Developing and implementing HF and TEM programs for Engineering and Maintenance

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Scope

- Understanding maintenance error
- The systems safety approach
- The context of aviation maintenance
- Maintenance Human Factors
- Threat and Error Management
- Risk and hazard awareness
- Human Factors challenges

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The need to address Human Factors

As the reliability and capability of new technology continues to improve, it is inevitable that more emphasis will be placed on the Human input to the system - the human element.

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What is Maintenance Error?

An unintentional departure from known procedures and/or regulations.

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The so what factor

Not all of the errors and non compliance issues in aviation maintenance are trapped (captured) on the ground

Maintenance error can also be a driver for airborne system malfunctions, often with catastrophic consequences.

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Mar 2001, Airbus A320-200 Serious incident

During repair work on the plug of the Elevator Aileron Computer (ELAC) no. 1 two pairs of wires had been connected inverted and the error remained undetected . The error was not recognized by the flight crew during the "FLIGHT CONTROL CHECK".

(Source: BFU report 5X004-0/01 April 2003)

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Jan 2003, Beech 1900D

Poor Maintenance Cited as Primary Cause of Air Midwest Crash

(Source: Air Safety Week, 01 Mar 2004)

Photo NTSB

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April 2005
RAN Sea King N16-100
Nias Indonesia

Removal of the Fore and Aft bellcrank was not documented … this was one of a series of maintenance failures which resulted in maintenance error going undetected

The failure of the flight control system resulted in a departure from controlled flight that was unrecoverable

(Source - BOI RAN Sea King N16-100)

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August 2005
Murchison, New Zealand
Robinson R22 Helicopter

Maintenance error - incorrect assembly

The Civil Aviation Authority investigation concluded that the failure of an incorrectly assembled tail rotor drive shaft caused the Robinson R22 helicopter to crash inverted in a paddock killing the pilot and seriously injuring the passenger.

(Source – NZ CAA)

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Sep 2008, Learjet 60
South Carolina, USA

Four of the six people on the plane died in the crash, with the other two, suffering severe burns.

Poor maintenance (severely under inflated tyres) started accident chain that resulted in Learjet high-speed runway excursion

(Source – Aviationsafety network.wordpress.com 07 Apr 2010)

Photo NTSB

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The systems safety approach

Systems-based approach to safety requires the application of scientific, technical and managerial skills to hazard identification, hazard analysis, and elimination, control, or management of hazards throughout the life-cycle of a system, program, project or an activity.

(Harold E. Roland, Brian Moriarty (1990). System Safety Engineering and Management)

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The systems safety approach

Could the influence of Human Factors (such as Human Error) be considered a 'hazard' under the systems safety approach?

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The need to address Maintenance Human Factors

- **To improve systems safety, practical tools and processes need to be developed which:**
  - optimise the relationship between humans and the characteristics of their working environment
  - manage and where possible minimise error (and rule breaking)
  - develop a culture of hazard awareness and risk management

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What's the point of maintenance Human Factors Training?

The goal of human factors training should be to provide the engineer or technician with practical tools and processes aimed at managing and where possible minimising human error and intentional non-compliance in the work environment.

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Optimising the relationship between our personnel and the characteristics of their working environment

- First we must clearly understand the environmental context
- The aviation maintenance environment is variable and presents a number of unique Human Factors challenges

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Maintenance Human Factors training programs

- **Some maintenance HF programs are (regrettably) rehashed Crew Resource Management (CRM) programs**
  - **This doesn't work because the error drivers, feedback loops and environmental factors in the maintenance environment are not the same as those for aircrew**

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Maintenance Human Factors training programs

- We also need to be wary of HF programs which are nothing more than a list of problems and human limitations which provide no practical solutions
  - For every (HF) issue raised, a practical tool should be provided and/or discussed

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How can we manage and where possible minimise error (and rule breaking)

- **There are very many underlying drivers for error (and violation) within the maintenance environment**

- **Proactive Threat and Error Management (TEM) should be an integrated component of any Maintenance Human Factors Program.**

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What is Threat and Error Management? (TEM)

- **TEM is the effective identification and management of threats and errors before they result in negative consequences**
- **TEM involves:**
  - **Threat / Hazard/ Error reduction**
  - **Threat / Error capture**
  - **Error tolerance**

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What is Threat and Error Management? (TEM)

Threat/Hazard/Error Reduction

- Training (Formal and OJT)
- Task Authorisation
- HF Awareness
- Maintenance Resource Management
- Maintenance Task Management
- Maintenance Coordination
- Maintenance Supervision
- Policy, process, procedure
- Equipment fit for purpose
- Aircraft Maintenance Documentation

Threat/Error Capture

- Trade Supervision
- Independent Inspection
- Functional Testing
- Maintenance Coordination
- Before Flight inspections
- Maintenance Release
- Pre Flight Inspections

Error Tolerance

- System Design
- System Redundancy
- Non-concurrent maintenance on critical systems.

How can we develop a culture of hazard awareness and risk management?

- **Risk Management – Must be understood and applied at the grass roots level**
- **Hazard and risk awareness should be internalised as the way individuals think and act**

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How do we manage re-currency training?

- More often than not, MHF re-currency training is just a re-hash of the same old classroom based course
  - Negative influence
  - People simply switch off

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How do we manage re-currency training?

- Where possible, actual case studies should be used to reinforce the previously learnt concepts
- Analysis of threats based on Safety Reporting should be used to drive targeted re-currency training
- The current CASA regulations actually give us a flexible enough approach to allow for this.

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How do we measure the success or otherwise of our MHF training programs?

- **Does your organisation have any goalposts to assess the success of your program?**
- **What measures would you use to demonstrate success?**
  - **Measurement of behavioural change**
  - **Retention of information**
  - **Reduction in Error/violation rates**
  - **Regulatory guidance?**

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The HF challenge

- **'The real challenge is converting the vast amount of (HF) information into understandable, practical (and workable) solutions for your organisation'.**

(After - Johnson and Maddox , 2007)

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Conclusion

- For any MHF program to be successful it must be a seamless fit with the organisational context.
- Maintenance HF training packages should include practical tools and processes aimed at developing safety culture and managing error (and violation)
  - The challenge is to find out why the errors occur and to integrate proactive and practical tools for their management
  - For this reason Threat and Error Management should form an integral part of any MHF program

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Conclusion

- The MHF program should also aim to develop a culture of hazard awareness and risk management so that they become internalised as the way individuals think and act

- The program should also include appropriate goals and measures to review behavioural change and to determine its success or otherwise in achieving its aims

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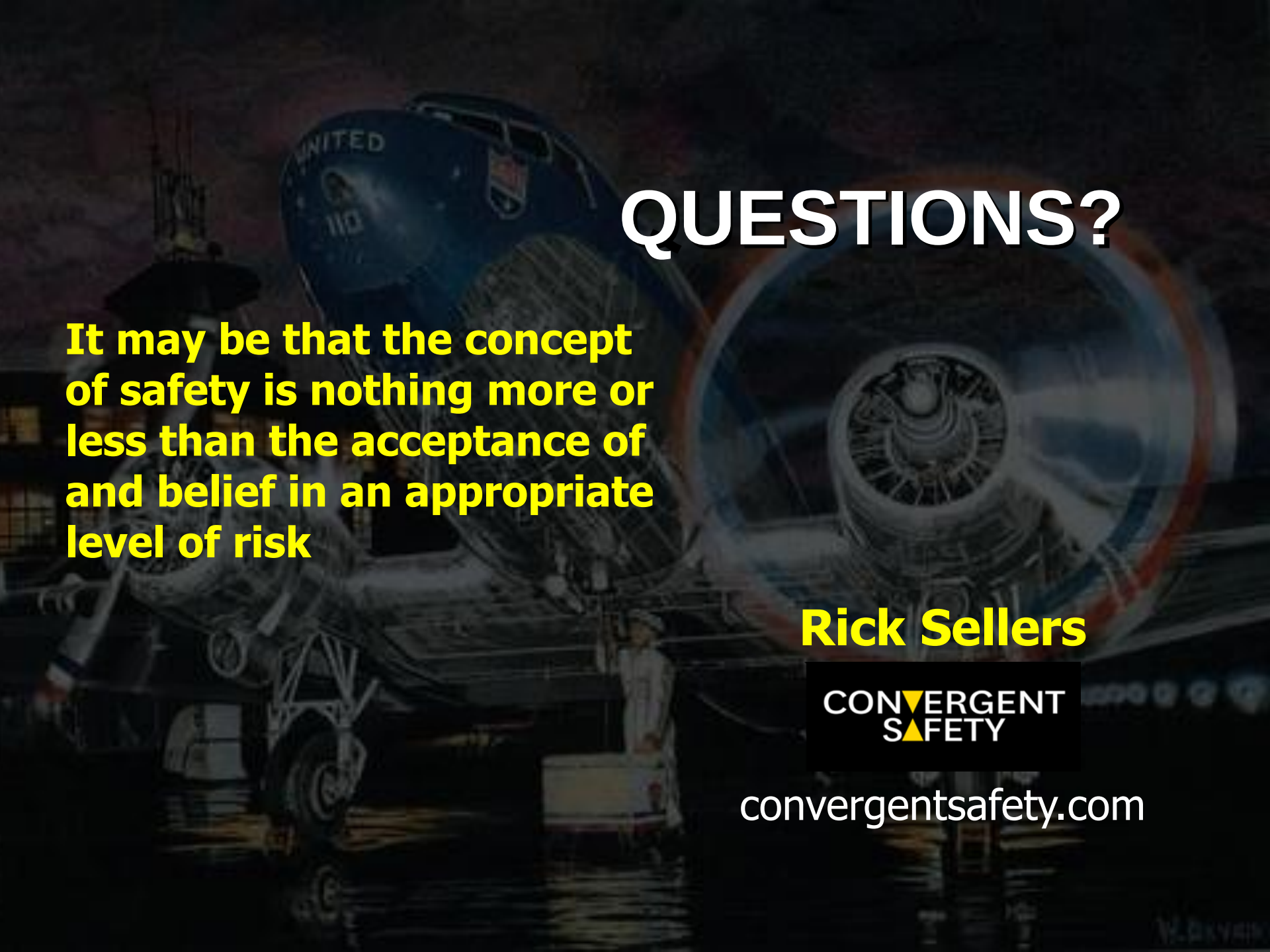

QUESTIONS?

It may be that the concept of safety is nothing more or less than the acceptance of and belief in an appropriate level of risk

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