EUROPEAN UNION AGENCY FOR RAILWAYS

webinars

HOF: From Busting Myths to Practical Tools

16 June 2022 12.00 [CEST]

#ERAwebinars

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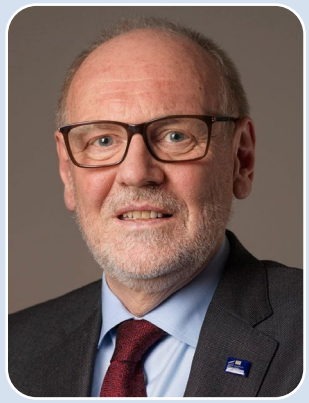
Speakers



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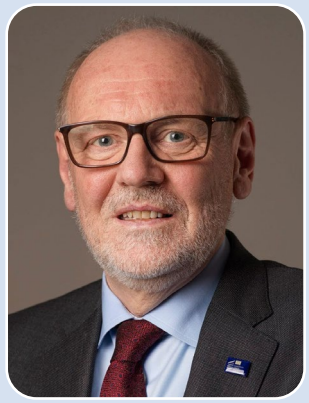

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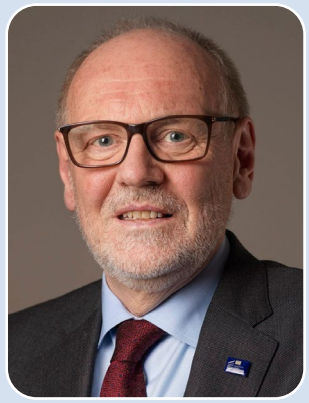

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Automated Railway - Operation as Usual: Best Practice to Achieve Situational Awareness

- Automation Myth Busting Series

- Kristin Mühl
- Human Factors | Traffic Research |
- German Centre for Rail Traffic Research (DZSF)

Automated Railway - Operation as Usual:
Best Practice to Achieve Situational Awareness

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German Centre for Rail Traffic Research at the

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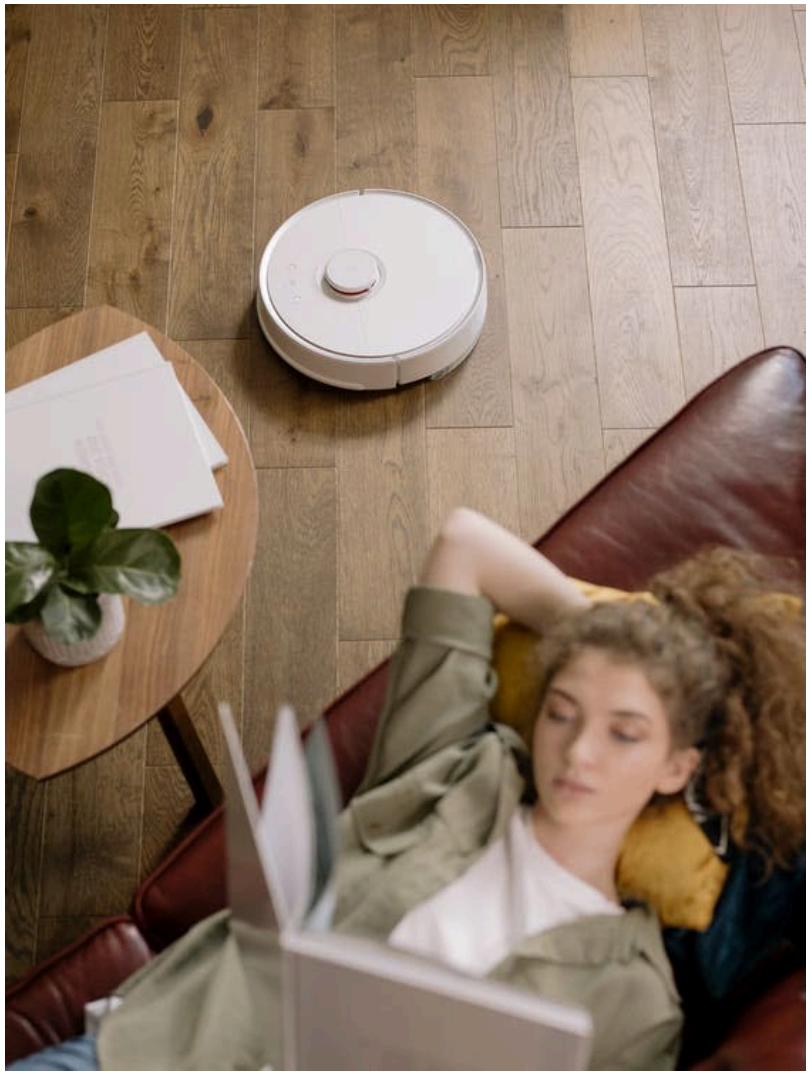
Automation Myth #1
Daily life example

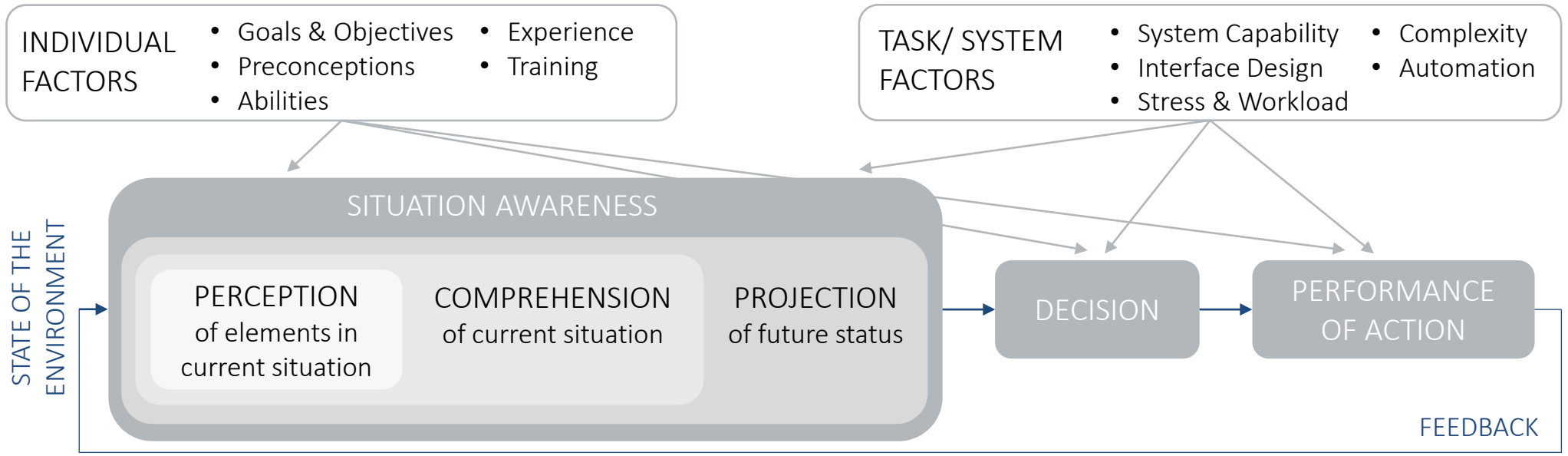


Why did they - human and robot - fail?

- recognize/know the limits
- recognize/know the skills
- anticipate/ know how it will work

Situation Awareness

Automation Myth #1
Situation awareness



three-level model of situation awareness adapted from Endsley (1995)

SITUATION AWARENESS IN RAIL

understanding signalling and control in rail operations (e.g., Golightly et al., 2010; Lo et al., 2016; Sharples et al., 2011)

train driving (e.g., Brandenburger & Naumann, 2019; Rose et al., 2018)

rail maintenance and trackwork (e.g., Golightly et al., 2013; Tretten et al., 2021)

Automation Myth #1
Levels of automation

LEVELS OF AUTOMATION

The system…

LOW (human)

1 … offers no assistance, human must take all decisions/ actions
2 … offers a complete set of decision/action alternatives
3 … narrows the selection down to a few
4 … suggests one alternative
5 … executes that suggestion if the human approves
6 … allows the human a restricted veto time before automatic execution
7 … executes automatically, then necessarily informs the human
8 … informs the human only if asked
9 … informs the human only if it, the computer, decides to
10 … decides everything, acts autonomously, ignores the human

HIGH (system)

a

GRADES OF AUTOMATION

GoA0	On-sight train operation
GoA1	Operation with ATP
GoA2	Operation with ATO & ATP
GoA3	Driverless train operation
GoA4	Unattended train operation

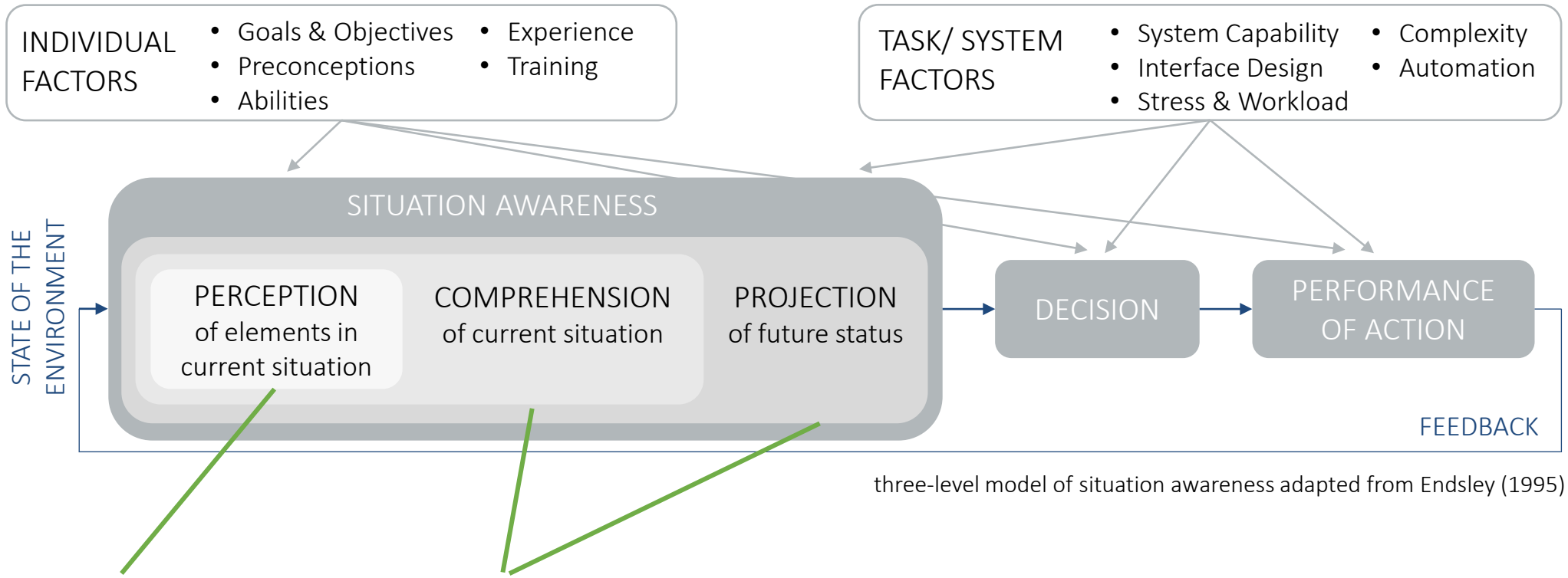
ATO – automatic train operation
ATP – automatic train protection

b

I information acquisition II information analysis III decision selection IV action implementation

a) Levels of automation relating to human information processing (Sheridan& Verplank, 1978; Parasuraman et al., 2000) and b) grades of automation (GoA) relating to train operation (Braband, 2021, UITP, 2018)

Automation Myth #1
Situation awareness & automation

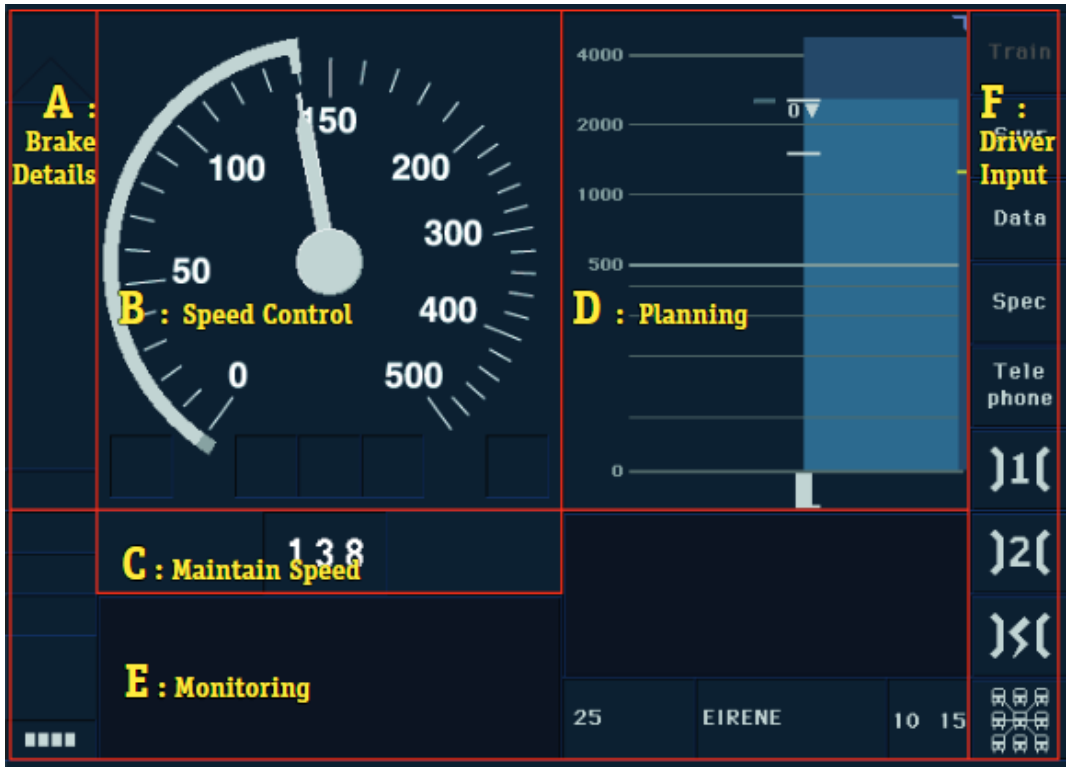


three-level model of situation awareness adapted from Endsley (1995)

I information acquisition II information analysis III decision selection IV action implementation

Automation Myth #1
Situation awareness & automation – example I

Driver Machine Interface (DMI)



Integrated Information in DMI (UIC, 1998, p. 5)

I information acquisition

ceiling speed
target speed
braking target points

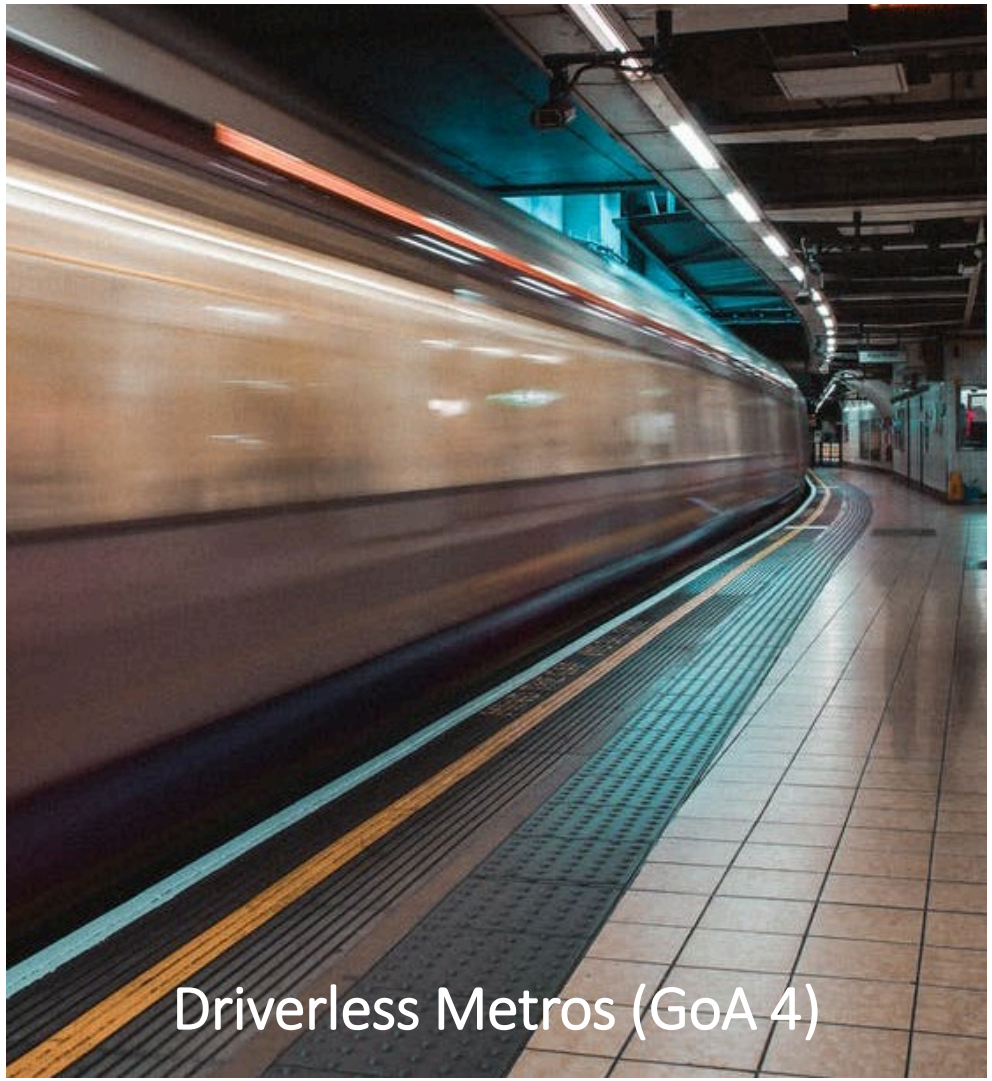
II information analysis

braking curve
speed control
warning

→ DMI supports anticipatory driving

→ DMI might lead to a reduction in specific practical and theoretical knowledge of operators

Automation Myth #1
Situation awareness & automation – example II



Control centre – Supervision

Challenges of information acquisition & analysis

- only via screens (no acoustic or haptic information)
- out-of-the-loop phenomenon

Automation Myth #1 Summary

‘operation as usual’

adequate situation awareness

enhanced through human-centred information and task design & training

The key is putting people at the heart and not underestimating the complexity of human and organisational factors that influence performance in a socio-technical system.

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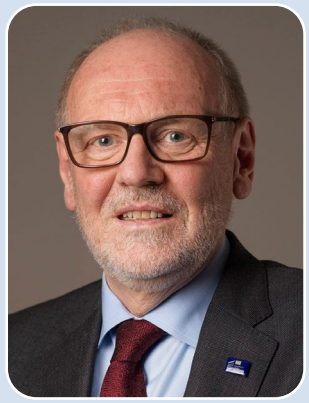

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The Changing Role of Staff in Automated Railway Operation and why Human Cognition is Here to Stay

Dr. Niels Brandenburger
German Aerospace Center, Berlin GER
16th June 2022

The Changing Role of Staff in Automated Railway Operation
Mainline railway automation is picking up pace

- Operating companies become increasingly aware of the central role of **railway automation** to
  - increase **transport capacity** for persons and goods
  - while complying with **energy saving** goals
  - on the **mainline**

- Thus, contributing to **overall European transport strategy** emphasizing rail transport

- Now, the most interesting part of it - **fall back layers for automation failure** - comes into focus to ensure
  - safe transport
  - the envisioned capacity gains
  - homologation and regulatory approval

5G remote control train tested | News | Rail...
railwaygazette.com

SNCF tests its first autonomous train | RailTech.co...
railtech.com

Remote control opens up autonomous operation | ...
railjournal.com

- Traditionally, the human perspective is captured in the **Grades of Automation** (GoA)
  - Rather **subsequent transferal of task** from human driver to automation technology
  - "Until everything is done automatically and we don't have to touch it again"

- Is this the **best way** of doing it from HOF perspective?
  - In terms of swift operational readiness to disruptions?
  - In terms of economic Return-on-Invest funding the development of automation technology?
  - In terms of regulatory safety and resilience considerations?
  - In terms of staff satisfaction?

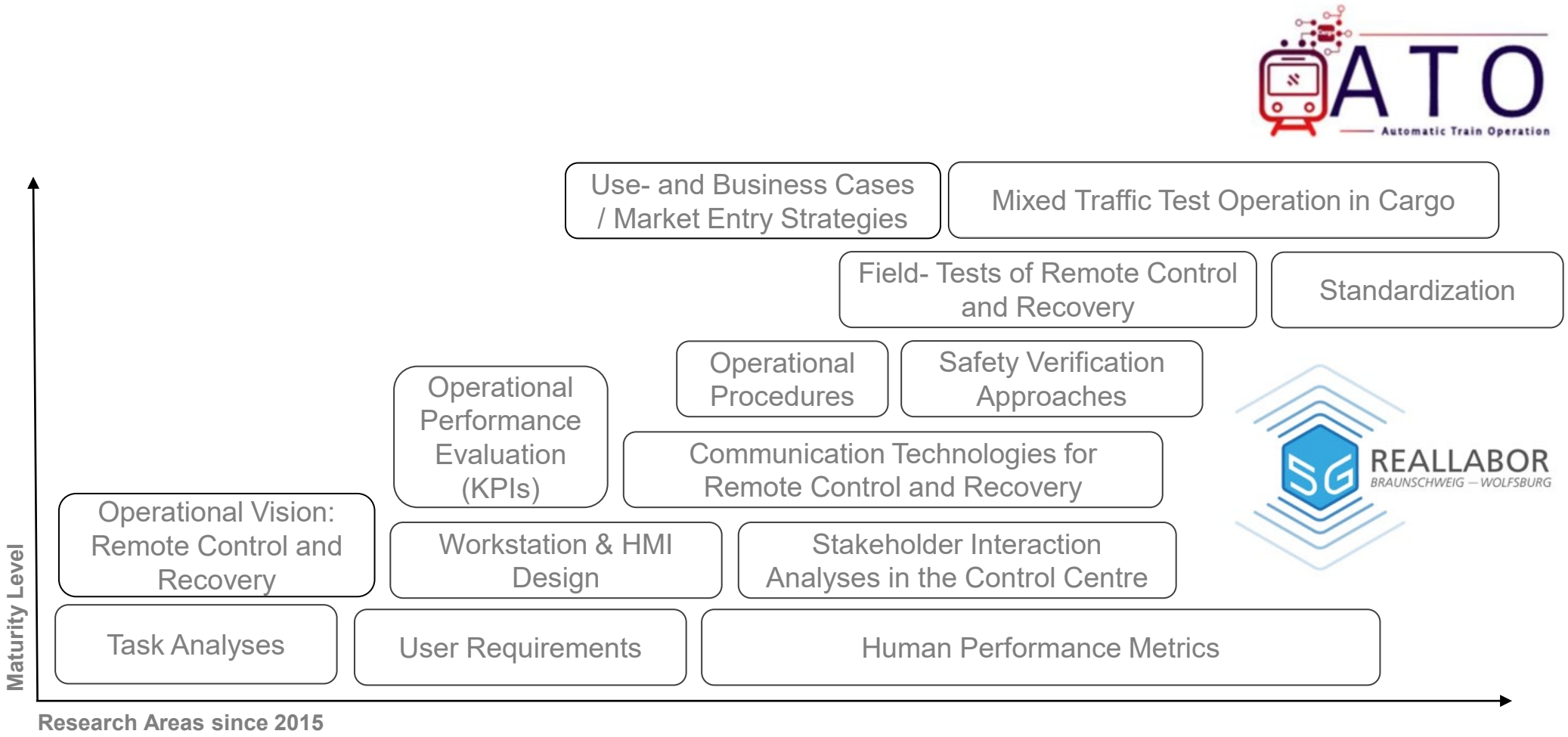
- Well, we have been thinking about this for a while…

Grade of Automation	Type of train operation	Setting the train in motion	Stopping train	Door closure	Operation in event of Disruption
Grade of Automation 1	ATP with driver	Driver	Driver	Driver	Driver
Grade of Automation 2	ATP + ATO with driver	Automatic	Automatic	Driver	Driver
Grade of Automation 3	Driverless	Automatic	Automatic	Train attendant	Train attendant
Grade of Automation 4	Unattended train operation (UTO)	Automatic	Automatic	Automatic	Automatic

Adapted from: VDE (2015). *Railway applications - Urban guided transport management and command/control systems - Part 1: System principles and fundamental concepts,* IEC 62290-1:2014

The Changing Role of Staff in Automated Railway Operation

Human and organizational research areas at DLR



The Changing Role of Staff in Automated Railway Operation

Human and organizational research: Some Insights

- During our line of research, it became apparent that **human machine collaboration setting** for GoA3/4 is probably superior to brute force automation approach
  - In terms of swift operational readiness to disruptions?
    - The staff as key **knowledge** holders, **decision** makers and **communication** agents
  - In terms of economic Return-on-Invest funding the development of automation technology?
    - Tailored **staff training** to catch the “real world corner cases” instead of trying to “hard code” every single exception to the rule into automation technology.
  - In terms of regulatory safety and resilience considerations?
    - See above. The “human factor” is saving the day, instead of being considered a safety risk to be mitigated
  - In terms of staff satisfaction?
    - **Meaningful future role** for well-trained expert staff is **eliciting positive outlook** instead of occupational worries (often associated with automation)

5G remote control train tested | News | Rail...
railwaygazette.com

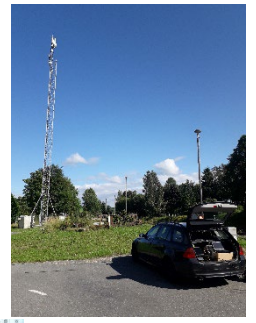
SNCF tests its first autonomous train | RailTech.co...
railtech.com

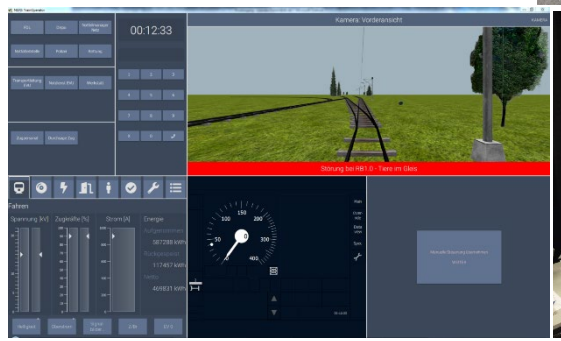
Remote control opens up autonomous operation | ...
railjournal.com

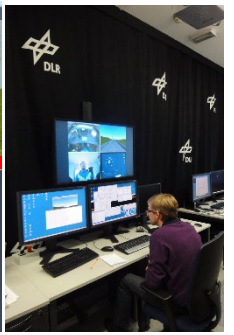
- The emerging vision to GoA3/4 mainline operation:

  Human remote control and recovery **interventions** in cases of disruptions (infrastructure and vehicle side) or lack of way-side equipment **are catalyst for automatic train operation**, as **they** may **serve as a valid fall-back layer** for automation technology.

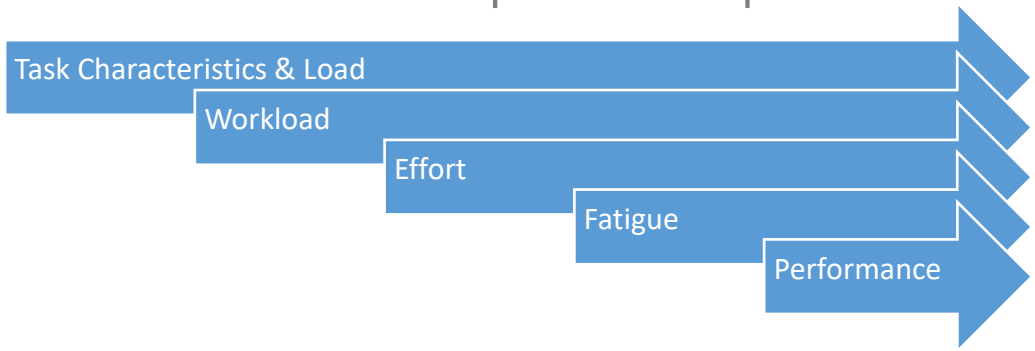
  → human machine collaboration

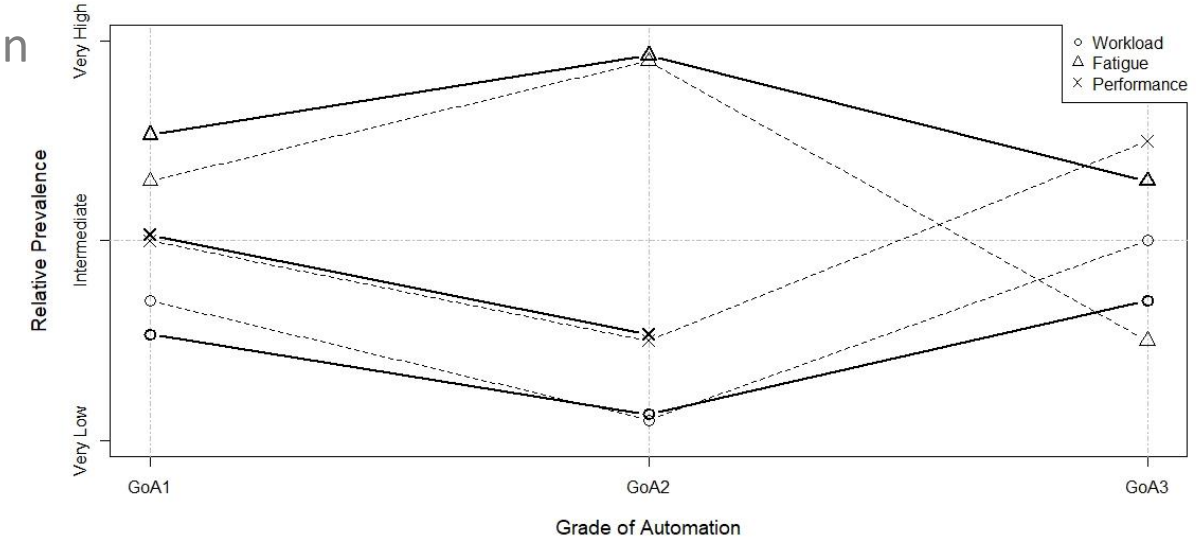






- **Psychological theory** can be (reprehensibly) simplyfied into chain of **layered effects** (left figure) determining the subsequent concepts and the resulting **performance**
- **Main messages**
  - Get the task characteristics right!
    - avoid monotony and continuous monitoring tasks -> multimodal varying tasks
  - Get the workload balanced right!
    - the subsequent concepts will follow accordin





Taking on the **Human and Organizational Factors** perspective enabled us to sketch and empirically validate a promising **vision for GoA3/4 mainline operation** that relies on the **human factor** to overcome the „fall-back layer“ problem hindering mainline railway automation for years.

Questions, Remarks & Criticism

Thank you very much for the opportunity to contribute

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16th June 2022

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- Please see the **reference section** of the underlying written publication:
  - Automation Myth #2 – Automation technology can operate mainline railways without human involvement
- Available at:
  - www.era.europa.eu/activities/safety-management-system/human-and-organisational-factors-hof_en

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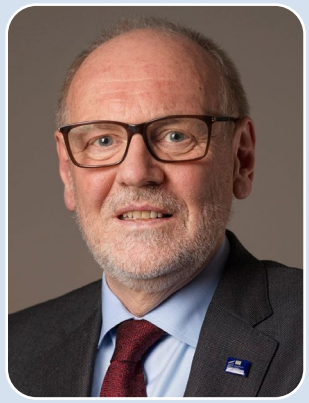

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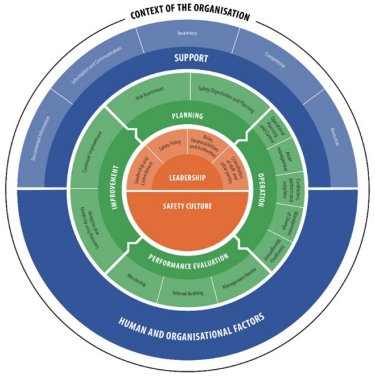
How to integrate HOF in change management?

The purpose of the SMS is to ensure that the organisation achieves its business objectives in a safe manner and complies with all the safety obligations that apply to it.

Change management process ensures that **changes within an organisation are adequately planned**, **implemented** in accordance with EU requirements, **monitored** and **adapted** to help the organisation achieve its business objectives.



Most railway systems rely on **human and organisational performance,** and integrating HOF from the start of a change will help to achieve business, safety and operational goals more efficiently with less errors and better acceptance of the change by end-users.

Adapted from aviation and developed with the support of railway sector representatives, the aim of this toolkit is to propose a **systemic and systematic HOF approach** throughout the change management process.

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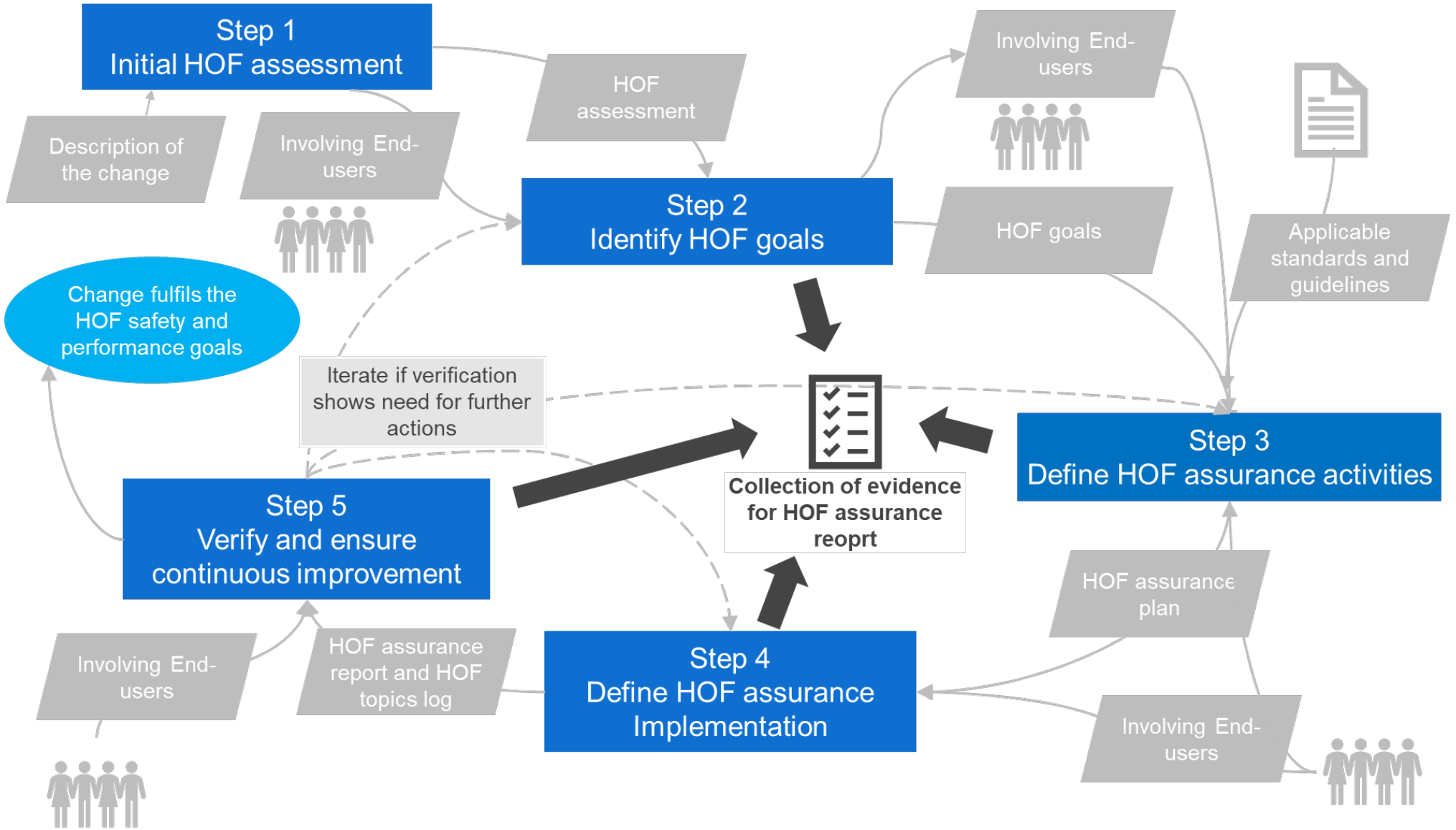
Proposed methodology



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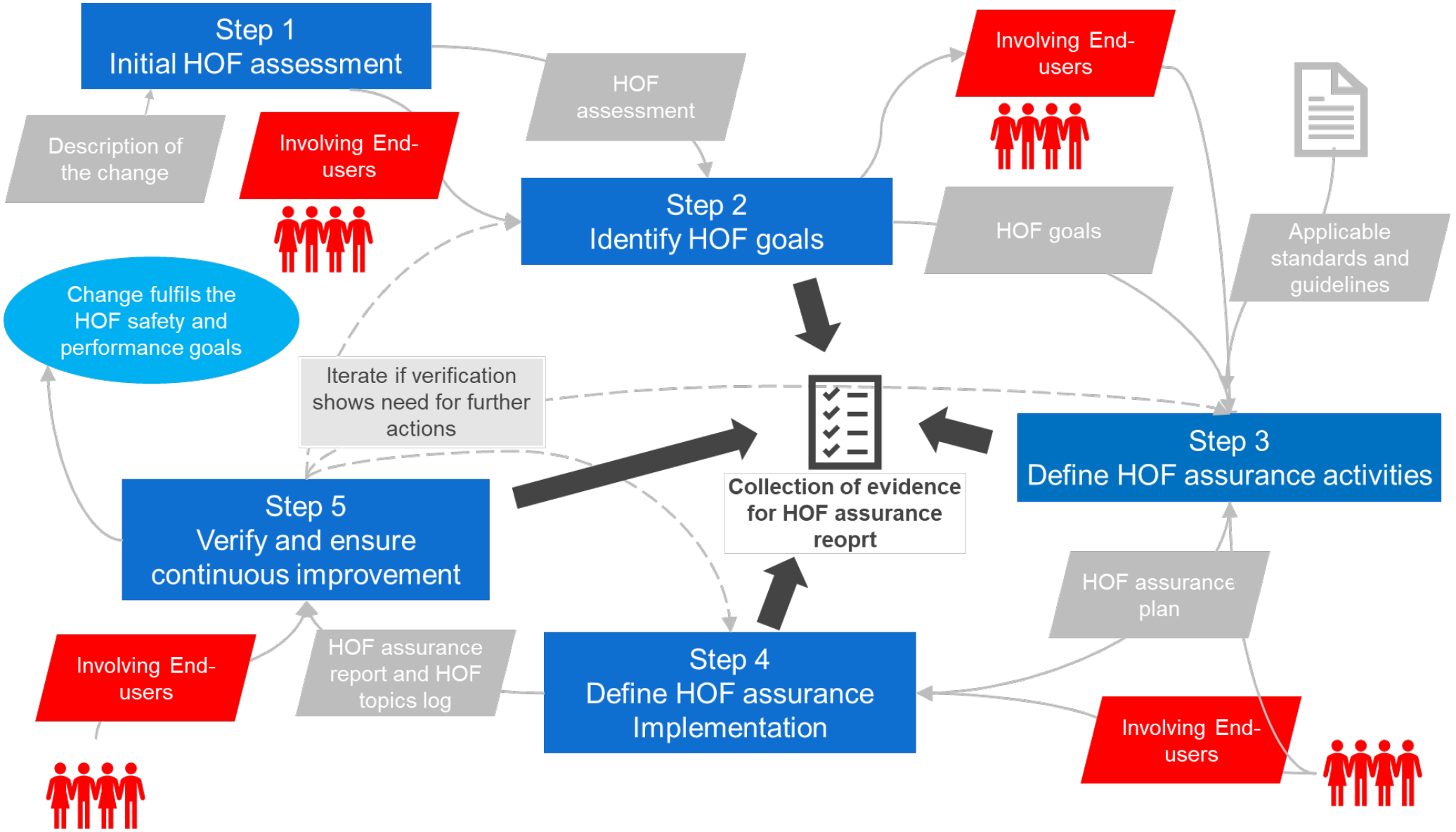
Proposed methodology



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HOF change management tool

Description of the (sub-)system under consideration within this assessment

Support to describe the change to be considered, and to chunk it if needed to facilitate its assessment

Information on the change					
Date					
Project Name					
Project Manager		Tel		E-mail	
HOF specialist (when needed)		Tel		E-mail	

Change	
Objectives	
Impacts on the existing system including interactions with other parts of the system or other systems	

Key Documentation

Key Stakeholders			
Name	Role	Expectations/Impact	contact

*Indicate E = Existing actor or N = New actor

** Indicate if change is ' Role ' Responsibility ' Task ' Working Method

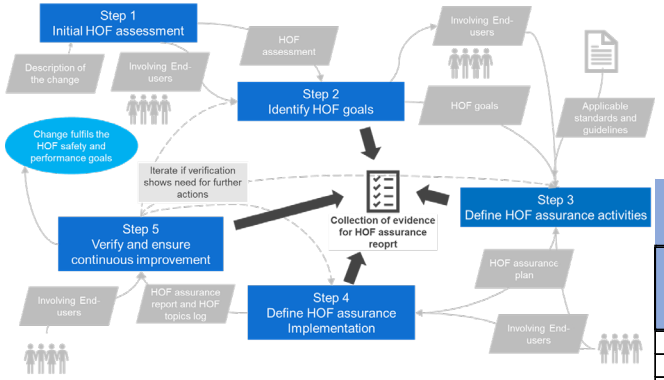
Impact on Actor(s)			
Actor	Initial system	Proposed change	Comments

Notes	

HOF Assessment		
Tasks impacted	HOF identified	Comments

STEP 1/ STEP 2 - Initial HOF assessment & Identified HOF goals

Ref./No.	Source of identification	Activities/ Tasks	HOF identified	Description of the HOF topic	Ranking/ Priority (if necessary)	HOF goals	Comments



STEP 3 - Defined HOF assurance activities to support the change

HOFAssurance activities	Monitoring Activities identified	Comments	HOF Assurance Plan

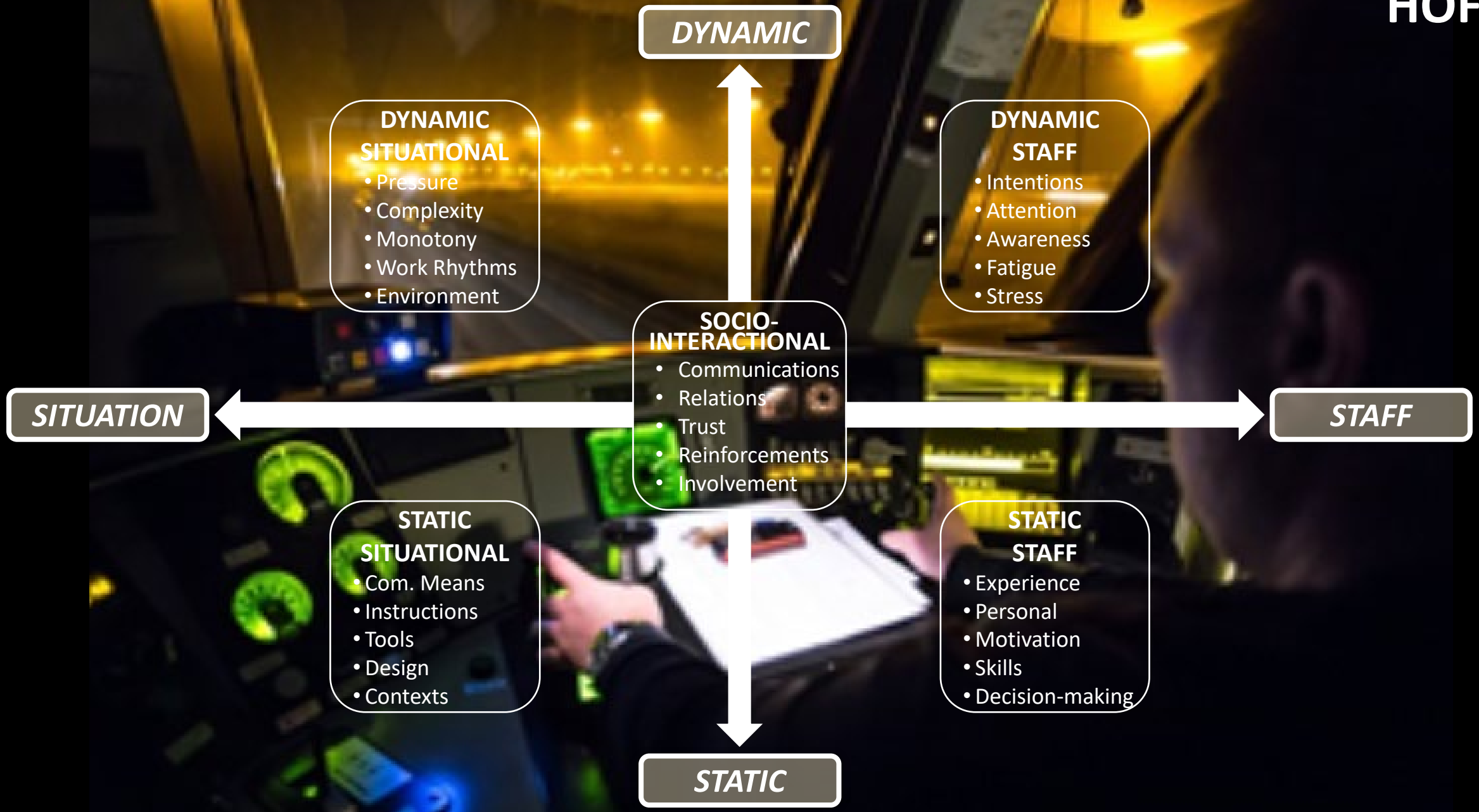
STEP 4 - HOF assurance implementation

Assurance implementation (link to HOF assurance plan)	Monitoring	Conclusion & Recommendations

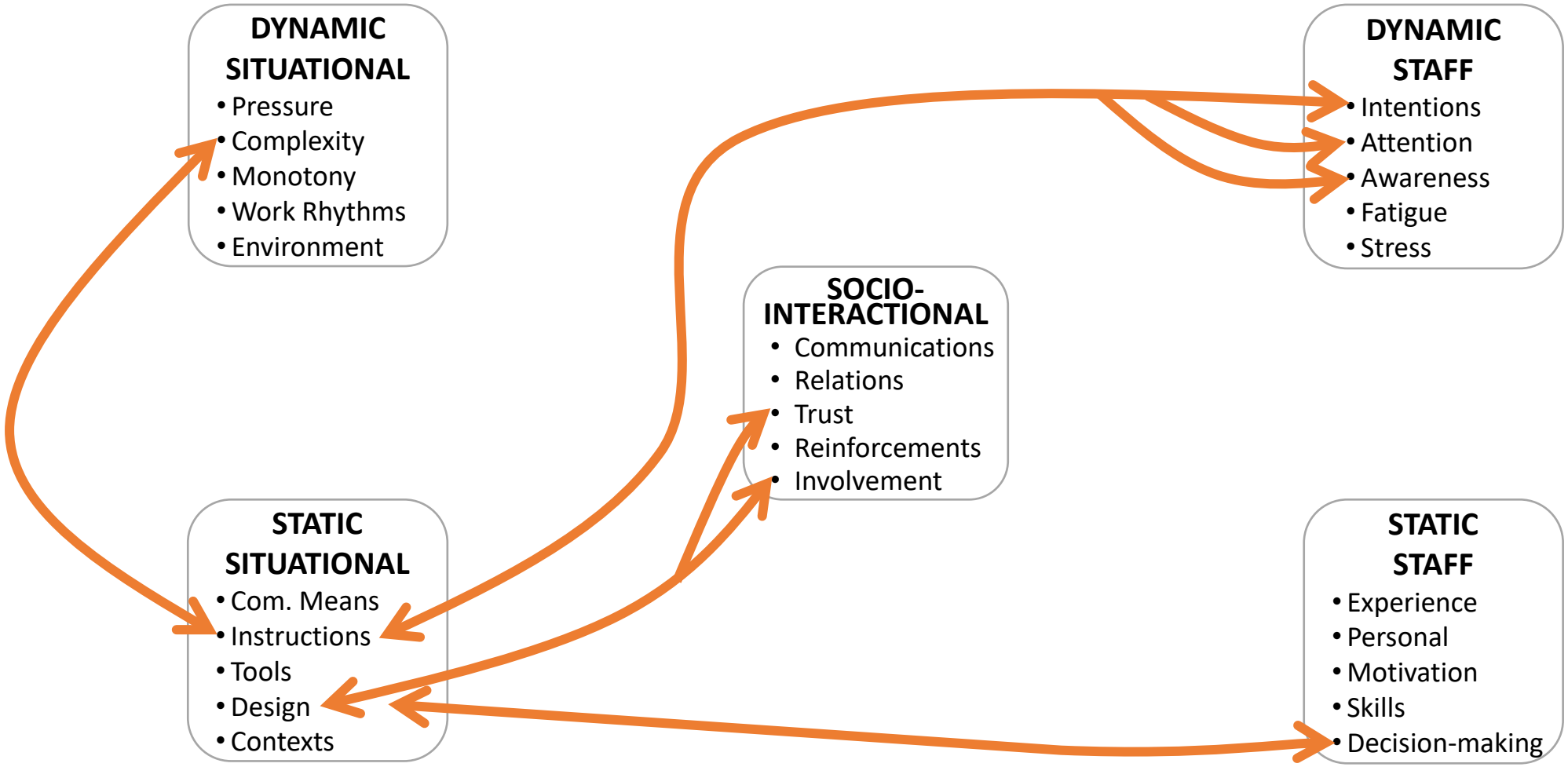
STEP 5 - Verified and ensured continuous improvement

Implementation of the recommendations	Results of monitoring of implementation	Conclusion

HOF 5x5


DYNAMIC
DYNAMIC SITUATIONAL
• Pressure
• Complexity
• Monotony
• Work Rhythms
• Environment
DYNAMIC STAFF
• Intentions
• Attention
• Awareness
• Fatigue
• Stress
SOCIO-INTERACTIONAL
• Communications
• Relations
• Trust
• Reinforcements
• Involvement
SITUATION
STAFF
STATIC SITUATIONAL
• Com. Means
• Instructions
• Tools
• Design
• Contexts
STATIC STAFF
• Experience
• Personal
• Motivation
• Skills
• Decision-making
STATIC

HOF SPV - Sources of Performance Variability - Example of Interactions « Creating (or updating) Procedures »



We represent here the patterns of influence with double arrows in order to make start and grow this reflection and analysis. Other interactions may be identified, or some may be absent, depending on the risks in question and the stakeholders involved.

HOF toolkit: example of overview of factors

Static situational factors				
Will the change have any impact on rules (incl. procedures), communication means, task/tools design, equipment use, or societal/institutional contexts? And conversely, could these factors impact on the planned change?				
Design	Instructions	Communication Means	Tools	Contexts
Could there be any change to the end-user based design approach?	**Could there be any change to work instructions, procedures or rules?**	**Could there be any change to the communication standards or means?**	**Could there be any change to tools and equipment used to complete the tasks?**	**Could there be any change to the context(s)? have an impact on the context in which the safety tasks are carried out ?**
Could the change have an impact on the task design (including demands / expectations) from all the concerned staff?	Could there be a change to current instructions, procedures or rules?	Could there be any change on the communication standards and protocols, means and tools?	Could the change have any impact on the tools - equipment, and more specifically on the command equipment (driving cab, control centre…) ?	Is there any requirement in the national or EU regulations concerned by the change?
Will a user-centred approach be followed to design the change from the early design stages?	Could new instructions procedures and rules be required to cover new situations?	Could the change have any impact on the amount and the variety of sources of the communication ?	Could the change have any impact on the tools - equipment, and more specifically on the visualisation devices, display settings (e.g. signalling…) ?	Could the new situation and all its components be more likely to be impacted by any internal or external sabotage?
In case of a new or change of the task, will it continue to support human performance and well-being (from the users perspectives)?	Will the new instructions, procedures and rules cover normal, rare, abnormal, degraded and emergency situations?	Could there be a completely new type of technology/equipment/tool to convey the information be acquired /designed /implemented /used?	Could the change have any impact on the tools - equipment, and more specifically on the computers usage (incl. software) ?	Could the new situation and all its components be more likely to be impacted by the internal social climate (e.g. staff previous complaints, Union relationships or negotiations, strike)?
Could the change have any impact on the roles, responsibilities, resources (rules, time, staffing,…)?	Could the change have any impact on the availability of the instructions, procedures and rules?	Could of the current communication tools/equipment be modified?	Could the change have any impact on the tools - equipment, and more specifically on the alerts, alarms, messages (e.g. clarity, relevance, quantity/frequency,…) ?	Could the new situation and all its components be more likely to be impacted by the external social climate (e.g. politics, economics, media, global health; related to problems like market high pressure, societal absenteeism, or lack of leadership/supervision due to global staff shortage)?
Could the change have any impact on the interactions between staff (e.g. all concerned (parts of the) job/tasks re-design, tasks/activities coordination)?	Could the change have any impact on the clarity of instructions, procedures or rules?	Could the change have any impact on the requirements in terms of competencies involved to use the communication means and/or apply the standards and protocols (selection,	Could the change have any impact on the tools - equipment, and more specifically on the technical support devices (e.g. diagnosis instruments, measure instruments, …) ?	Could the change have any impact on the internal or external social climate (feelings and attitudes of staff or other stakeholders) ?
Could the change have any impact on technical or organisational means in place to support the operator's ability to work autonomously?	Could the change have any impact on the way the procedures are designed, maintained, monitored?	Could change have any impact on the current communication monitoring process ?	Could the change have any impact on the tools - equipment, and more specifically on the protection or prevention devices or equipment ?	
Could the change have any impact on technical or organisational means in place to support the task workload, and its variations/extremes?	Will the change have an impact on their interactions all together (e.g. timing of tasks, concurrent objectives/resources, even for several job tasks and staff categories incl.	Could the change have an impact on the need to switch between different communication means within the same task?	Could the change have any impact on their availability, maintenance (and time to maintain) and back-up for all the staff concerned?	

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Next steps

- Publication by the end of 2022:
    - Guidance document on HOF in change management
        - Part 1 – Methodology
        - Part 2 – Guidance on HOF change management tool
    - HOF change management tool
    - Training materials currently under development

For more information, please contact: HOF@era.europa.eu

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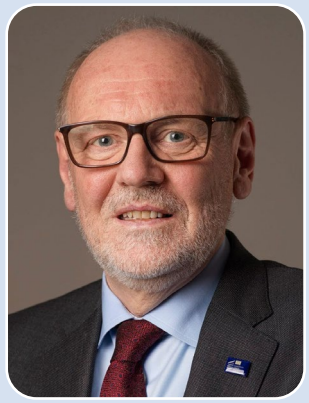
Speakers



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Safety Manager

DB NETZE DB Netz AG

User Experience „HOF Toolkit“

Change: Communication process

16.06.2022 | Marcus Arenius, Charlotte Karpa | DB Netz AG | I.NBB 42

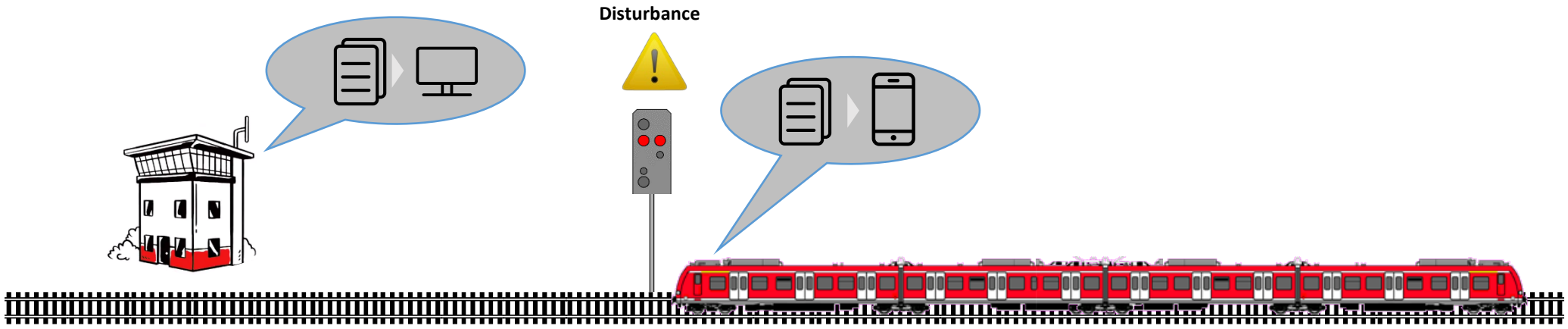
Change: Introduction of IT software to change a communication process

Current State

Disturbance	Contact by phone	Dictation	Reception – Hearing & Repetition
Disturbance, fulfillment of operational requirements	Contact beween train driver and signaller	Signaller transmits the information to train driver	Train driver repeats information

Target state

Disturbance	via IT-Software	Dispatch	Reception - Reading



HOF-Toolkit – Pros and Cons

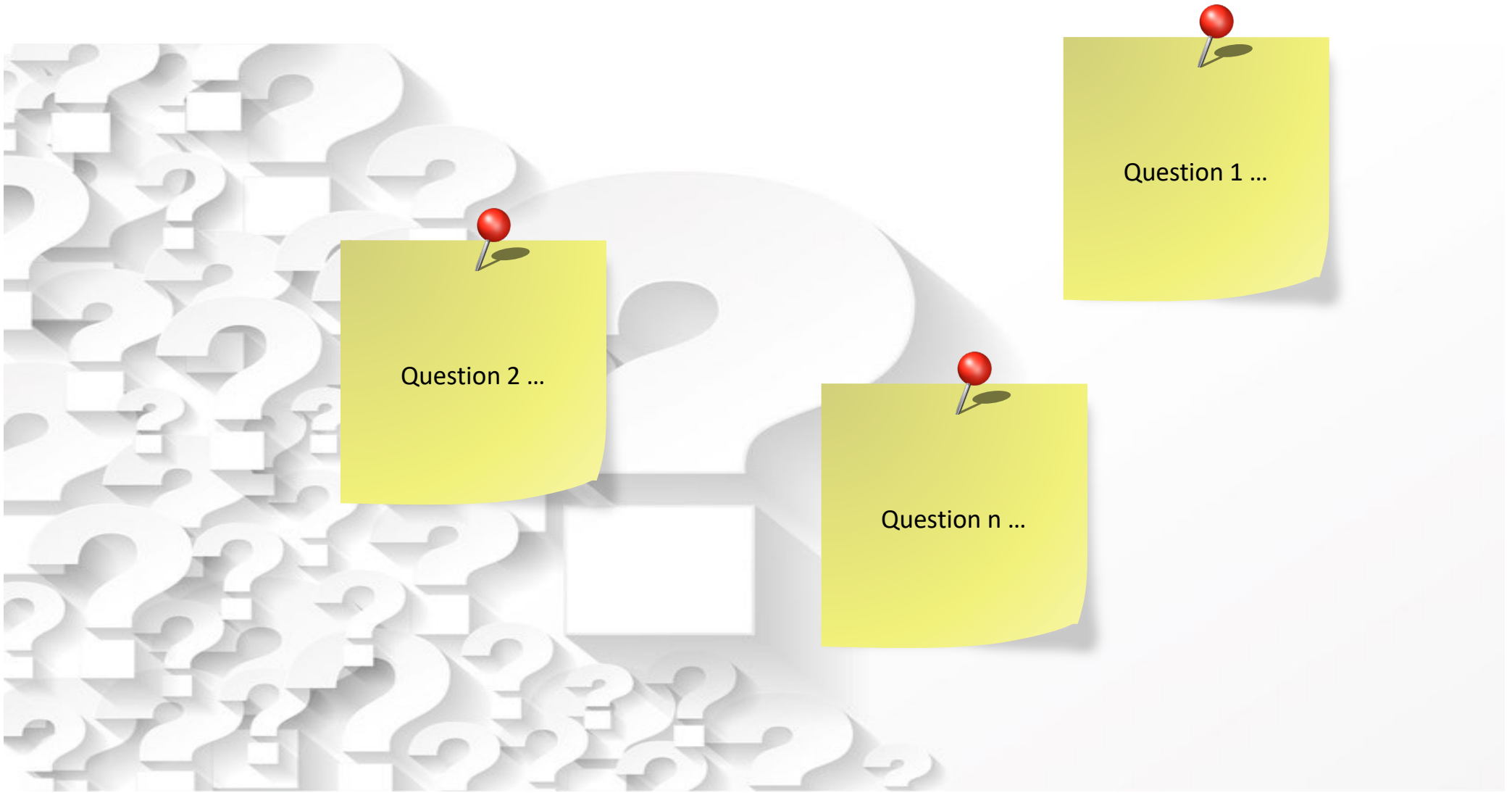
Existing Strengths

- The participants appreciated the **questions for the CSM ASLP-factors**.
  - They aided greatly in the HOF evaluation of the change. Especially for the “softer” organizational/societal factors
- They appreciated the **filter/scanning logic**
  - e.g. moving from general HOF to more specific factors and questions
- They also liked the **automatic support** and “aids” provided by the excel document

Areas of Improvement

- **Aim and Redundancy with existing processes (time requirement)**
  - Recommendation: Check the compatibility of the tool with existing processes and documents, “focus” the tool application, e.g. in Step 1
- **Application for activity or complete change?**
  - Recommendation: Apply it to the change and not specific activities
- Explanation of **Human Factors concepts**. E.g. trust in automation, societal absentism or degrees of automation
  - Recommendation: Improve description and add to training material

Questions?



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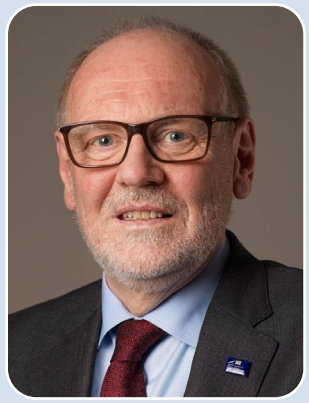

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Give us your feedback

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Upcoming Free Webinar

24 June, 13h00-14h00 (Paris Time, CET - UTC+2)

Railway Safety & Interoperability: the Importance of Data Sharing

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Upcoming ERA Event

SAVE THE DATE

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