

Safety-Critical Systems in the Hands of Human Operators

An Introduction to the human-
dimensions of safety

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Agenda

- Introduction
- The « Engineer view »
- Another Perspective on System Safety
 - Basic Assumptions on human activity in complex systems
 - A Study of 'automation' in Health-Care
- Conclusion
- Selected Bibliography

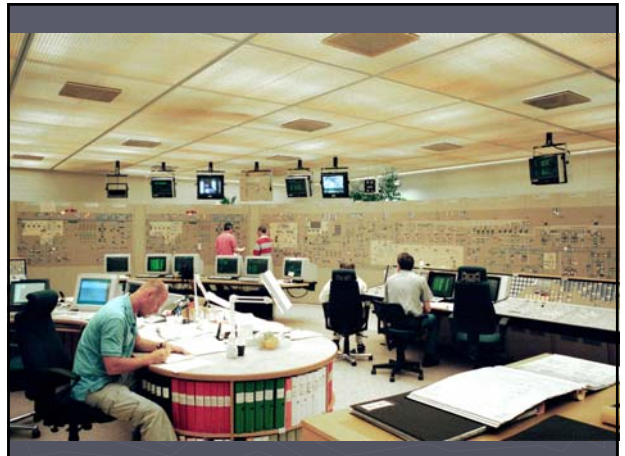
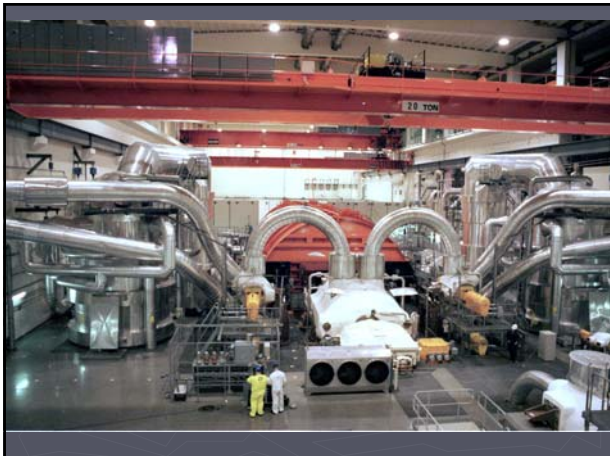
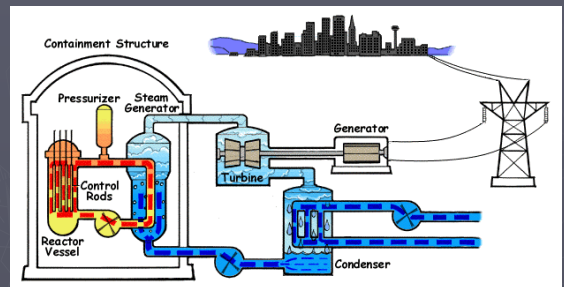
Safety first?



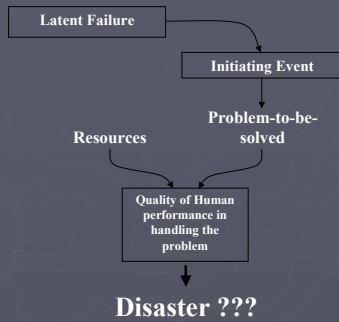
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The Safest NPP is the one we haven't built.
Safety & Productivity are two inseparable goals!

Harrisburg, 1979

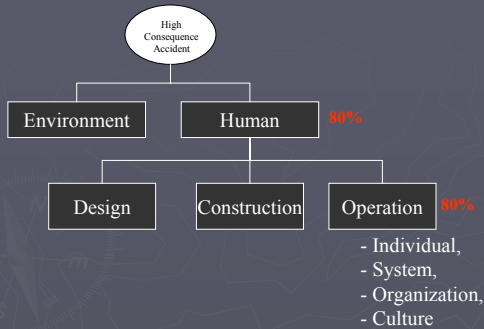


Wood's Anatomy for Disaster



Are Human Unreliable?

Are Human Unreliable?



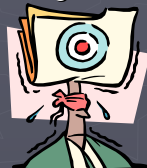
Breakdown of Accident Origin from Bea, R.G. & Moore, W.H. (1993) "Operational Reliability and Marine Systems"

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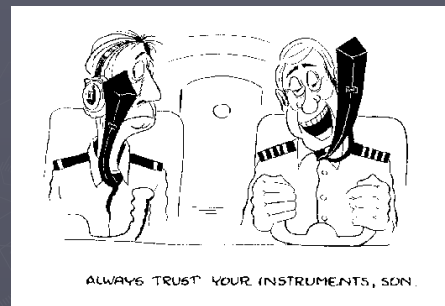
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A Common View on Safety

- Complex Systems are basically safe, and human errors make them unsafe,
- Human errors cause accidents
- « Failures come as unpleasant surprises. They are unexpected and do not belong in the system. » (Dekker, 2002)



Why not get rid of the pilot, then?



Some Consequences

- ▶ There is a tendency to limit, to control human operation in the systems, through
 - An increasing number of procedures,
 - An increased level of automation
- ▶ A Decreasing number of opportunities for trial-and-error learning.

The Changing Roles of Human Operators

- ▶ From Operation to Supervision
Pilot: an operator
a navigator
a symbol of responsibility
- ▶ “The ironies of automation”

What is wrong with this view?

Human Rationality

- ▶ Humans are usually not stupid, but our rationality is bounded / contextual

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Another View on Safety

- ▶ Systems are basically unsafe...
... and Human operators create safety everyday!



Accidents are « Normal »

- ▶ Perrow (1984) « Normal Accidents »: because we created systems that are both interactively complex and tightly coupled system accidents are normal!
- ▶ Roberts (1993): Some Organizations are so reliable that they operate safely despite interactive complexity and tight-coupling.

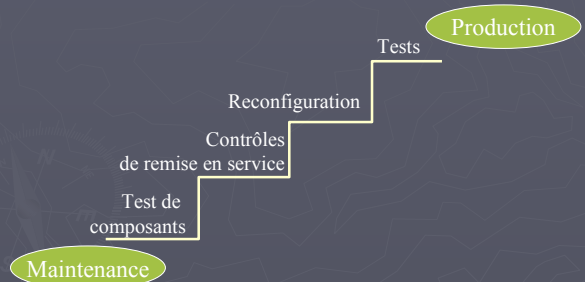
Basic Assumptions in order to understand human behavior

- ▶ The 'Activity' always differs from the 'task'
- ▶ Our actions are always a trade-off between Efficiency and Thoroughness
- ▶ Work Practice is embedded
- ▶ We need to understanding learning processes

Task vs. Activity

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

An Exemple (1/2)



An Exemple (2/2)

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

Efficiency and Thoroughness

Embeddedness

- Physical Context,
- Social Context,
- Discursive Context,
- « Culture »

Cultural Context

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

Studying Situated Learning

- Communities of Practice
- Openness
of the tools

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Methodological Issues

- Ethnographically inspired methods,
 - Observations

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Research Questions

- How do nurses take care medications?
- What Makes this Activity Reliable?
- How does the new tool influence reliability?
(in an idéal case!)

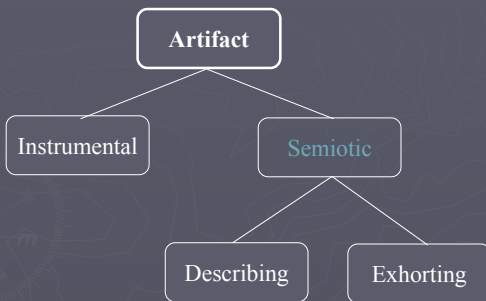
The Study...

- ▶ Pré-study: 4 clinics
- ▶ 1 Clinic (medicine), 3 years after.
- ▶ Observations: « reactive » « non-obtrusive »
- ▶ Interviews

Results (1/3)

- ▶ Dispensation / Healing Process
- ▶ Activity characterized by constant interruptions (from different origins), in which nurses find support in different artifacts :
 - Different values of artifacts,
 - Relatively small place left to the IT tool.

Results (2/3)



Results (3/3)

- ▶ More than a simple change of support (not a surprise!)
- ▶ 1 Boundary-Object --> 2 objects
- ▶ New functions --> redistribution of power
- ▶ Is the round disappearing?

Implications for patient safety...

- ▶ Improvement?
 - ... surely
- ▶ BUT:
 - Some dangers are still present
 - Need to take into account the evolution of practice
 - Judicial frame needs to evolve?
 - Education?
 - etc.

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Designing for Safety

- ▶ Systemic view of Safety:
 - M / T / O
 - Safety / unsafety is at the interaction!
- ▶ Adaptation through practice
- ▶ Reliability and Safety?
 - Unreliable systems create opportunities for learning,
 - Testing the frontier, the limits of operation

Selected Bibliography

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- ▶ Norman (1993) « Things that make us smart: Defending human attributes in the age of the machine »