

Christian Bjursten Carlsson

AUTOMATION SURPRISE – CHALLENGING SAFETY ASSESSMENTS

HFN, 26 April 2024, Ljungbyhed, Sweden

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Future Work Position



“air traffic controller
in a far future work
position” AI Art
Generator

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What happened here?



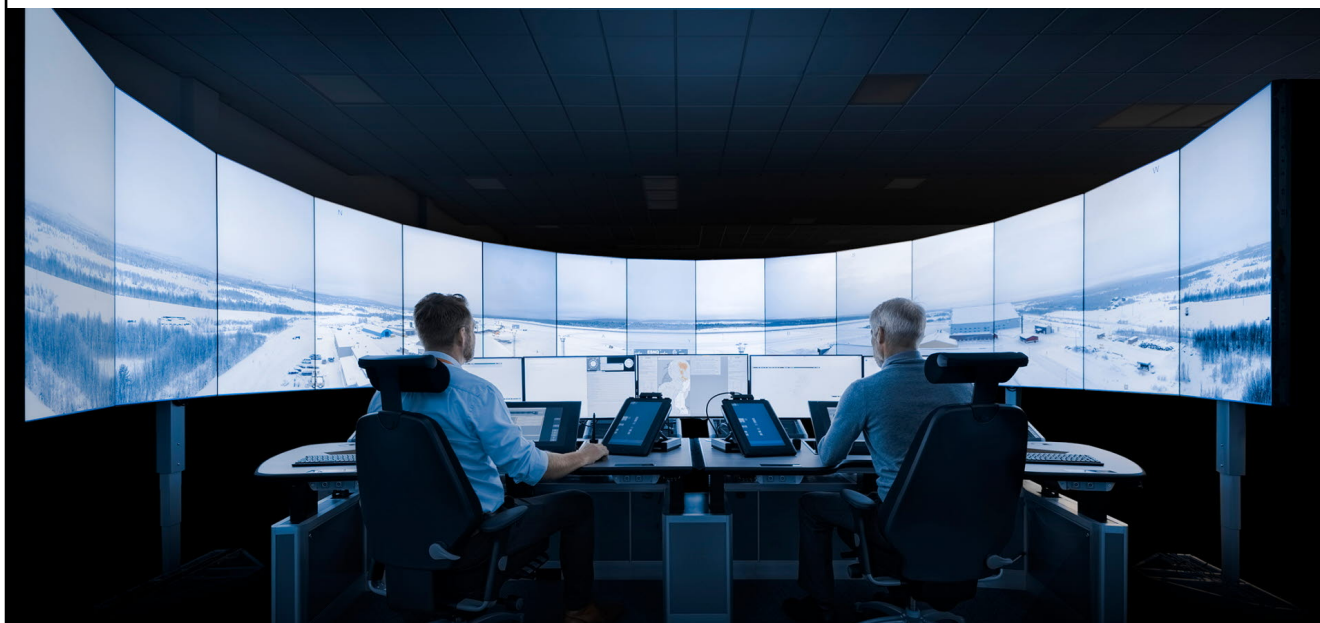
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Automation in Air Traffic Control



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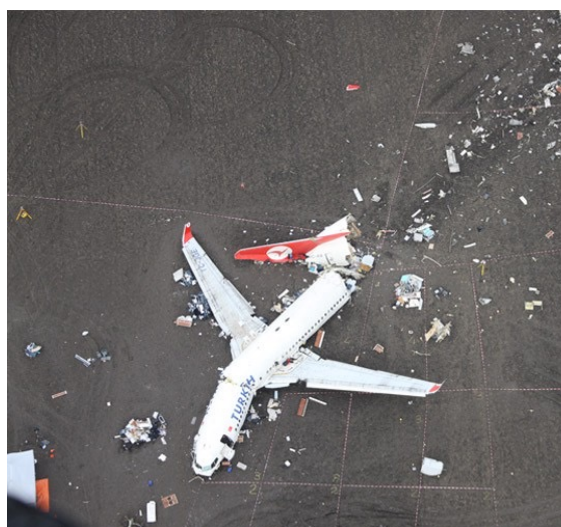
Increasing the relevance of Automation



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Automation



- ✓ Automation Complacency
- ✓ Automation Bias
- ✓ Out-The-Loop Effects
- ✓ Complexity
- ✓ Surprise



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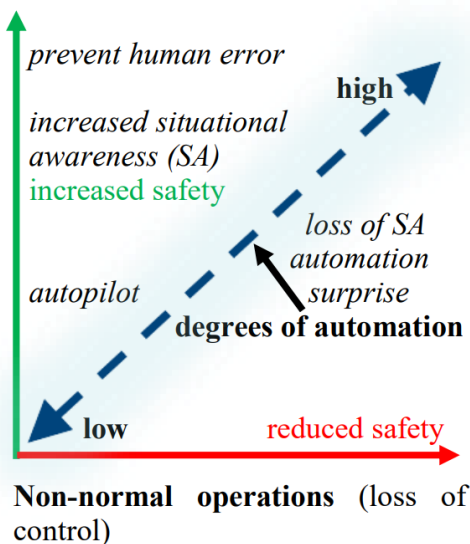
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Automation Safety Paradox

Normal operations
(technology and human in control)



Evjemo, 2018

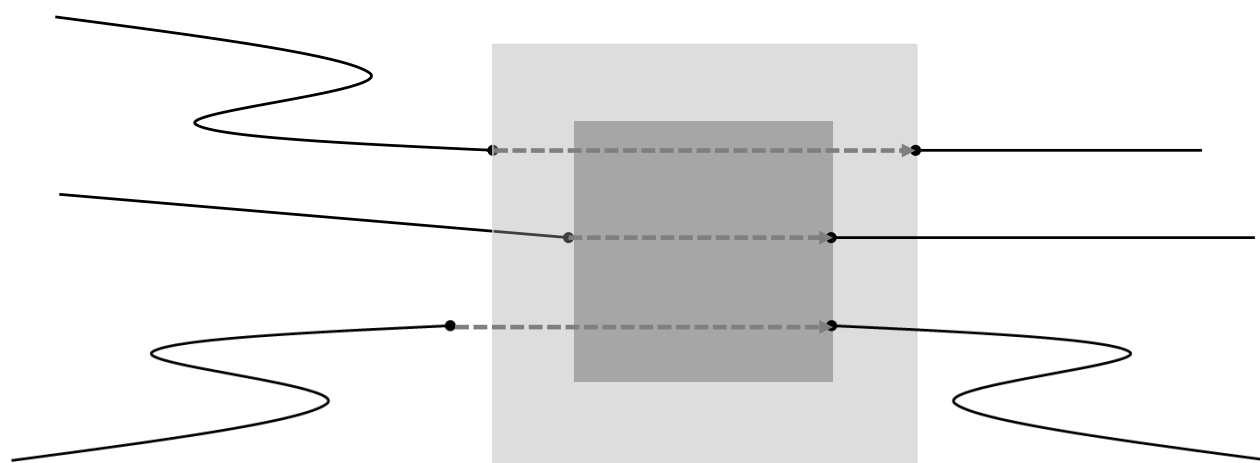
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Automation Surprise



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AS Phenomenon

- ✓ AS is derived retrospectively, explaining a generic event with uncertain boundaries.
- ✓ With a lack of further explanation of the causes, it is deemed to be called a "phenomenon"
- ✓ No causal model concept available that explains the arousal on cognitive level
- ✓ No reproduction possible, rather unique events with poor objective/observational documentation (subjective impact/ bias of operators)

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A LITERATURE REVIEW

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Literature Review

- ✓ Explore reasons why safety assessment methods struggle to proactively identify and mitigate the AS phenomenon
 - What AS-contributing factors can be used for indication of risk?
 - What support do safety assessment methods provide?
- ✓ Gaps between both concepts and propose a way to go.

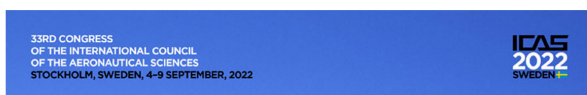
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Article and Final Report



STRESSING SAFETY ASSESSMENT METHODS BY HIGHER LEVELS OF AUTOMATION

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Abstract

Automation aims to improve the system performance by reducing the workload for the operator, increasing the precision of the work tasks executed, enabling high reliability of the operations, and making sure the system is more efficient in performing the operations and in the end increasing safety. The side effect of higher levels of automation is increasing complexity of the socio-technical system that has the potential for automation



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AUTOMATION SURPRISE CONTRIBUTING FACTORS

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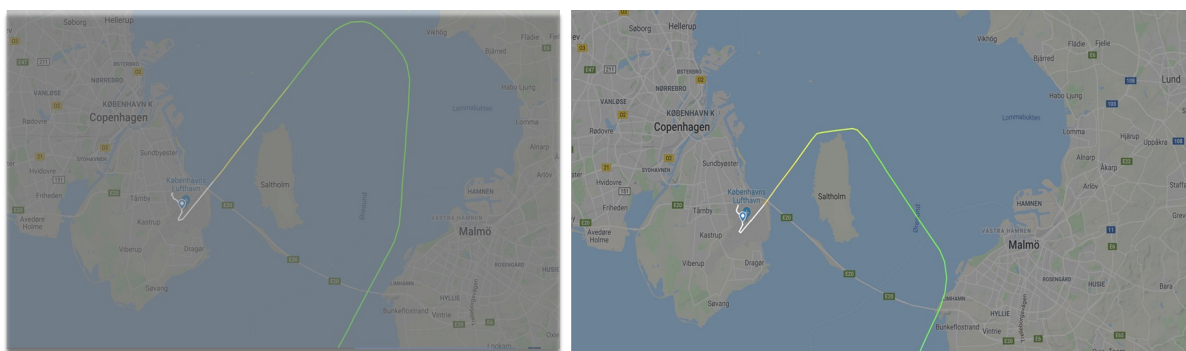
Literature Review

Factors	SOAM Category	SOAM Element
Out-the-loop effect (low vigilance, incomplete or corrupted situation awareness)	Human Performance Limitation	Contextual Conditions
Lack ("masked"/"silent"-mode change) of or excessive feedback from system	Workplace Conditions	
Contradictory feedback from system	Workplace Conditions	
Automation complacency	Human Performance Limitation	
Automation bias / Overtrust	Attitudes and personality factors	
Fatigue	Physiological and emotional factors	
Low workload and High workload	Workplace Conditions	
Complexity (unmanageable number of dependencies between the operator- automation and automation-automation)	Human Performance Limitation	
Poor understanding of automation working principles	Human Performance Limitation	
Poor training in the handling of automation	Human Performance Limitation	
Gap between technology-centered design and human-centered design	Equipment and Infrastructure	Organization
Technical-related breakdown/degradation of automation level	Maintenance Management	
Poor automation design	Equipment and Infrastructure	

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Context Conditions



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SAFETY ASSESSMENT METHODS

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Review Result

- ✓ Review of 17 methods in total, with 15 providing no support for Automation Surprise or Situational Awareness issues
- ✓ **Leveson's STPA method** is an exception, which relies on a control model framework that defines operator and automation in a continuous loop
- ✓ The **Human Reliability Analysis (HRA)** represents the franchising of methods that rely on predefined error classes applied to human perception, decisions, and actions
- ✓ The overview does not claim to be exhaustive

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Contrasting both Concepts

AS Phenomenon (retrospective)

- ✓ High variability of occurrence characteristic
- ✓ Complexity cannot be modelled
- ✓ Lack of observations/ Lack of analytics/ Lack of empiric data
- ✓ Concept of AS phenomena is poorly operationalized

Safety Assessment (prospective)

- ✓ model-based for anticipating future risk
- ✓ Requires knowledge on causal relations
- ✓ Linear relationships
- ✓ Binary event occurrence

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CONCLUSION

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The Challenge



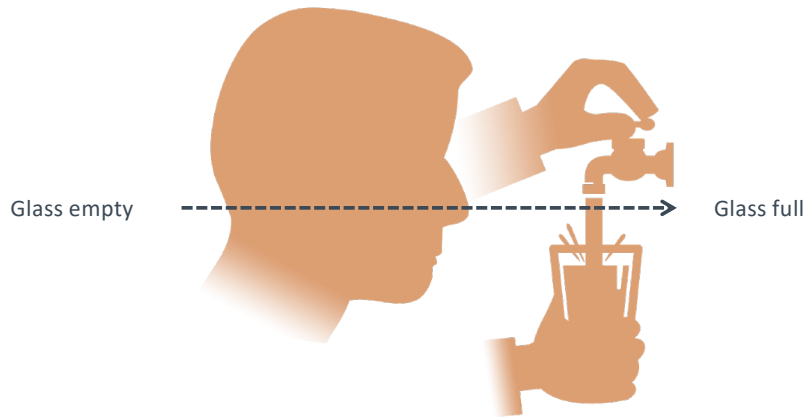
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System Approach - Linear



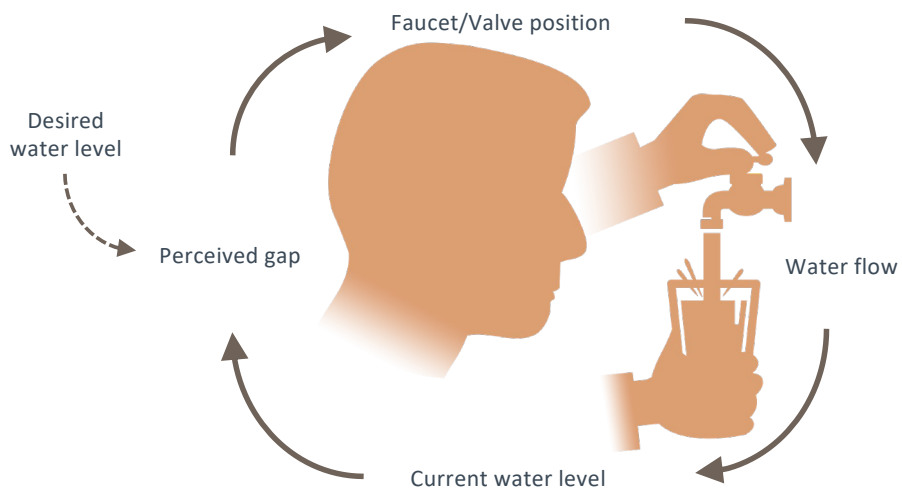
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System Approach - Dynamic



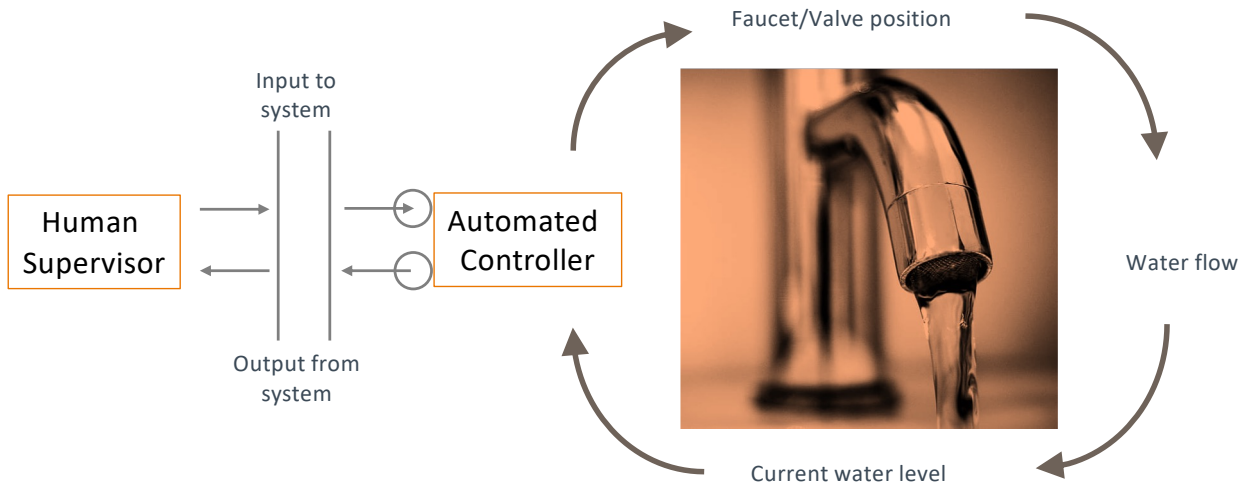
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System Approach – Control Theory

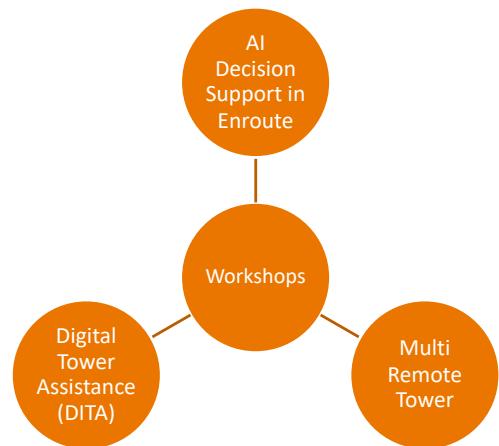


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Guideline to Safety Workshop

1. Identify automation
2. Identify related functions
3. Identify expected states of functions
 - a. What decision is at hand?
 - b. What context is present?
 - c. What information is involved?
4. How could the automated function deviate from expectations (failure modes)?
5. What harm can this cause?



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The Team



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THANK YOU

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