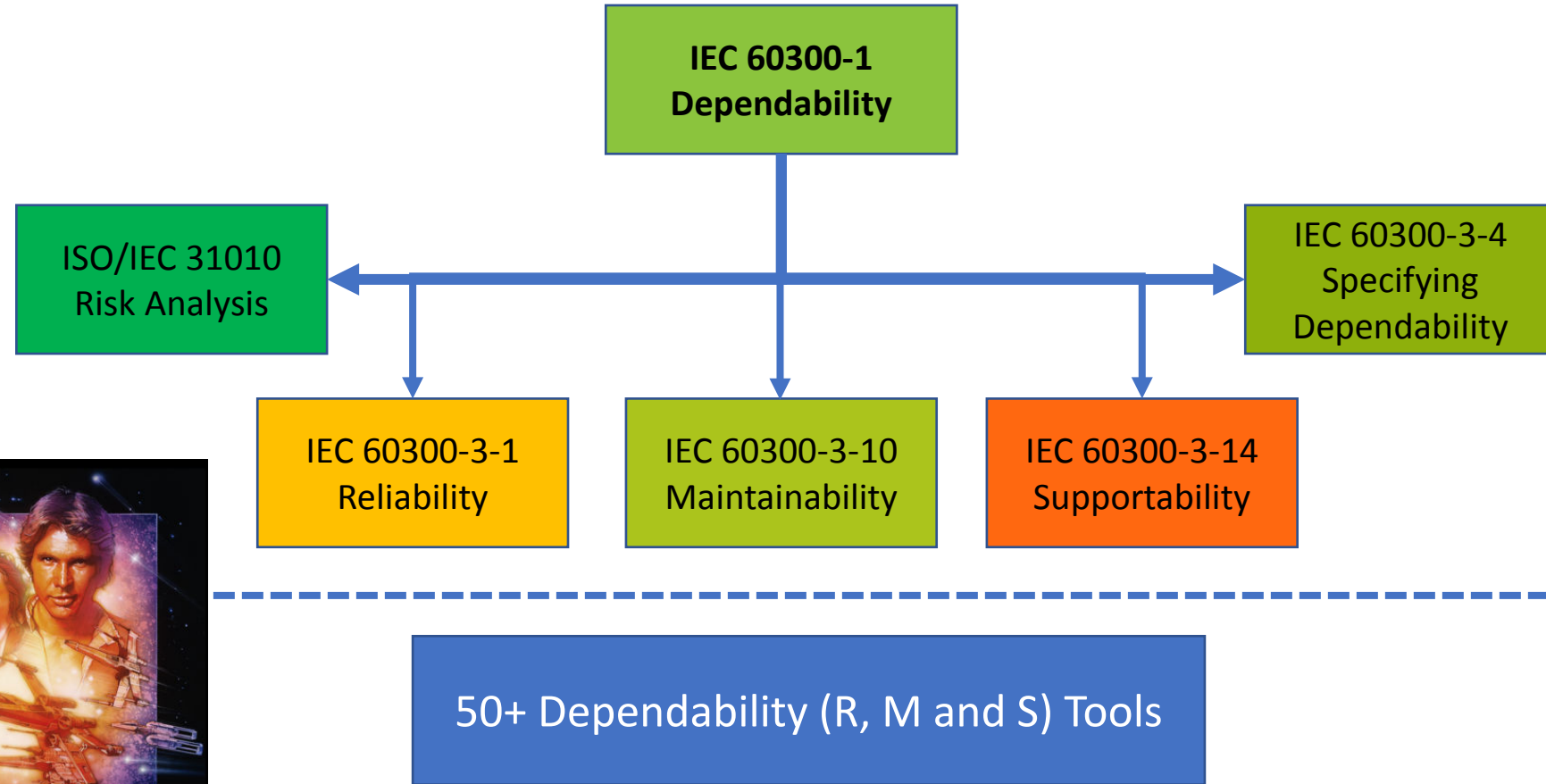
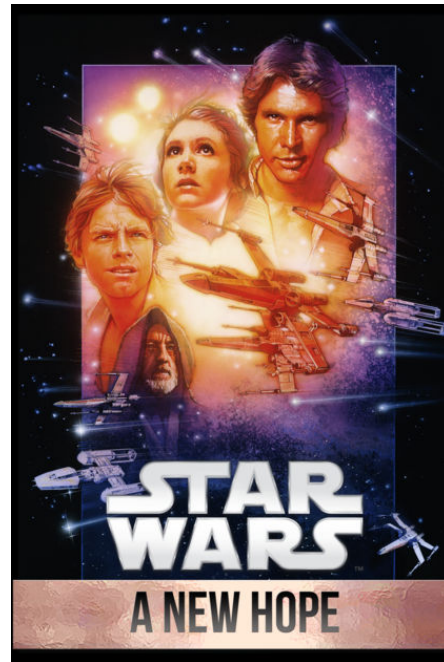
# International consensus is a very slow boat!



- 2012 Pau – we **need to do something** but what?
  - 2013 Milwaukie then Denmark – we need to **do M & S together**
  - 2014 London then Prague – somethings amiss – all **M&S goes on hold**
  - 2015 Helsinki then Glasgow – conducted a **stakeholder** analysis
  - 2016 Paris then Sydney – realisation that **change must happen**
  - 2017 Copenhagen and Tokyo – a **decision made!**
  - **2018 Waterloo – a direction agreed**
  - 2018 Milan – the **Renaissance begins** – NOW!
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- New **Reliability** standard
  - New **Maintainability and maintenance** standard
  - New **Supportability and support** standard
  - New **Specifying for Dependability** standard

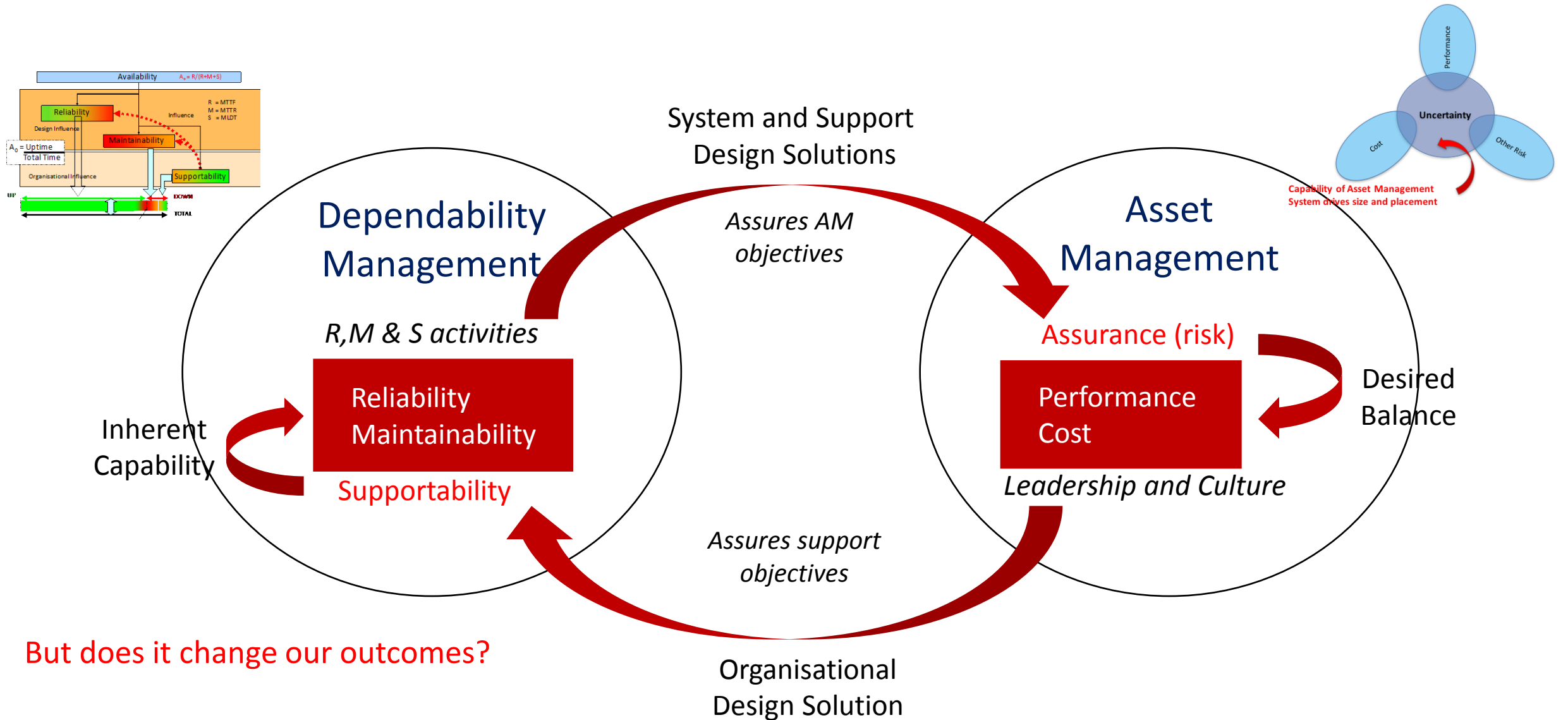


# Tokyo 2017 - A new structure rises



R, M and S bookended by Risk Methods and How to Specify

# Why does this matter? - A symbiotic relationship model



But does it change our outcomes?

# Does the model work – RailCorp Experiment 2004/5?



## Four key elements to pilot project

- Understand how tasks are determined (**Reliability Culture**)
  - Root cause analysis to assess drivers
  - Reliability characteristics of equipment and humans
- Understand why tasks are done (**Maintenance Culture**)
  - Objectives of maintenance
  - Types of maintenance
  - FMECA/RCM/TA
- Treat behaviour justly (**Reason's Just Culture**)
  - Human errors are a fact of life
  - Continuous improvement requires people to speak up
- Develop capability through mentoring and championing (**Delivery approach**)
  - Delivered on site – normal tool box meeting
  - By the staff's managers – responsible discipline manager

11 July 2006

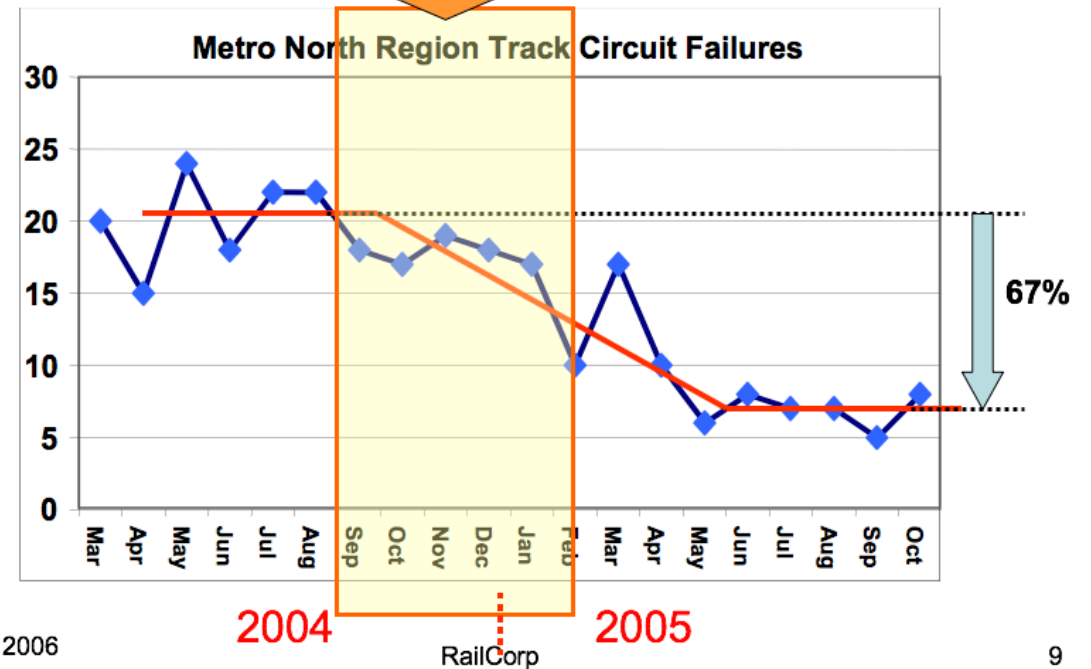
RailCorp

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## Operational reliability benefit

Staff Development Period



11 July 2006

RailCorp

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Kennedy/Sweeney 2006

OMAINTEC 12

# Summary - Asset Management and Dependability



We need to connect  
**Assurance in technical design (Dependability)**  
To  
**Assurance in organisational design (Asset Management)**

