CIR Risk Management AWARDS 2014 winner

Risk Management Specialist Company of the Year

The Automation Myths

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CRA risk analysis

IOP Institute of Physics Awards 2015
Winner! Best Practice in Professional Development

SYNERGY
people in complex systems

Fitt's List

Humans surpass machines

Detecting of small amounts of visual or acoustic energy

Perceiving patterns of light or acoustic energy

Able to improvise and be flexible

Storing large amounts of information and retrieve it

Reasoning inductively

Exercising judgement

Men Are Best At

Machines surpass humans

Responding quickly to control signals

Applying great force smoothly or precisely

Storing information briefly, then erase it completely

Reasoning deductively, including computational ability

Handling highly complex operations

Doing many things at once

Machines Are Best At

Alternative Models of Complex Control Systems

Model 1: Most problems in complex systems are caused, or exacerbated by, human intervention from incompetent or careless operators – So systems should be designed to limit human involvement as much as possible

Why do users keep messing up my systems?

Safety = System – Human

Model 1 Problems

- Reduced operator vigilance
- Reduced situational awareness
- Deskills operators. Potential for less demanding recruitment criteria
- Lack of familiarity with manual systems makes it difficult to operate in reversionary mode after failure of automatic systems
- Increased technical complexity requiring additional software, sensors and actuators, therefore more sources of unreliability

Model 2: Human operators can overcome problems, or deal with unexpected events, but problems occur when systems are not designed to support human tasks – So systems should build on human strengths and avoid human weaknesses

I cannot be in two places at once

I misread the …

I closed the wrong …

Safety = System + Human

Three Automation Concerns

- Brittle Automation
  - Automation that only operates safely within boundary conditions. But outside the boundary conditions often include off normal situations
- Automation-induced Decision Bias
  - When the cues given about potential targets were unreliable, these poor cues were used even when target position was known to pilot and was displayed
  - Partially reliable diagnostic aids accepted even when conflicting with directly visible evidence
- Automation surprises
  - Weight on wheels sensors used to prevent inadvertent deployment of reverse thrusters, but if sensors fail thrusters cannot be used on landing

Human Factors Issues: Introduction

- Poorly designed automation can have serious consequences
  - Tesla car
- Review of 120 papers revealed that automation often fails to deliver the enhanced safety that is expected
  - Role of human becomes more important as automation becomes more sophisticated
  - Often automation is designed for normal tasks and may be little use when alternative action needed
- When driving, small cues outside car useful
- Too much attention to building and demonstrating than obtaining valid scientific conclusions
- Automation is often system-driven rather task-driven*

Human Factors Issues: Vigilance

- Overall vigilance can be reduced by automating one vigilance task and removing another
- The more support an automated system provides, the less well this system will be monitored
- Sheridan 2016 "*It is fallacious to assume a human driver will stay alert and ready to take over control within a few seconds should the automation fail*"
- Potential to sustain vigilance by altering the level of automated support given for monitoring tasks

Human Factors Issues: Situational Awareness

- Operators scan raw data much less with automation than under manual control
- Reduced monitoring of automated systems can leave operators unaware of the state of plant after an automation failure
- When alarms automatically returned to normal, operators unaware that they had occurred

Human Factors Issues: Trust

- When automated system identified potential threats, subjects found more of these, but missed other, more important threats
- Trust in automation can induce other unsafe behaviour
- If operators cannot knowledgably oversee automation, they must trust it without being able to assess it (Responsibility-Authority Double Bind).

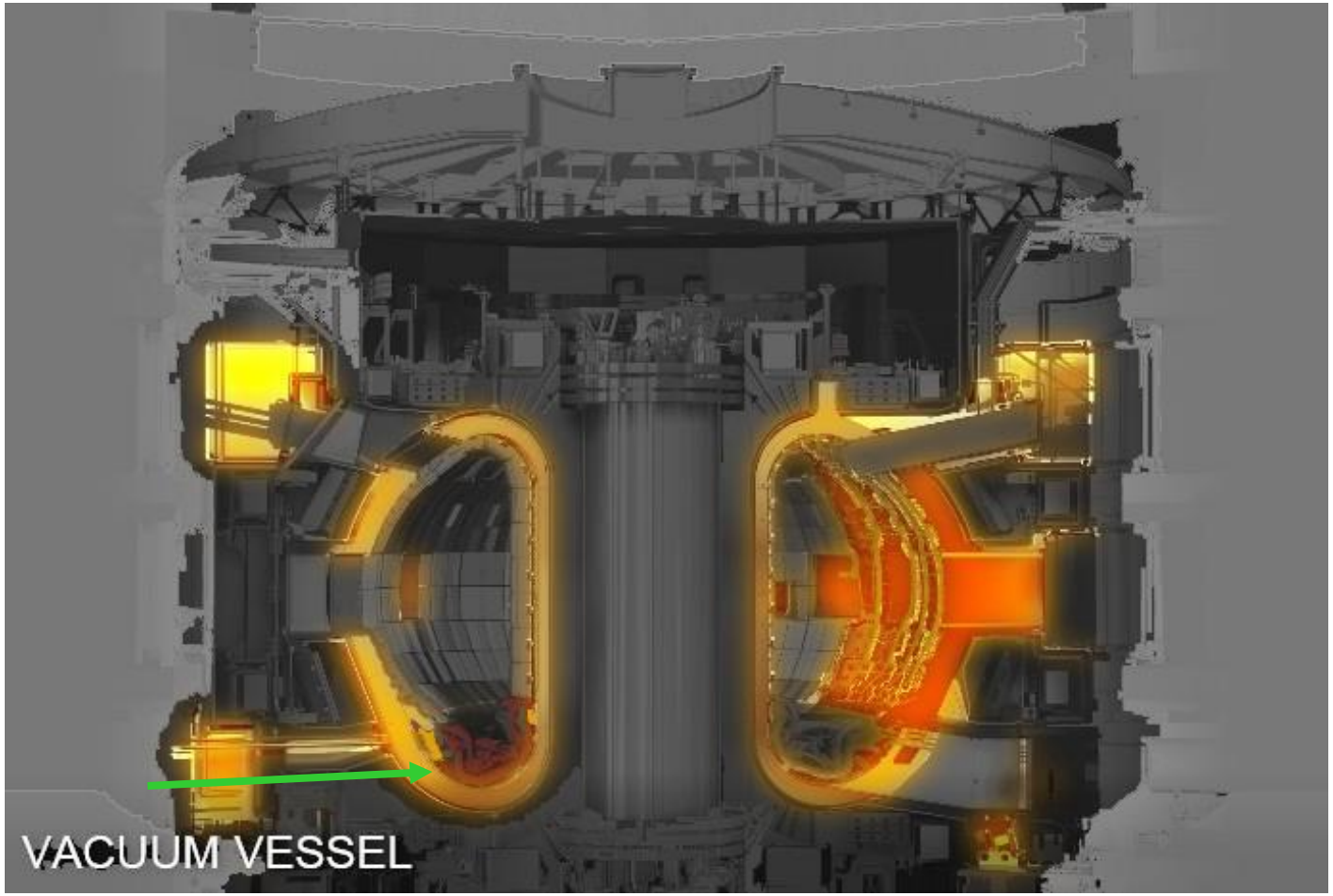
Degree of Automation

1. Human takes all decisions and actions
2. Computer offers complete set of decisions and/or actions
3. Computer offers limited set of decisions and/or actions
4. Computer suggests one alternative
5. Computer executes suggestion if human approves
6. Computer allows human limited time to veto before automatic execution
7. Computer executes automatically then informs human
8. Computer only informs human if asked
9. Only informs human if computer decides to
10. Computer acts autonomously and ignores human

Automation/Human Collaboration

- Human-centred automation facilitates a cooperative relationship
- Degree of Automation can be divided into:
  - Information acquisition
  - Information analysis
  - Decision-making
  - Action
- Concerns if Decision-making and Action are both fully automated, because this provides no opportunity for error trapping
- Actively selecting actions supports situational awareness

ITER



ITER: Interface Proposals

- Predictive virtual reality displays to identify potential problem points in advance
- Operators initiate automatic movement of manipulator arms, but they are responsible for close movement
- Prompts to confirm visual checks are required, rather than full reliance on automation
- Limit on operator interactions during main movements
- Main movements to named points
- Display screens mainly task-based

The Three Automation Myths

- Safety = The system – the human
- Automation eliminates human error
- Automation only impacts those tasks that are automated

Final Thoughts

- Automation decisions must consider all aspects of the functions being automated. For safety critical systems automation MUST be supported by thorough task analysis, error identification and risk assessment
- Automation decisions must exhaustively assess the impact of all situations that might impact the adequacy of the automation
- The design of automation and human interaction with automated systems must fully consider the implications of psychological research
- Automated systems must be designed to enable reversionary operation and to maintain the skills for non-automated working
- The question is not whether to automate, but how to best integrate automation and human control

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