EUROPEAN UNION AGENCY FOR RAILWAYS

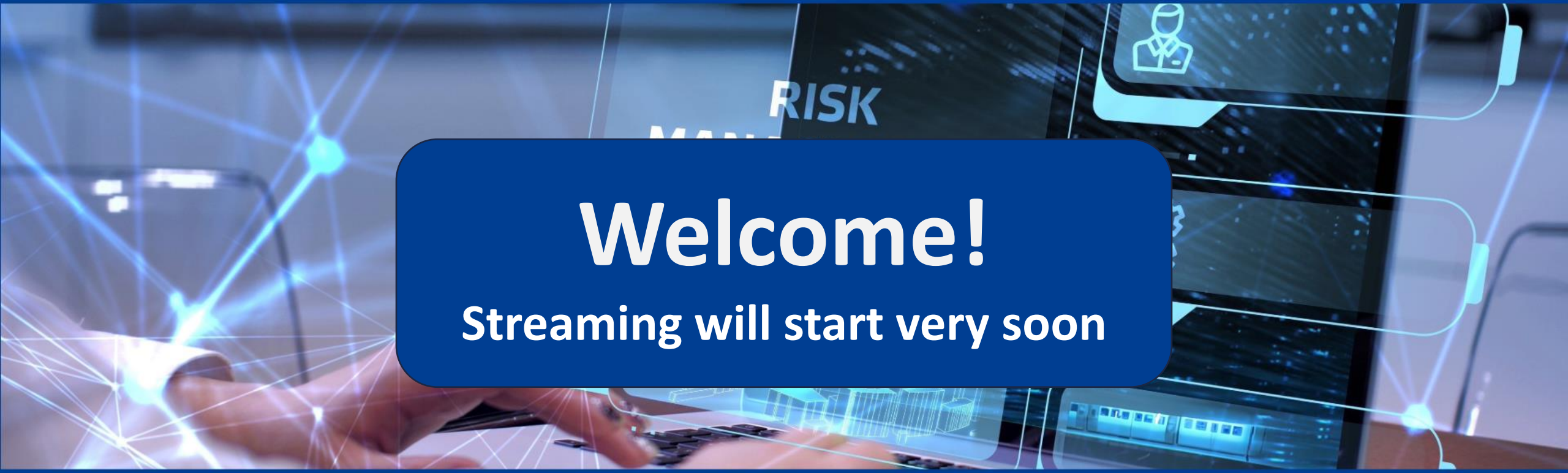
HOF Conference

Human & Organisational Factors

22-23 October 2024 - Valenciennes, France

era.europa.eu

Human & Organisational Factors (HOF) Conference



Welcome!

Streaming will start very soon

22-23 Oct 2024 Valenciennes, France

era.europa.eu

Proactive risk management and investigations

Authors: Bjorn Feys, Elaine Thompson

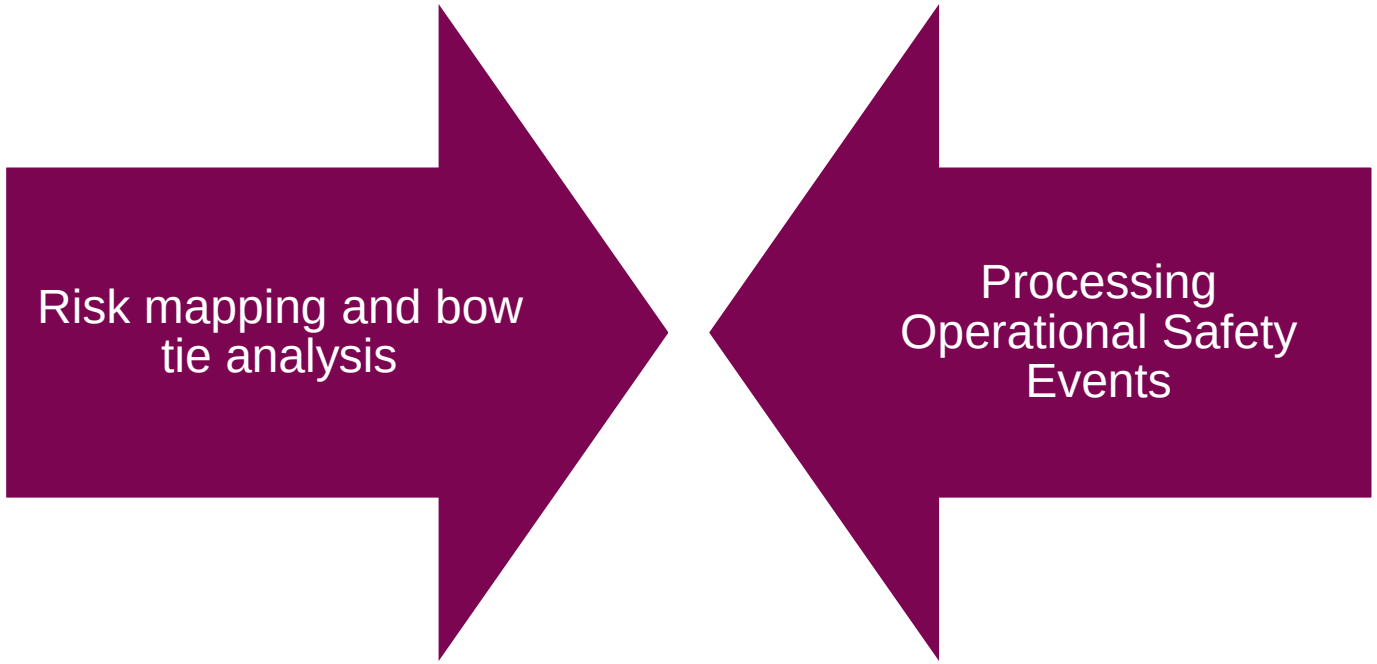
23/10/24

Effective Risk Management

To achieve effective risk management we need to understand and model the risks we have as Railway Undertaking

We have taken two initiatives to move us forward as a business:

1. Systematic risk mapping and bow tie analysis
2. Adopting a proactive incident analysis approach to investigate based on the number of barriers that failed, rather than consequence alone



1

Risk mapping and bow tie analysis

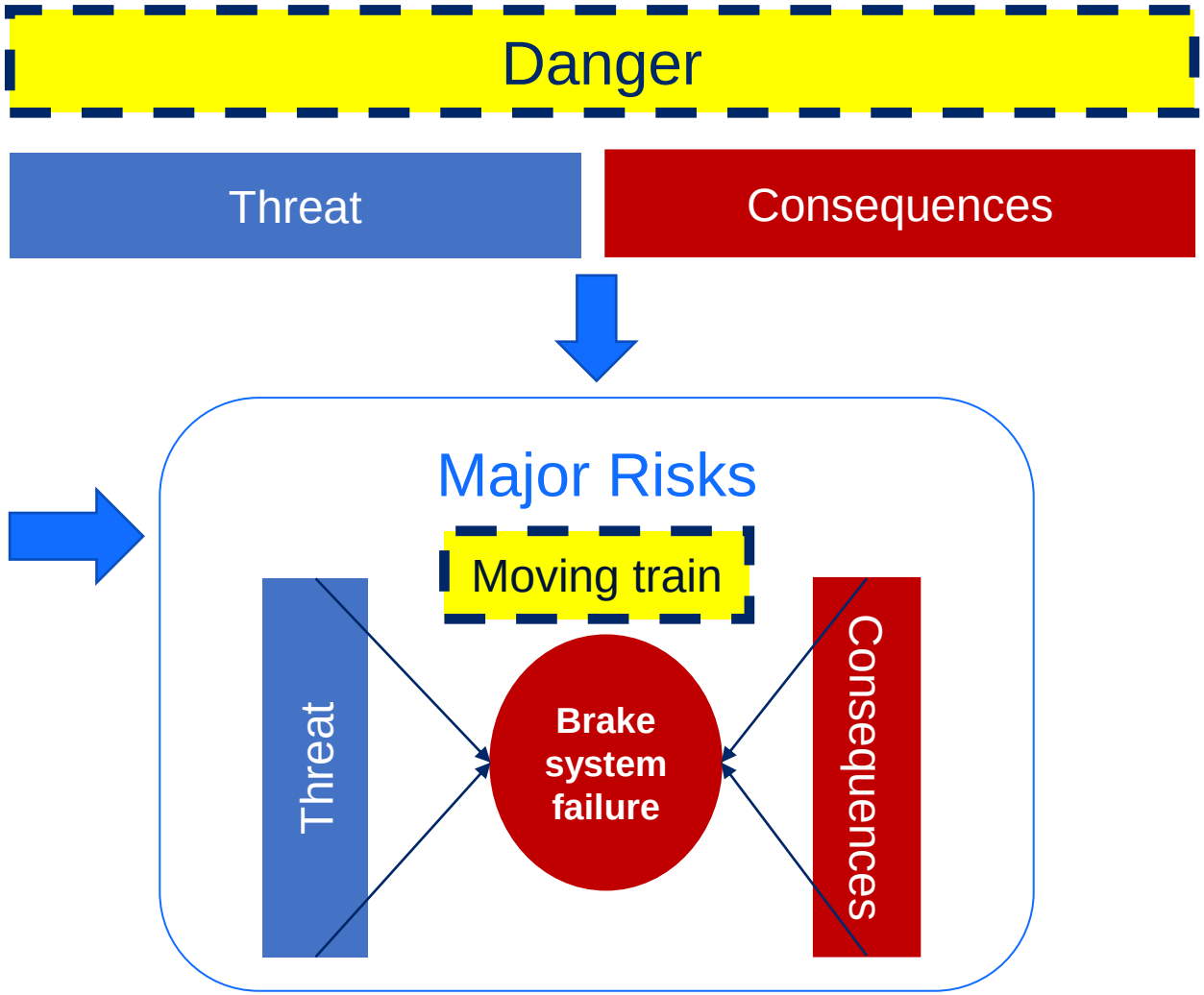
Objectives for the risk analysis

- Construct Bowties of Major Risk scenarios to support transition from rule-based/reactive to a more risk-based/proactive approach
- Construct and maintain a Hazard Register to meet regulatory requirements
- Identify key leading safety performance indicators
- Support training, incident reports and safety communication to create a common understanding of major risks
- Ensure that the importance of HOF barriers are recognized and maintained
- Increase efficiency for change management regarding organisational and procedure changes.

Identification of Major Events

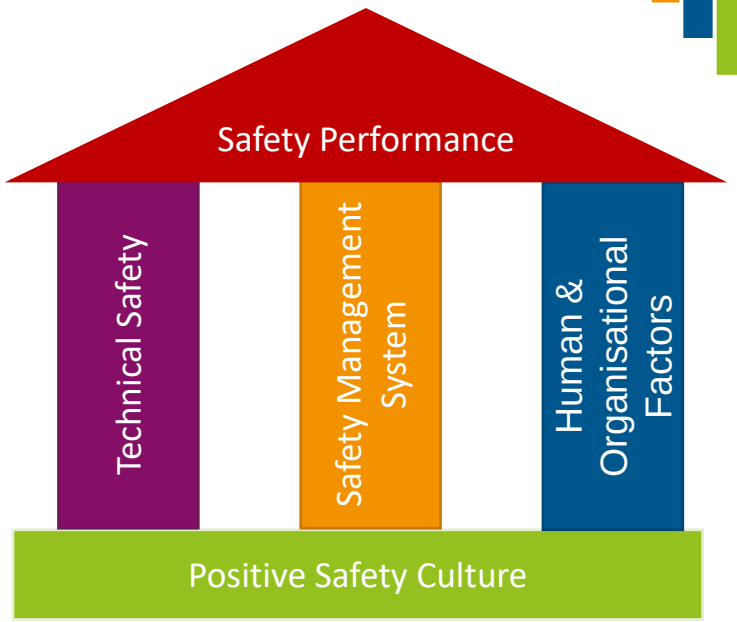
Operations		Maintenance	
Signal passed	Door opening outside of platform	Broken wheel	Coupling failure
Runaway	Departure with open door	Broken axle	Losing vehicle parts
Overspeed	Electrical current failure	Suspension failure	Odometry error
Train compositio n failure	Movement while a door is opened	Brake system failure	Train detection system failure

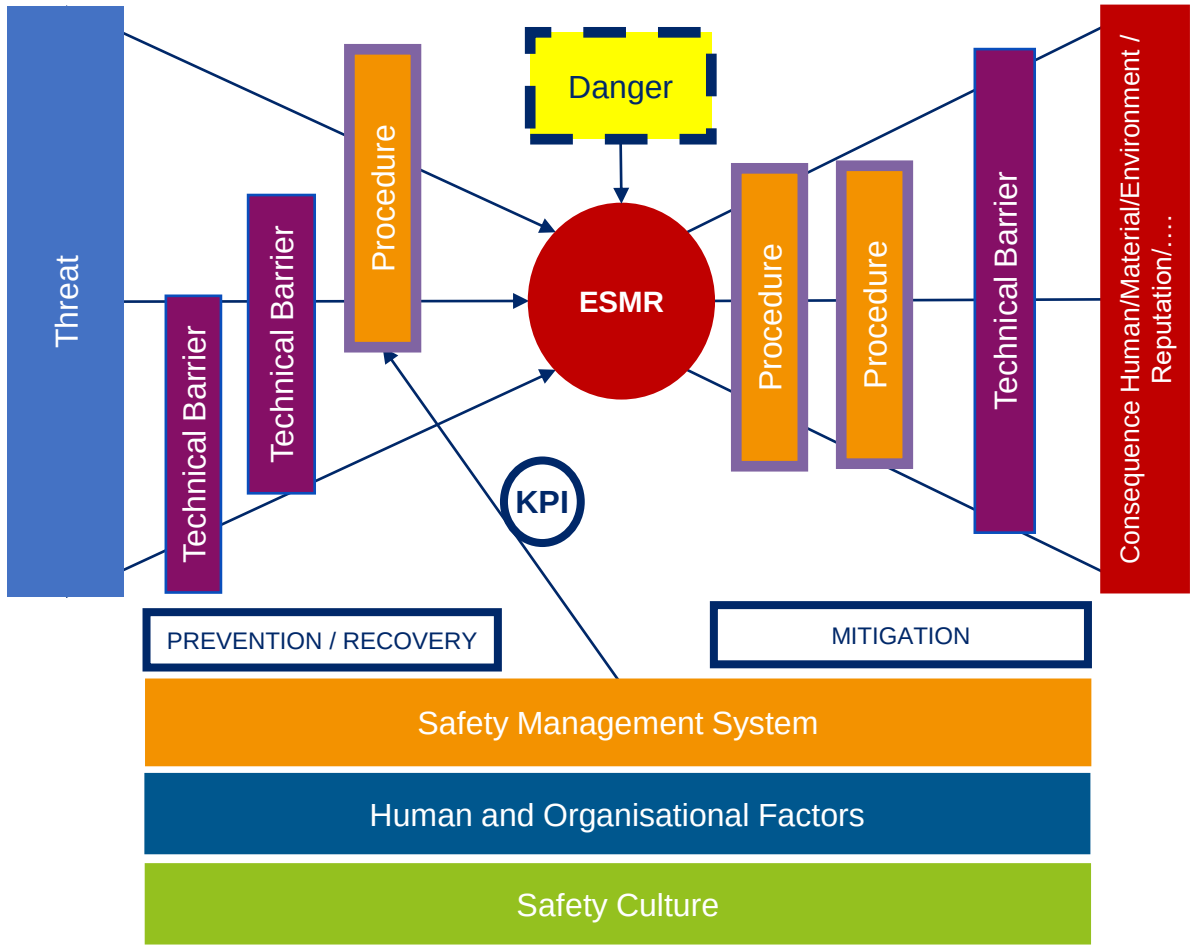
Understanding Major Risks



Map our risks

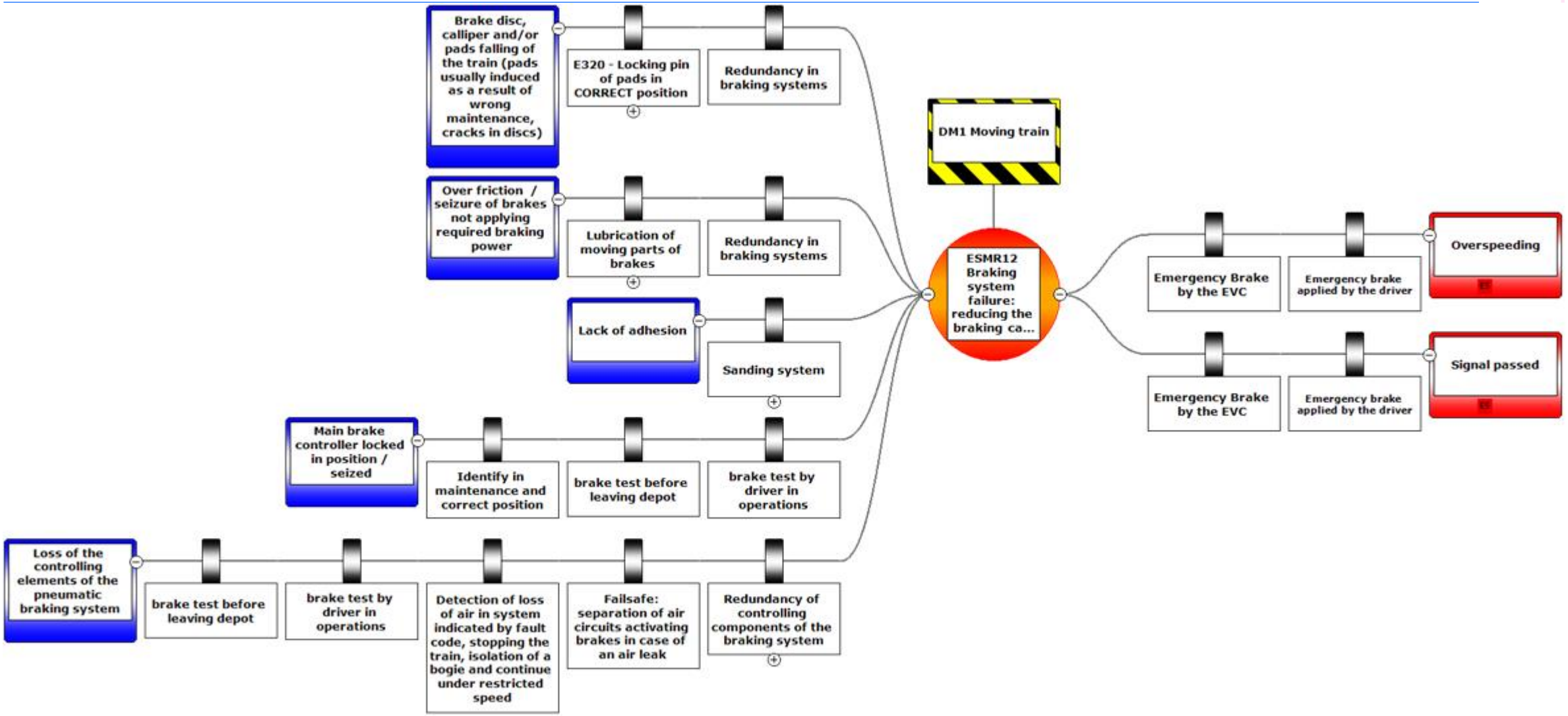
Model the controls in place to manage the risk





@ICSI

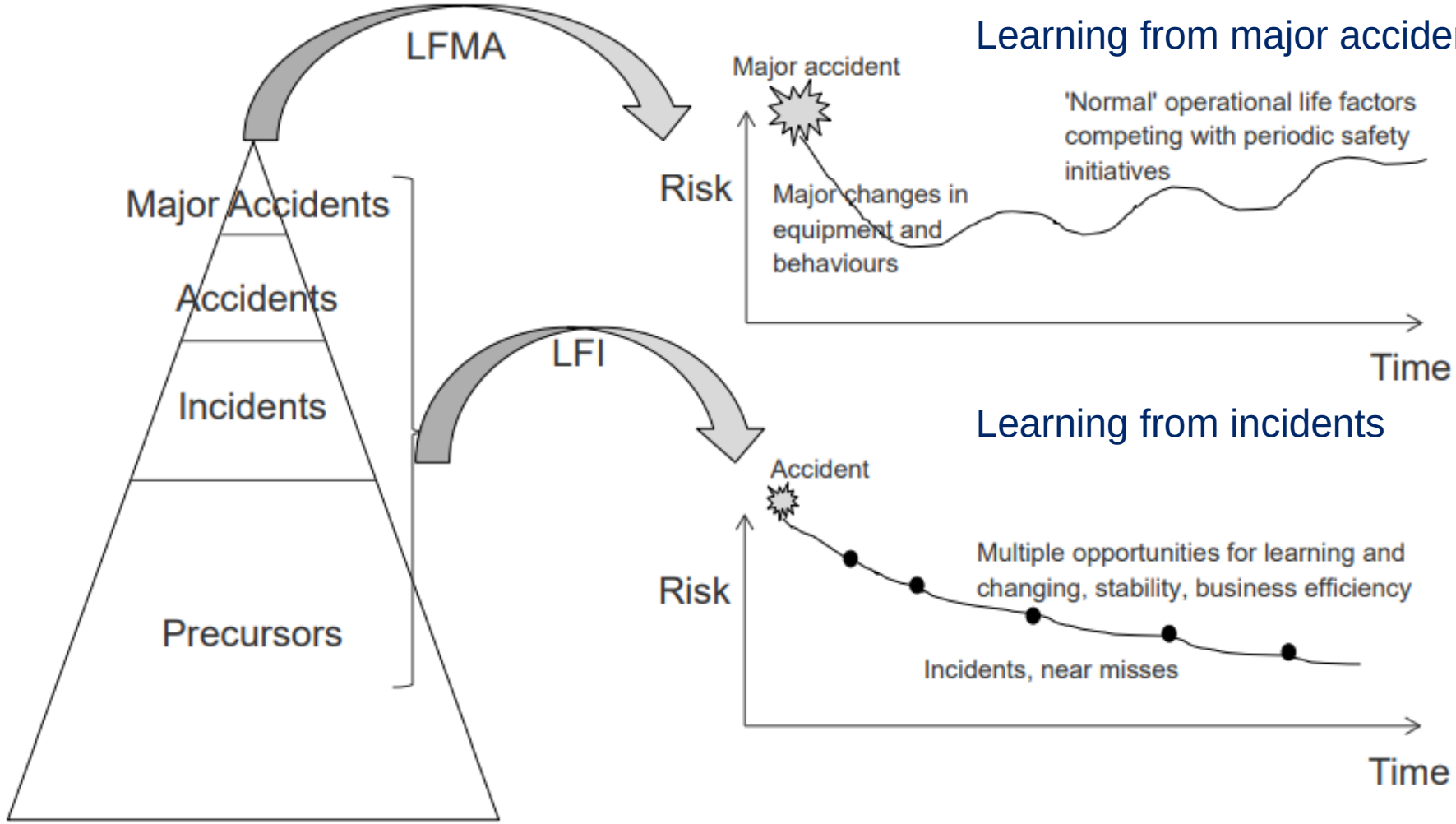
Example of bow-tie model



2

Processing Operational Safety Events

Why Investigate?



Source: Energy Institute (2016) Learning from incidents, accidents and events

Types of investigations

- The seriousness of the event is assessed based on actual and potential consequences
- But also considers the number of barriers that have failed or were missing
- The Evènement de Sécurité Majeur (ESM) level is assigned during a review meeting that gathers experts in various operational functions

Events are assigned of one of the following categories, and the appropriate level of investigation agreed:

- ESM1: Managed Safety Event
- ESM2: Minor Safety Event
- ESM3: Significant Safety Event
- ESM4: Major Safety Event Safety

	All the barriers have worked	1 barrier has not worked	At least two barriers failed
Catastrophic / several deaths	1	3	4
Critical / 1 death	1	3	3
Major / Injuries	1	2	2
Minor	1	1	1

What have we learned?

- This approach offers the opportunity to learn from events and address weaknesses to prevent catastrophic events
- It’s is not always perfect, sometimes there are disagreements about the event classification and which events need further investigation
- Creates a ‘fair’ approach so that we learning from the weaknesses in our systems, not assigning blame
- We are working to improve investigation techniques, and how we transfer learning from events into operations and maintenance
- By continuously improving, we can understand more about the risks we have in our business and how to manage them.

3

Case study
Stranded train in Paris

Investigation & Lessons Learned

Thalys SAFETY

ESM4

survenu en juillet 2022

Réseau SNCF

Panne du 9369 à Saint-Denis

Le mardi 19 juillet 2022, le train 9369 en direction d'Amsterdam Centraal part de Paris-Nord. En raison d'avaries du matériel liées à la chaleur caniculaire, le train se retrouve à l'arrêt et en panne après quelques kilomètres, sans ventilation ni climatisation à bord. Malgré les efforts individuels de chaque acteur, les passagers ne pourront évacuer la rame que 3h plus tard.

FAITS

18:35 L'UM du 9369 part de Paris avec 650 passagers à bord, avec 3 compresseurs en état de marche sur 4, ce qui est autorisé.

La température extérieure était supérieure à 35° et l'Europe traversait un épisode caniculaire.

Les 3 compresseurs en fonction devant compenser le travail du 4ème isolé, sont sur-sollicités.

18:43 Dès les premiers kilomètres, la forte température en motrice et à l'extérieur rend le travail de compression plus difficile. La protection thermique joue son rôle de sécurité (risque d'incendie ou dégagement de fumée) et met progressivement hors service les 3 compresseurs restants : Le train s'arrête après 4 kilomètres avec les 650 voyageurs à bord.

19:26 Comme les compresseurs sont HS et que la pression de la Conduite Principale diminue, l'alimentation électrique ne fonctionne plus et la climatisation s'arrête.

Suite à la résolution partielle de l'avarie, le train repart avec 2 compresseurs sur 4. Le TD vise une arrivée sur le quai de secours de Garges pour poursuivre son dépannage et récupérer les 2 derniers compresseurs HS.

19:36 Les deux compresseurs en service se mettent à nouveau en sécurité et le train s'arrête avant St Denis, sur une voie sans quais. L'alimentation électrique est coupée, de même que la climatisation, la ventilation et les lumières.

20:02 Avec la chaleur très élevée, la situation devient critique à bord. Le TM demande l'intervention des secours pour plusieurs malaises voyageurs.

Vitre du Welcome Bar brisée par des passagers

Le train étant au milieu du faisceau de voies avec du trafic sur les voies adjacentes, l'intervention des secours est impossible sans l'arrêt des circulations.

20:32 Demande de protection de voie.

21:03 Les passagers commencent à briser des vitres. La ventilation et la climatisation commencent à revenir progressivement mais toujours en insuffisance. **Le train est déclaré en détresse.**

21:17 La protection de voie est accordée par SNCF Réseau, la préparation pour l'évacuation du train commence. Les passagers seront invités à prendre un transilien pour retourner à Paris-Nord.

21:29 Descente sauvage de voyageurs sur côté non-protégé.

21:50 Début de l'évacuation.

22:35 Évacuation des 650 voyageurs terminée.

RISQUE

Selon l'étude RSSB*, en situation caniculaire, les risques (hyperthermie et évacuation sauvage) de rester à bord d'un train en panne au-delà d'une heure sans air conditionné, ni ventilation sont de l'ordre d'au moins **80 fois plus élevé** que celui d'une évacuation contrôlée

Research into the management of passengers on trains stranded in high ambient temperatures www.rssb.co.uk

L'IMPORTANCE DE LA PRESSION D'AIR DANS LES CIRCUITS

De nombreux systèmes équipant les rames ont un fonctionnement pneumatique, et sont alimentés en air par les compresseurs. Afin de ne pas introduire d'humidité dans le circuit, les compresseurs sont couplés à des sécheurs d'air. **En période de canicule, il peut arriver que le sécheur d'air ne fournisse pas suffisamment d'air au compresseur.** Ce dernier ne fonctionne plus pour atteindre la pression d'air attendue et peut chauffer. Les systèmes de protection incendie isolent alors automatiquement le compresseur.

À noter que le bon fonctionnement du circuit électrique de la rame, qui alimente entre autres la climatisation et la ventilation, est directement lié aux performances des compresseurs.

Ainsi, en cas de baisse de la pression d'air, le circuit électrique est impacté, comme lors de cet incident.

MESURES D'AMÉLIORATION

→ Mettre à jour les conditions d'utilisation d'une rame Thalys avec un compresseur principal isolé : Interdire la remise en exploitation si la température extérieure est supérieure à 30°C, interdire la circulation en service commercial si la température extérieure est supérieure à 35°C

→ Ajouter un module de formation permanente pour le personnel roulant pour gérer une situation dégradée (en cas de conditions météorologiques exceptionnelles)

→ Mettre en place ou adapter la documentation existante avec les enseignements tirés de cet événement pour les équipes opérationnelles et astreintes

CAUSES

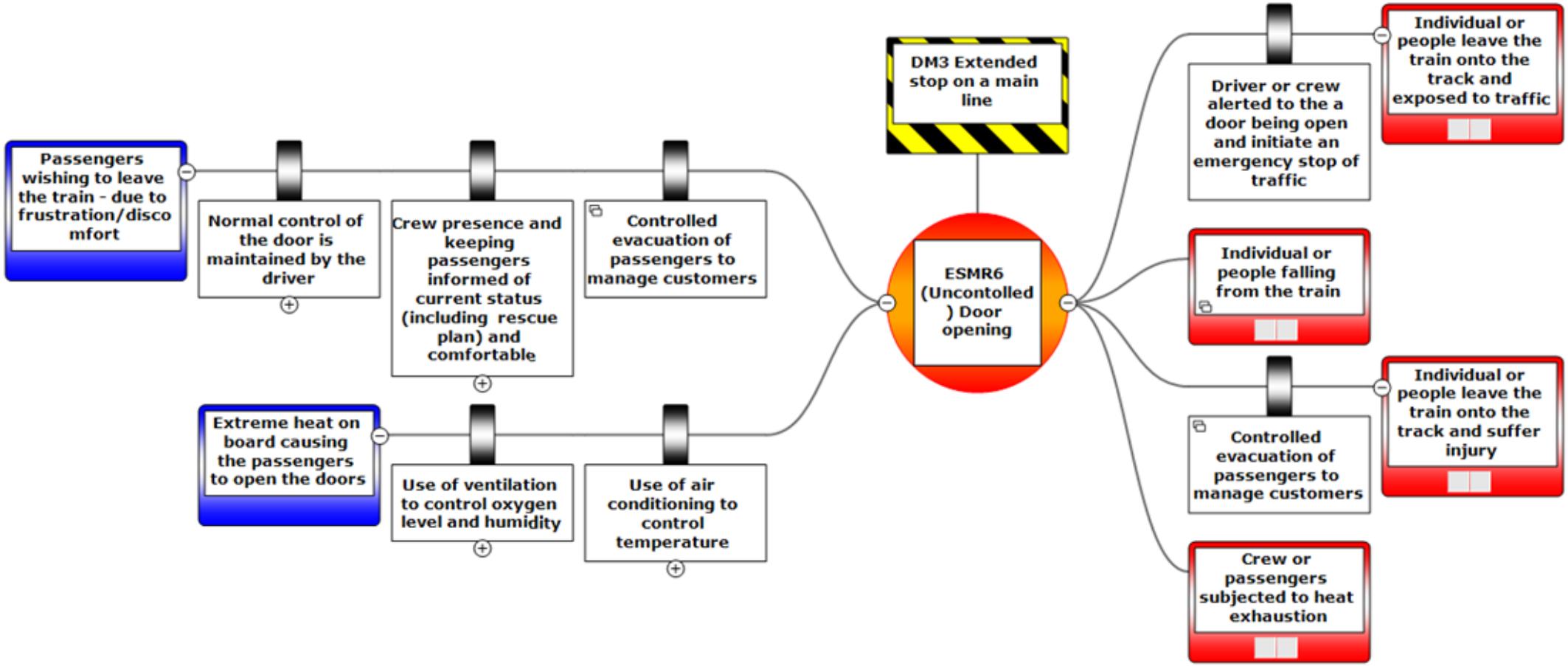
- Indisponibilité des compresseurs restants en raison de la protection thermique
- Lien entre la panne et le système de protection thermique des compresseurs pas établi lors du dépannage
- Manque de connaissances pratiques pour déclarer le train en détresse en France
- Absence d'intervention externe pour faciliter l'évacuation
- Difficultés dans la communication entre les acteurs à bord à propos des solutions possibles (ouverture des portes, remise en marche de la climatisation...)
- Délai trop important pour obtenir la protection des voies, pour commencer l'évacuation

→ Utiliser l'étude RSSB pour déterminer le temps maximum pour évacuer selon les différents scénarios, et mettre à jour la documentation du CO et des astreintes en conséquence

→ Établir des groupes de travail avec les différents gestionnaires d'infrastructure pour garantir une meilleure préparation à ce type d'incident

→ Organiser des simulations de crise avec les différents acteurs impliqués dans ce genre de situation

Bow-Tie of related ESMR



How we share the lessons learned

- The analysis of the incident helped to identify the lessons learned for this situation and how we could mitigate
- The proactive bow tie analysis identifies all of the areas that could contribute to the risk of this type of event
- Understanding our controls and how effectively these work, also allows us to understand the potential impact on passenger behaviour
- e.g. the loss of ventilation means that safe and controlled passenger evacuation should be prioritised
- This approach will improve our management and maintenance of controls.

Merci
Thank you
Danke
Dank je wel

eurostar

EUROPEAN UNION AGENCY FOR RAILWAYS

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Human & Organisational Factors

22-23 October 2024 - Valenciennes, France

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A Network of HOF Experts to support the transformation of Safety Culture

Florence Magnin-Lot, Pippa Trahant, Yann Cahue

22 and 23 October 2024

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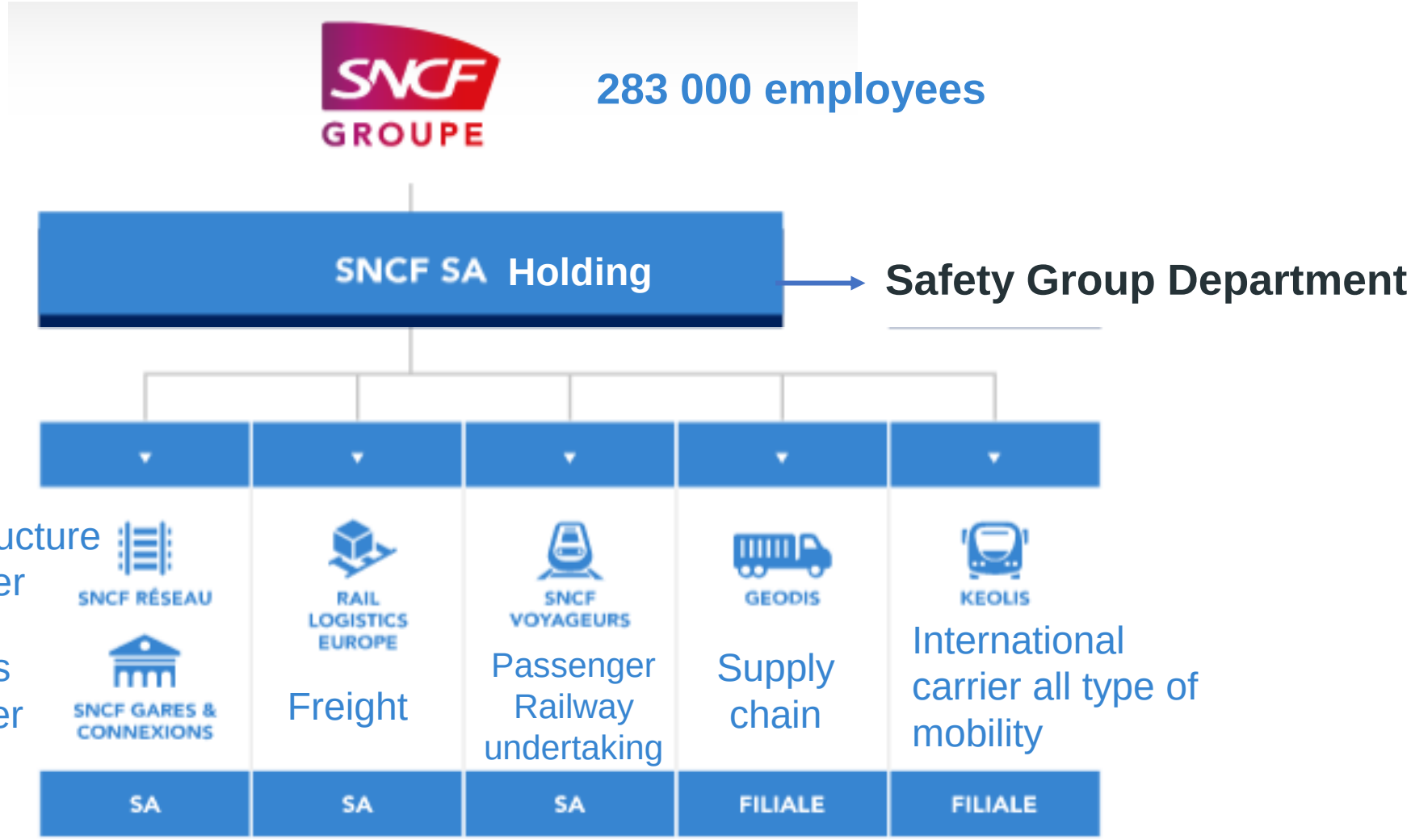
2. HOF Approach and ambitions at TER
3. Practical examples of HOF contribution to the performance

Conclusion

1. SNCF Group

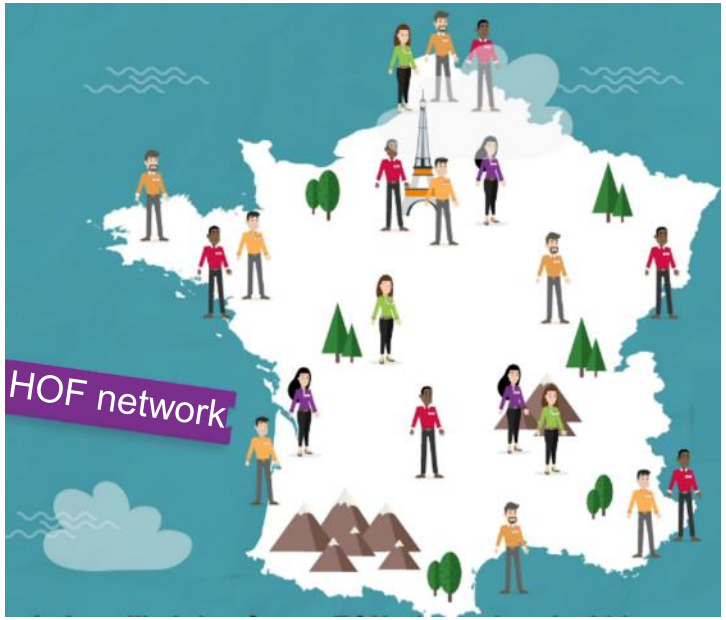

SNCF GROUPE
283 000 employees
SNCF SA Holding
Safety Group Department
Infrastructure manager
SNCF RÉSEAU
Stations manager
SNCF GARES & CONNEXIONS
RAIL LOGISTICS EUROPE
Freight
SNCF VOYAGEURS
Passenger Railway undertaking
GEODIS
Supply chain
KEOLIS
International carrier all type of mobility
SA
SA
SA
FILIALE
FILIALE

Our Safety Culture Program : PRISME

- In 2015, SNCF Group launched PRISME program to transform and improve Safety Culture
- A unique SNCF's Safety Culture definition and model for the whole group.
- Several projects to improve the 7 safety culture's characteristics including Human and Organisational Factors (HOF)

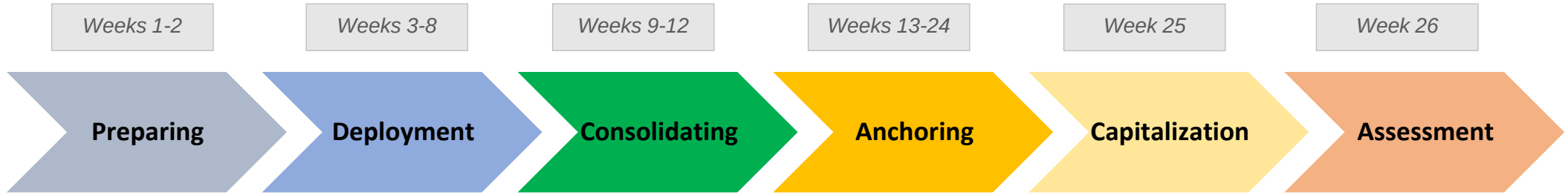
Our Human and Organisational Factors network

- In 2016 : HOF awareness campaign for 5000 executives and managers + Leadership training for top managers (from the entire group)
- 2017 : beginning of the HOF professionalized training program
- To date we have trained over than 300 HOF correspondents disseminated in operational entities



Our HOF network (training program)

↗ Duration : more than 90 hours over 6 months

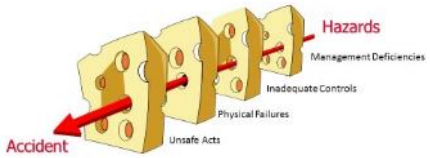


Preparing	Deployment	Consolidating	Anchoring	Capitalization	Assessment
Participants' engagement - Participants' assessment - Appraisal of their level of maturity in relation to the HOF and Safety Culture fundamentals - Virtual launch classroom preparation - Individual debriefing with Participants' commitment	**3 e-learning lessons** - Lesson 1: **Human Factors** + Virtual Classroom n°1 - Lesson 2: **Organizational Factors** + Virtual Classroom n°2 - Lesson 3: **Safety Culture** + Virtual Classroom n°3	**4 Virtual Classrooms (VC) for skill building** -Virtual Classroom n°4 and 5 : Consolidation & links with participants' activities - Virtual Classroom n°6 : Case study about HOF and root cause analysis - Virtual Classroom n°7 : Acting on Safety culture -1 day presential meeting : Topics' presentation for the anchoring projects	**12 Workshops** - 1 workshop by week dedicate to deepening and Peer coaching -Individual coaching session (2 x1h by trainee)	**1 Sharing seminar (2 days)** - Projects presentations - Valuing the work of the HOF trainees - Sharing experiences, learnings, and difficulties -Anchoring proposals and / or actions - Competence assessment - Celebrating the end of the course	**Validation of gain knowledge** - Progress assessment - Skills assessment - Review of success and difficulties

Our HOF network (its missions)

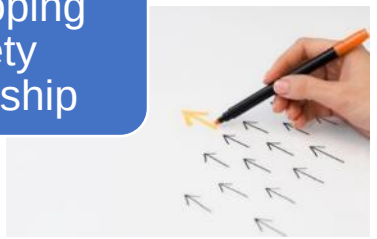
HOF Correspondents actively promote safety culture

Applying Just & Fair approach



Implementing HOF

- Changes
- REX / Incident Analyses
- New design



Developing safety leadership

Promoting Non-Technical skills

Encouraging Cooperation

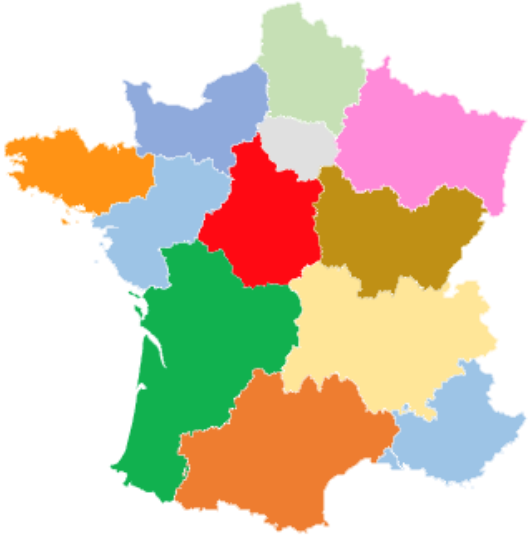
Providing trainings and safety culture

SNCF SÉCURITÉ

SNCF

2. HOF approach and Ambition at SNCF VOYAGEURS TER

Regional services



11 Business Units
HQ in Lyon

27 000
Staff
diversity of
professions

PRISME

2015

Trainings for managers
Implementation of new safety culture

2020

Low Safety results

APPORT

2022

Decided by TER EXCOM

APPORT Network set-up

2024

Development of tools specific training

…

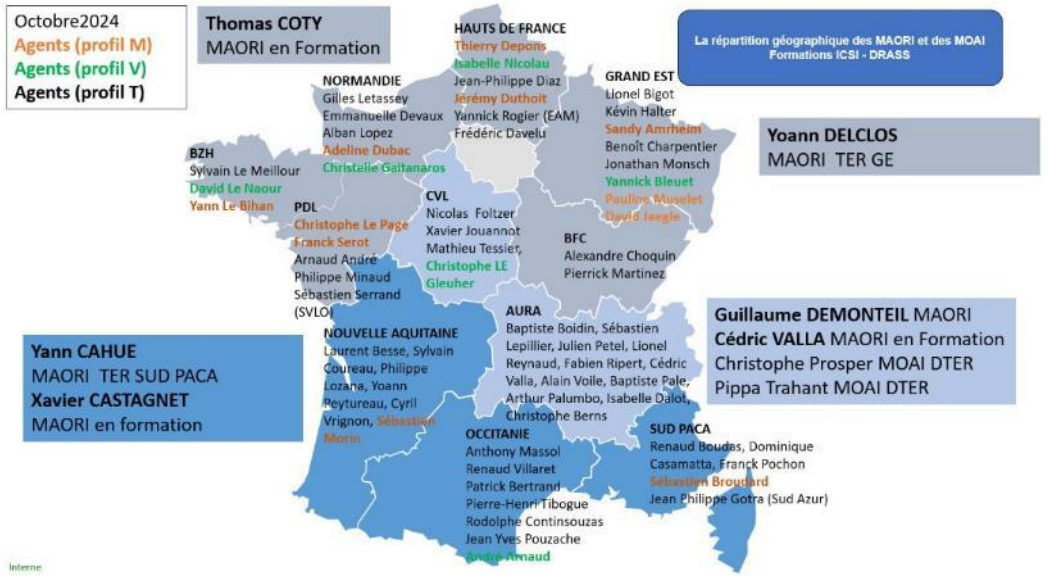
APPORT provides his services to All new SNCF subsidiaries

SNCF SÉCURITÉ

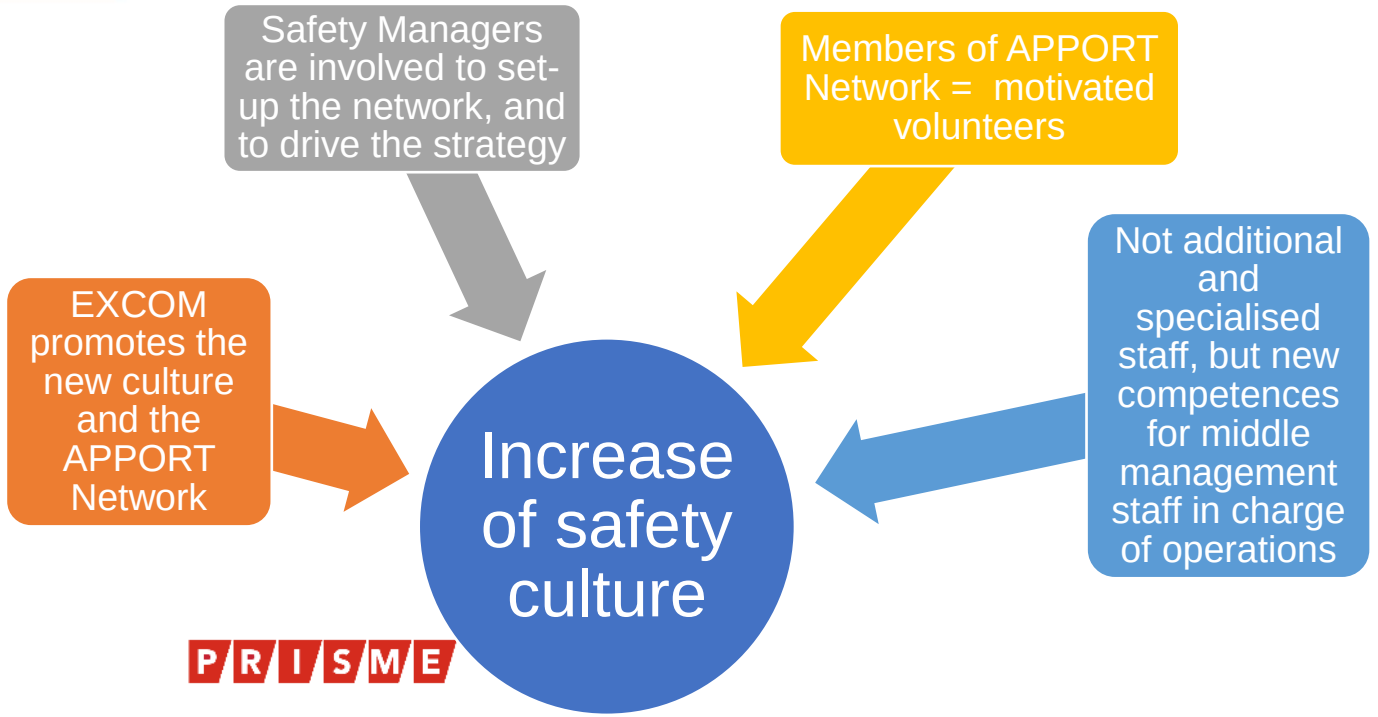
PRISME

SNCF

Key points of success of APPORT



- 3 qualified experts : a 2-year Masters in Managing Organisations at Risk delivered by ISCI in collaboration with ESCP Business School.
- Over 60 correspondents, **operational managers** (train drivers, ticket controllers, rolling stock maintenance) who have followed the training program of the ISCI
- 1-2 experts and 10 referents in training each year



Ambitions of the APPORT network at TER

- **Booklets**
  - Mechanism of error
  - Interview practices
  - Reliability practices
  - Promotion of Non-technical skills
  - How to encourage hazard detection
- **Workshops and training sessions**
  - Potential Optimisation Skills (TOP)
- **For each expert**
  - Work on specific issue in domaine of expertise
- **Benchmarking**
  - EDF
  - Army
  - Hospital
  - Keolis
  - ...
- **Specific support for entities**
  - Participation in Accident Investigation Investigation (HOF approach to identify key events)
  - Post traumatic stress disorder prevention using 6C Protocole
  - Focus Groups

3. Practical Case in TER SUD - Ouest Provence Line

Think HOF at anytime !

In design

During work

Feedback from experience

Observed benefits

- Accident prevention
- Reduction of risky behaviour
- Better understanding of malfunctions
- Organisational learning

Actions engaged

- Training on error mechanisms and reliability practices
- Training in interview techniques
- Support in the "Just and Fair" approach

Participation in post-event reviews (J+1) highlights weaknesses

- Situation awareness
- The implementation of robust human barriers
- The freedom of speech

SNCF SÉCURITÉ

PRISME

SNCF

Practical Case in TER SUD – Ouest Provence Line

During field tours or discussions with managers and operational staff, it is often observed that agents do not feel involved in the organisation and in safety management

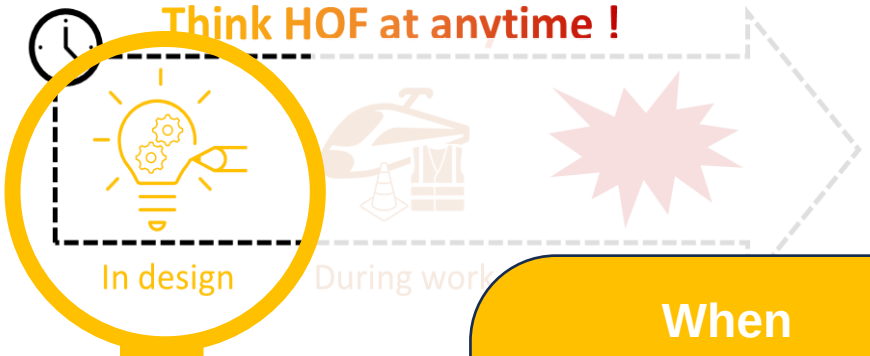
Actions engaged

- Implementation of Focus Groups
- Co-construction of action plans
- Working towards the development of an integrated safety culture

Gains

- Improvement of overall safety
- Consideration of interactions between different stakeholders
- Recognition of internal expertise

Practical case in TER SUD – Ouest Provence Line



When implementing a new organisation or restructuring an existing one

Lack of consideration for Human and Organisational Factors (HOF).

Actions engaged

- Conducting CSM (Common Safety Methods) on risk management
- Conducting Focus Groups
- Ergonomic study of the organisation

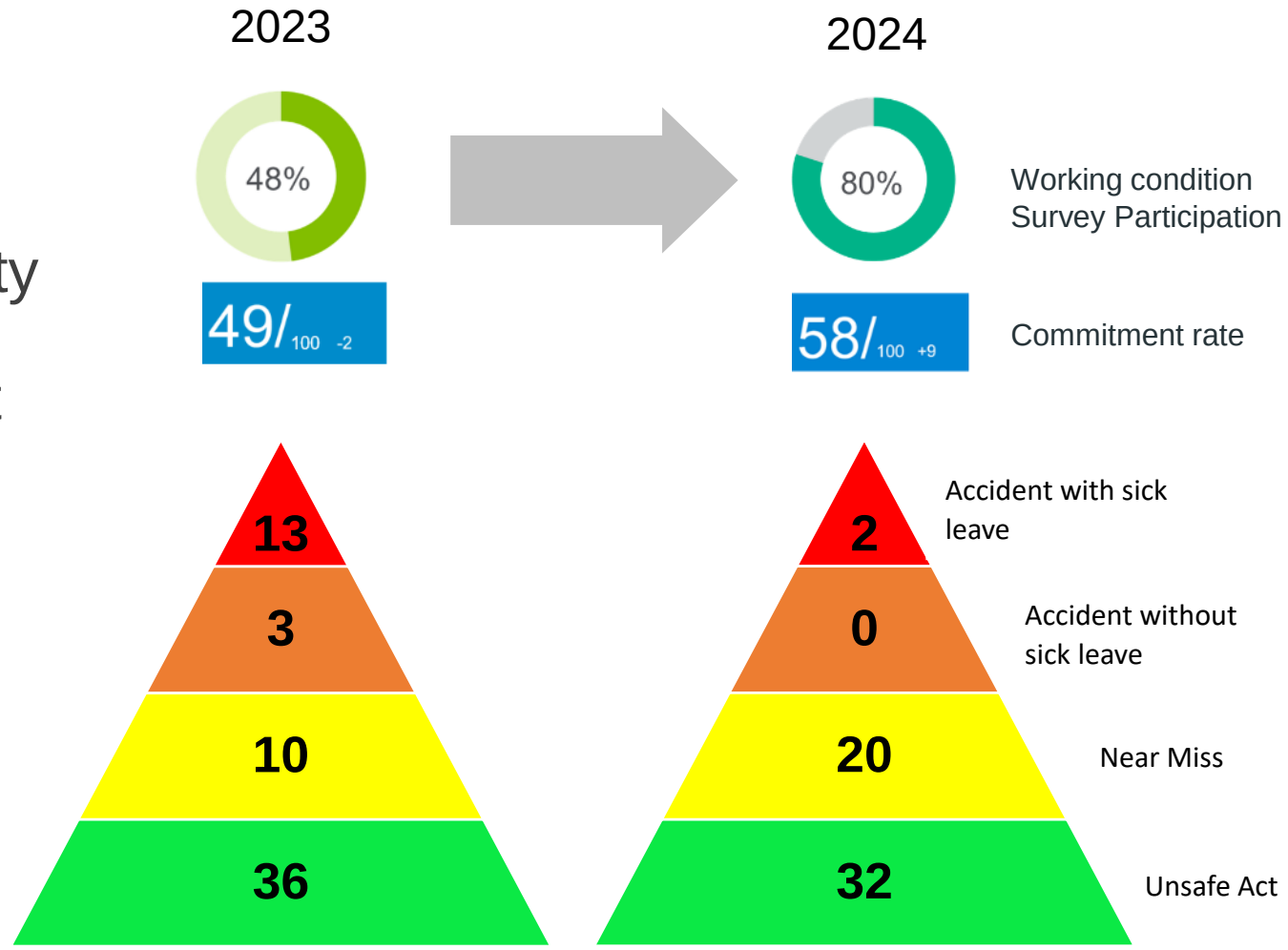
Gains

- Improvement of overall safety
- Consideration of interactions between different stakeholders
- Recognition of internal expertise

Practical case in TER SUD – Ouest Provence Line

The HOF network

- Helps to understand real working situations in order to improve safety
- Provides managerial methods that contribute to better performance
- Has an impact not only on safety, but also on production and staff commitment
- Diffusing Safety Culture to less mature units



Conclusion : remaining challenges and perspectives

- Including HOF comes from an ambition from the highest level of the group
- HOF network has its own adaptation in each company of the group
- A safety culture is not imposed, it is co-constructed.
- Behavioral changes take time to evolve.
- Our role is to sow seeds

Thank you for your attention.
Do you have any questions ?

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Development & Innovation
in Transport Systems

Sharing Enterprise Well-being (SEW): from HOF to the development of the organisational value of railway operators

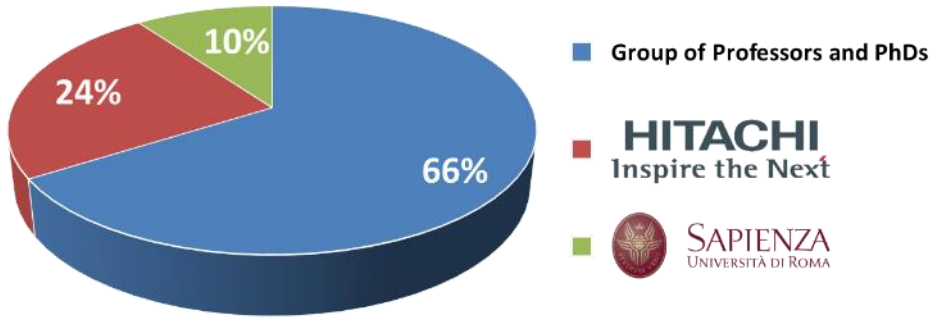
Massimiliano Bruner
Giovanni Costanza
Andrea Quattrini
Luca Rizzetto
Giuliano Rossi

EUROPEAN UNION AGENCY FOR RAILWAYS
HUMAN & ORGANISATIONAL FACTORS (HOF) CONFERENCE
22-23 OCT 2024
VALENCIENNES, FRANCE

DITS s.r.l. – The Company

DITS s.r.l. is a **Spin-Off** company of the **Sapienza University of Rome** that develops and implements innovative products and services in in various railway-related fields, including:

- support to railway companies for the implementation of their Safety Management System (SMS)
- training on railway safety
- support for HOF integration in the SMS
- risk analysis



In addition to 15 senior researchers (professors and PhDs), the shareholders of DITS are Sapienza University itself and Hitachi Rail STS.

Principles and strategy

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"Mature organisations recognise that efficient control of risk can only be achieved through a process that brings together three critical dimensions:

- a **technical component** with the **used tools and equipment**,
- a **human component** of front line people **with their skills, training and motivation**,
- an **organisational component consisting of procedures and methods** defining the relationship of tasks."

Management Maturity Model

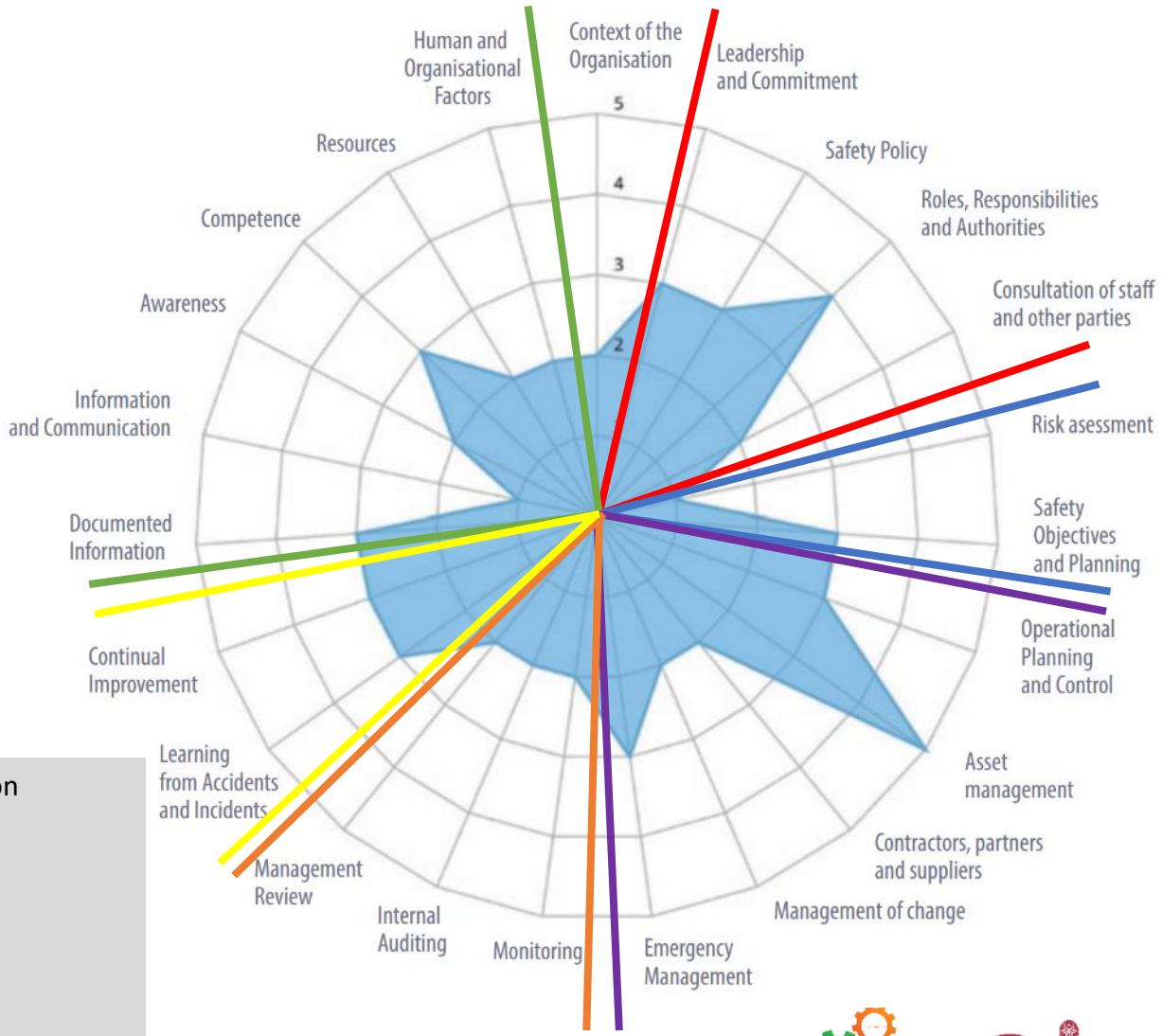
Guidance for safety certification and supervision

The chapters of safety

EUROPEAN UNION AGENCY FOR RAILWAYS

"If the SMS is working well, it is a **reasonable assumption** that the risks from the organisation's operations are being well controlled."

"If the organisation's **SMS** has **weak areas** [...] it is likely that in these areas there will be the greatest possibility of the conditions existing which will allow an accident or incident to occur compared with other areas where the SMS is performing well."



0 – Context of the Organisation

1 – Leadership

2 – Planning

3 – Support

4 – Operation

5 – Performance Evaluation

6 - Improvement

ITS

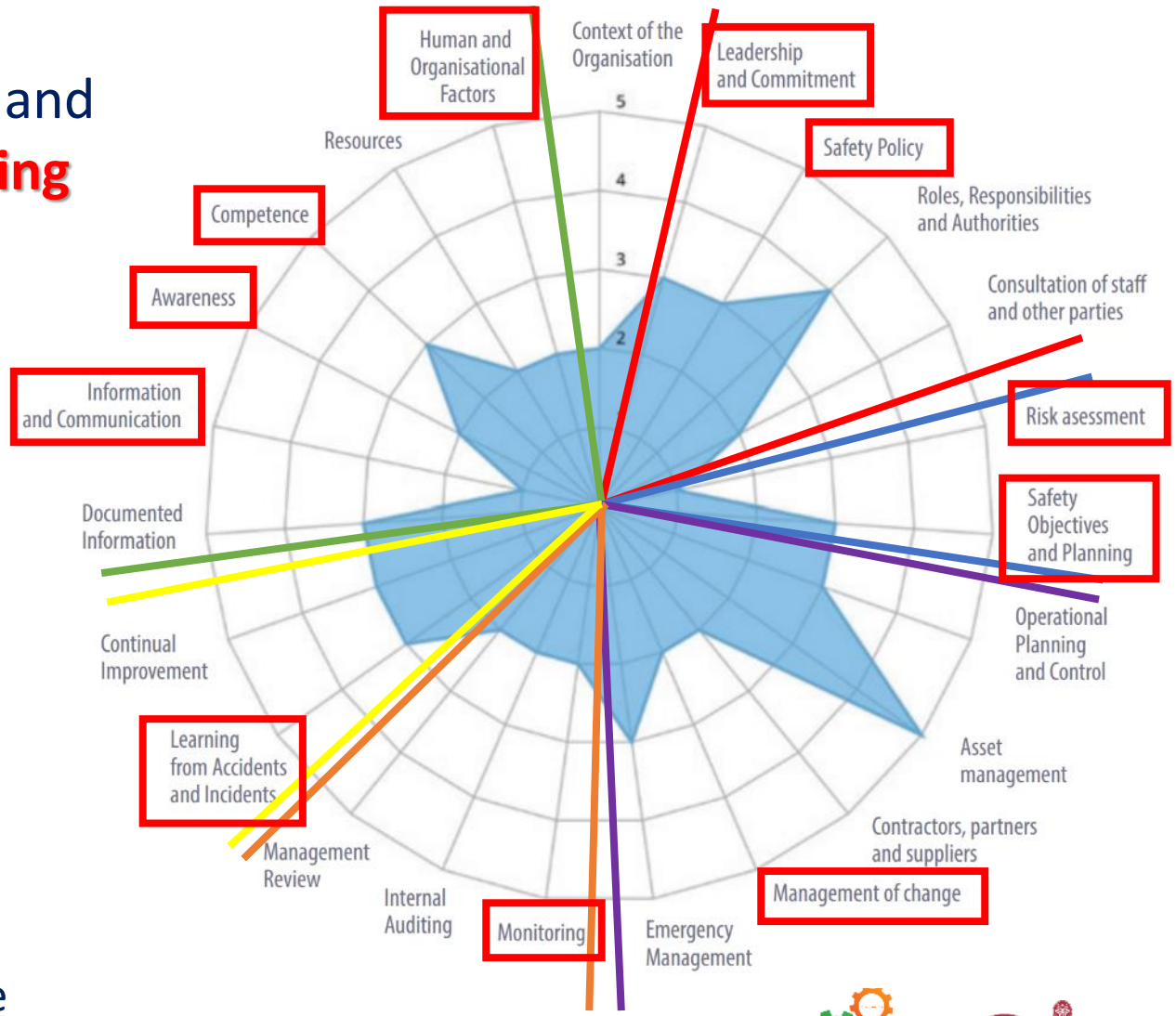
SEW in action

SEW *is rail native*

SEW is a philosophy that integrates training and intervention methods from **safety engineering** and **organisational psychology**.

SEW is a protocol for:

- **integrating HOF within the Safety Management System**
- **increasing the safety culture in the organisation**



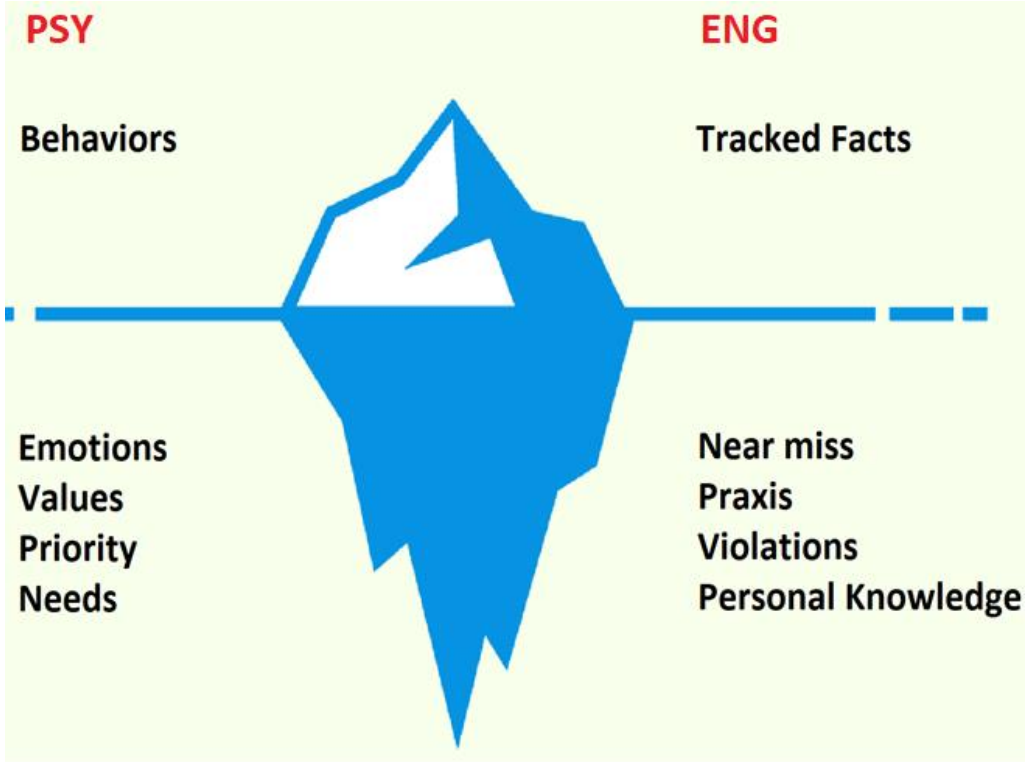
SEW, with its own tools, directly supports the organisation in 11 of the 23 SMS areas.

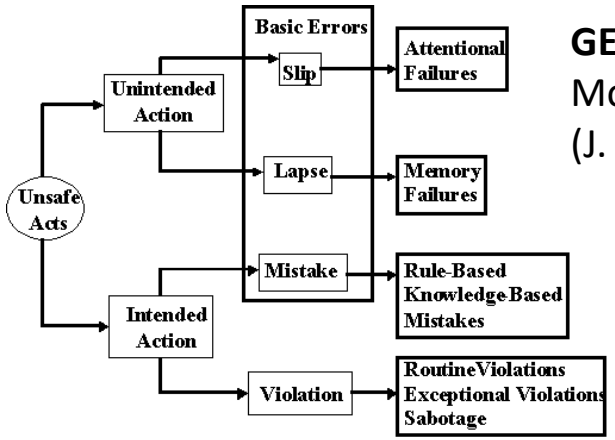
The development of the other areas is driven by the improvement of those on which SEW operates directly.

SEW steps

SEW is a synergic application of engineering and psychological methods comprising the following steps:

1. Analysis of the company's Safety Culture
2. GEMS implementation of the Hazard Log
3. Intervention on Safety Culture
4. Introduction and monitoring of HOF macro-indicators
5. SEW training
6. Implementation of HOF-relevant procedures
7. Support for company self-development



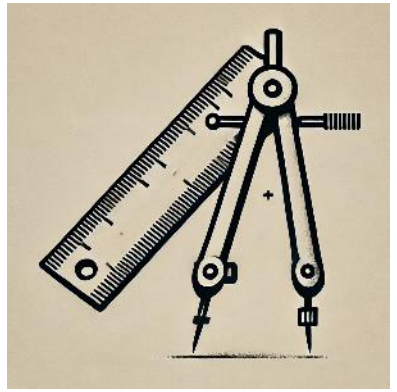


GEMS: Generic Error Modelling System (J. Reason, 1990)

SEW Focus: analysis of the company's Safety Culture

Tools:

- **QE_HFRr**: Questionnaire Human Factor Reliability Rail (64 items in Likert scale, on 3 areas and 6 scales); aim: to identify the relationship between individuals, groups of workers and the organisation
- **EPA's**: Emotional Potential Analysis of safety (52 items in Likert scale, on 2 areas); aim: emotional aspects regarding safety issues and the level of socialisation of groups of workers
- **Focus Group** on each Homogeneous Group of Workers; aim: to provide interpretative criteria



Output:

- **Overview of HOF issues** in the company
- **Risk Control Measures** of the socio-organisational area (corresponding to the **Contributing Factors** of the *Draft CSM for Assessing the Safety Level and the Safety Performance of railway operators at national and Union level*)

Contributing factors

-

Actions, omissions, events or conditions that affect an occurrence by increasing its likelihood, accelerating the effect in time or increasing the severity of the consequences, but the elimination of which would not have prevented the occurrence

Code of event type	Name of the event type	Definitions	By default allocation of related occurrences (see Annex IV for details)
F.2	**Performance relevant factor**		
F.2.1	**Dynamic staff factors**		
F.2.1.1	Expectation / Intention while acting / Decision model / Error type		
F.2.1.2	Vigilance/ concentration		
F.2.1.3	Fatigue		
F.2.1.4	Stress (incl. emotions & psychosocial factors)		
F.2.1.5	Situational awareness (incl. self-awareness - situational self-knowledge)		
F.2.1.6	Other	A reporting of information in accordance with Article 3.2.1. of this Appendix shall apply.	
F.2.2	**Dynamic tasks factors**		

SEW Focus: level of socialisation of groups of workers

Poor socialisation is more frequent in the working groups of maintenance and train preparation, which therefore have the highest relative tendency to the risk of procedures violation (occasional or systematic, according to Reason's taxonomy) than train and office staff (Business Unit: instructors, technicians and managers). The latter are the most socialised.

Data on 952 railway workers (923 valid cases) were analysed

Homogeneous Group of Workers	Cases	Poorly socialized	Socialized	Socialization in progress
Business Unit	measured	28	**185**	73
	expected	40,9	**171,4**	73,7
	difference	-12,9	**13,6**	-0,7
Maintenance workers	measured	**25**	94	39
	expected	**22,6**	94,7	40,7
	difference	**2,4**	-0,7	-1,7
Train preparation	measured	**30**	51	21
	expected	**14,6**	61,1	26,3
	difference	**15,4**	-10,1	-5,3
Train Staff	measured	49	223	**105**
	expected	53,9	225,9	**97,2**
	difference	-4,9	-2,9	**7,8**

SEW Focus: support for self-development

The "Safety Table"

- Working Alliance & Construction of Setting that allows competent thinking on HOF dynamics
- Project phase (constituent) of the Safety Table as a space for dialectical collaboration
- Establishment phase of the Safety Table, with support for the first meetings, including the definition of performance indicators

In the rail sector, SEW intervention and the establishment of the Safety Table have reduced occupational accidents significantly (source: RFI report 2011 and PSR Rail 2012).

	Decrease in accident rate	Decrease in accident severity
RFI - Ancona Department Year 2010 vs 2009	-31%	-27%
RFI - Torino Department Year 2017 vs 2016	-20%	-10%

SEW applications to Italian railway operators

SEW Case Studies

TFT

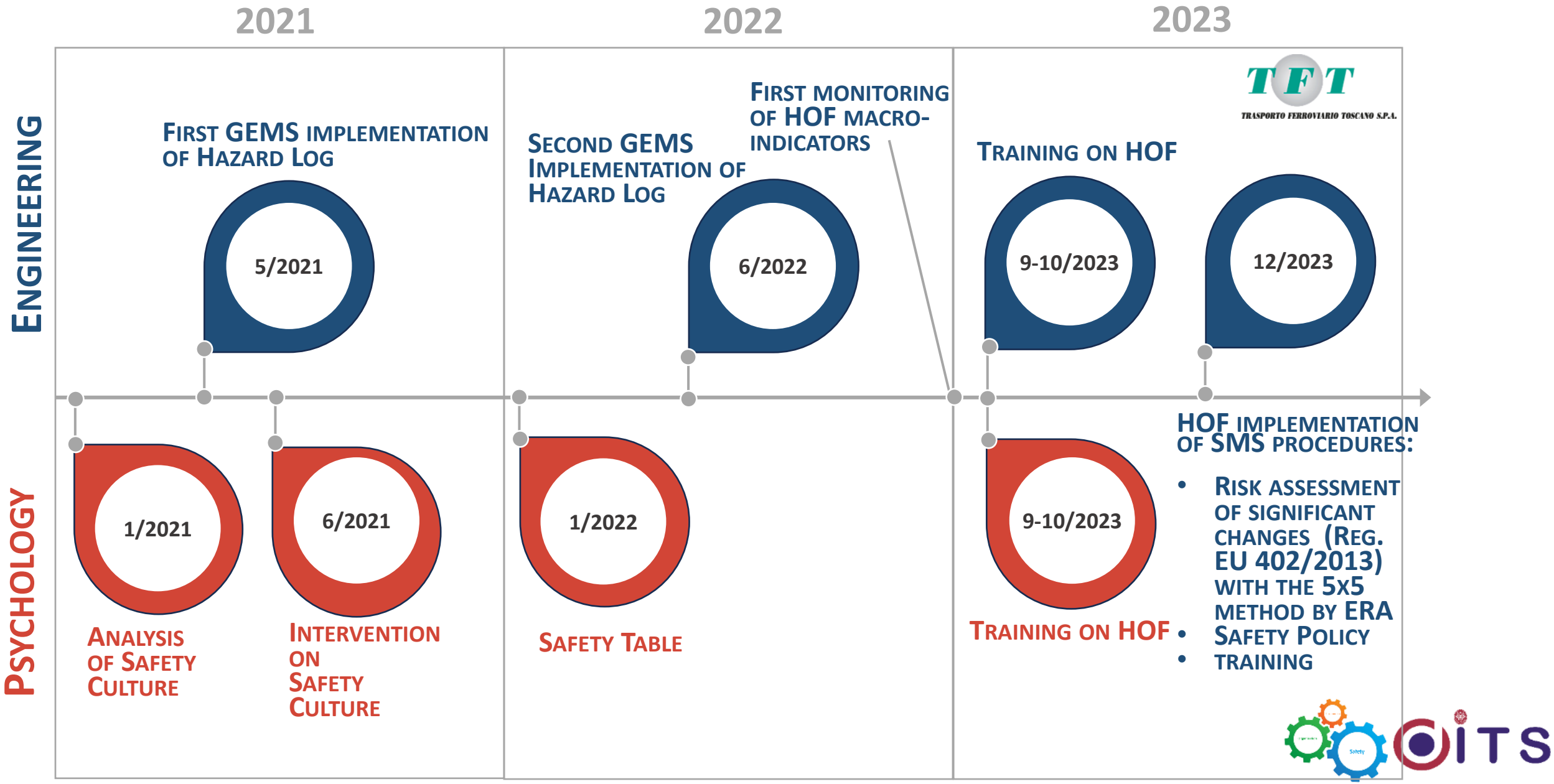
TRASPORTO FERROVIARIO TOSCANO S.P.A.

Railway Service (2023): 0.75 M train-km
Employes: less than 100

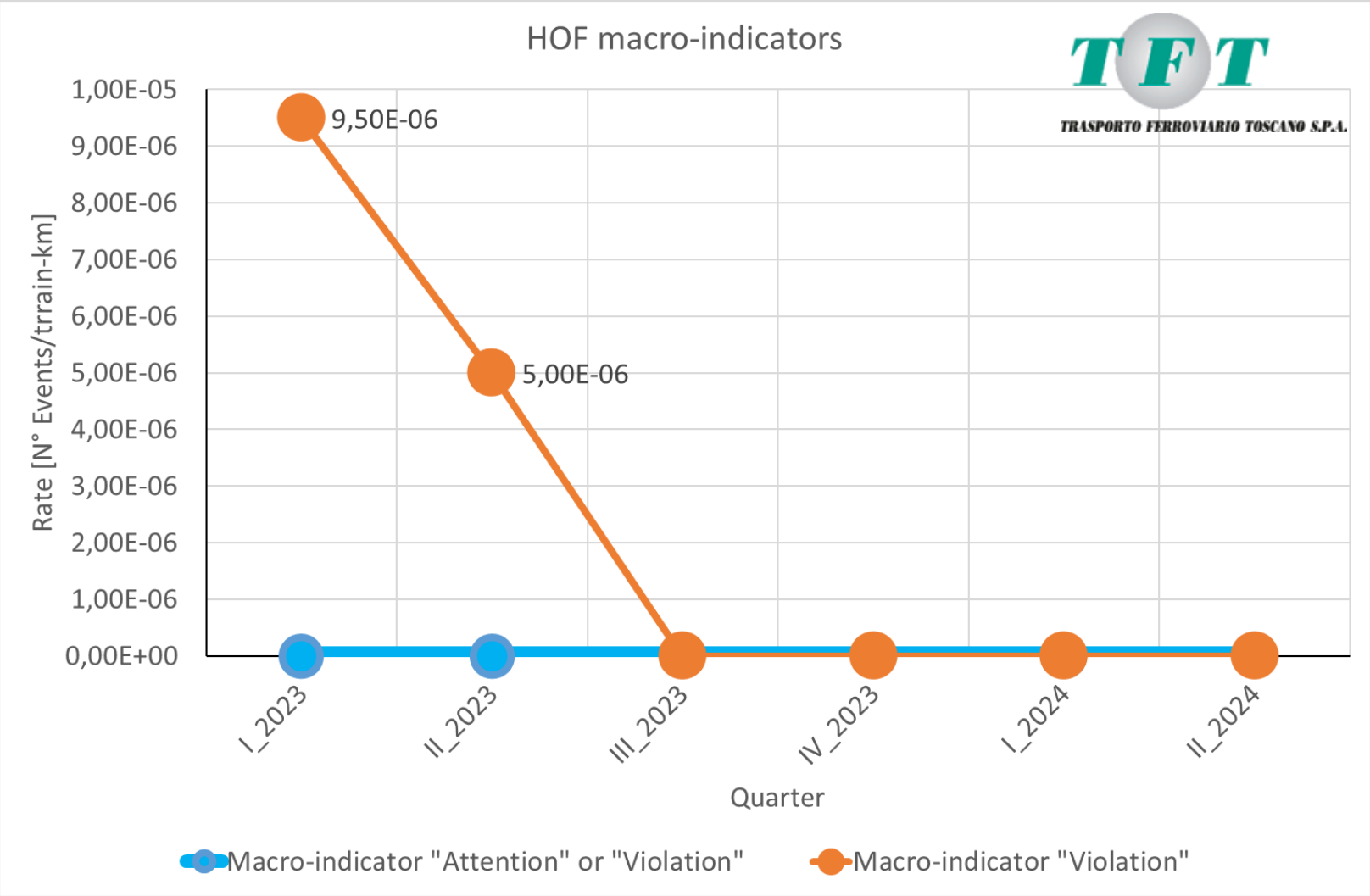
TRENITALIA TPER

Railway Service (2023): 17 M train-km
Employes: about 1400

SEW implementation timeline on TFT



TFT: monitoring on HOF macro-indicators



SAFETY TABLE

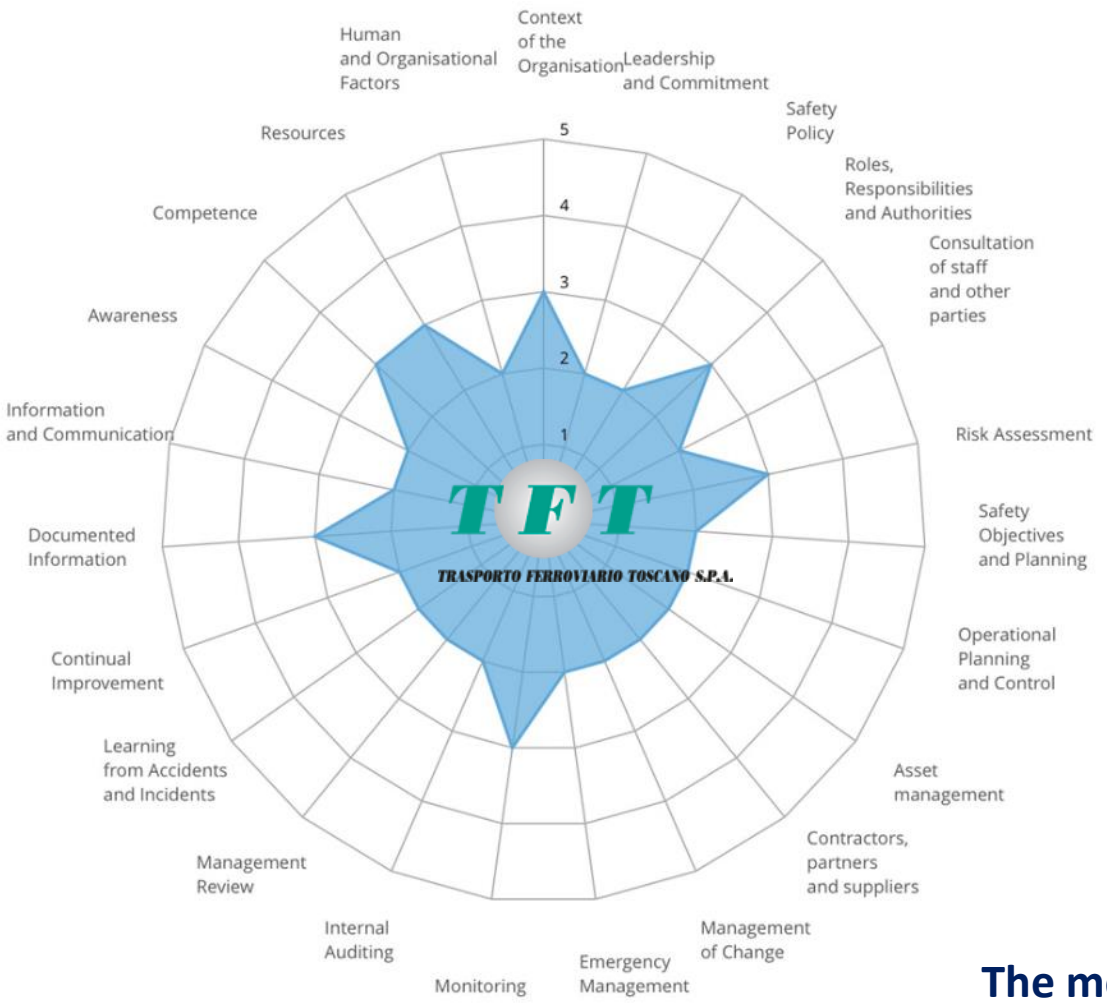
Actions managed by the Safety Table	Closd Actions	Actions in progress
31	23	8
	74%	26%

HOF macro-indicators: aggregation of safety indicators caused by specifics unsafe acts (ref. GEMS). E.g.:

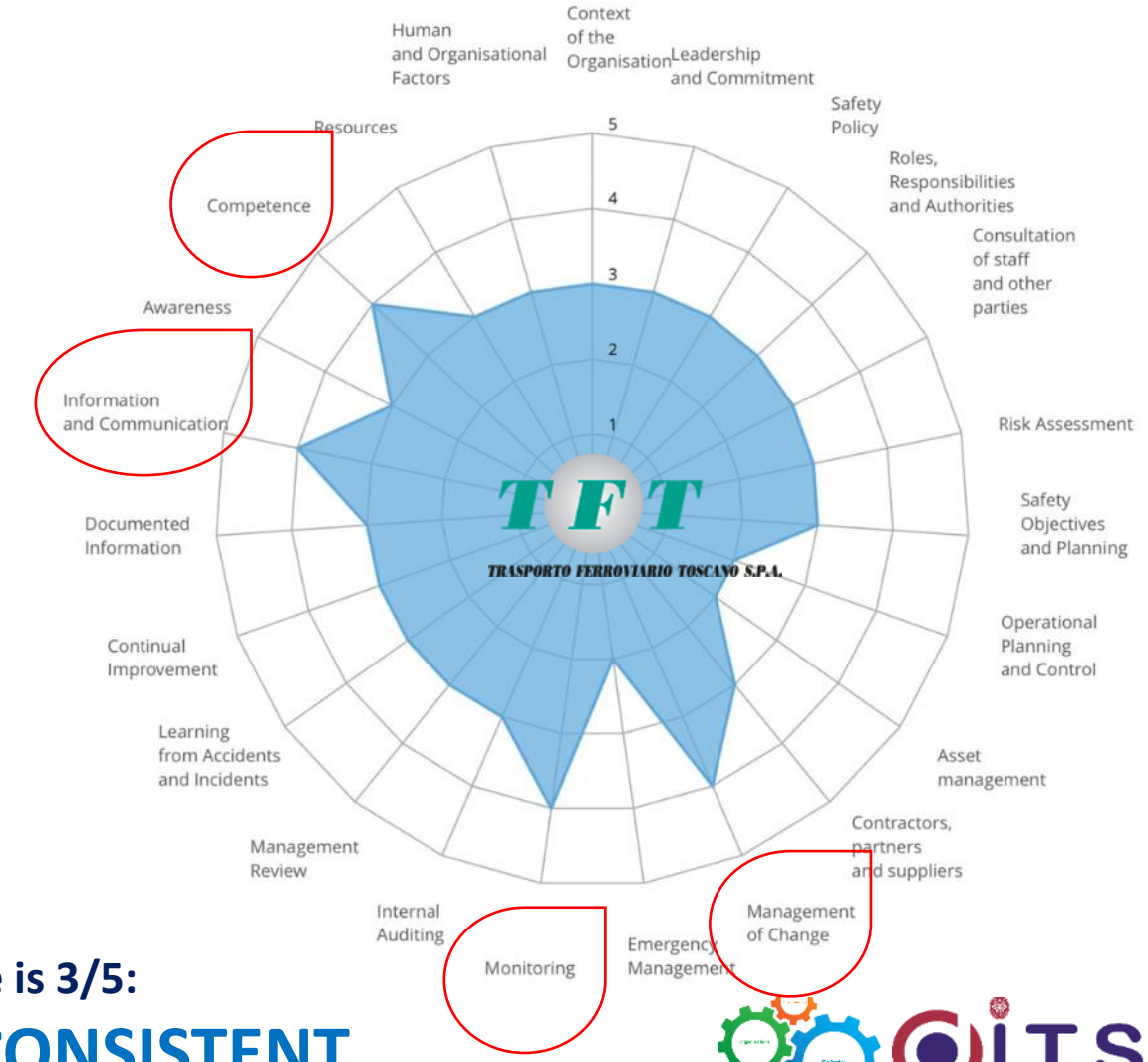
- unsafe acts caused by **slip:** macro-indicator **Attention**
- unsafe acts caused by **violation:** macro-indicator **Violation**

The «Maturity» of TFT SMS

Before SEW application



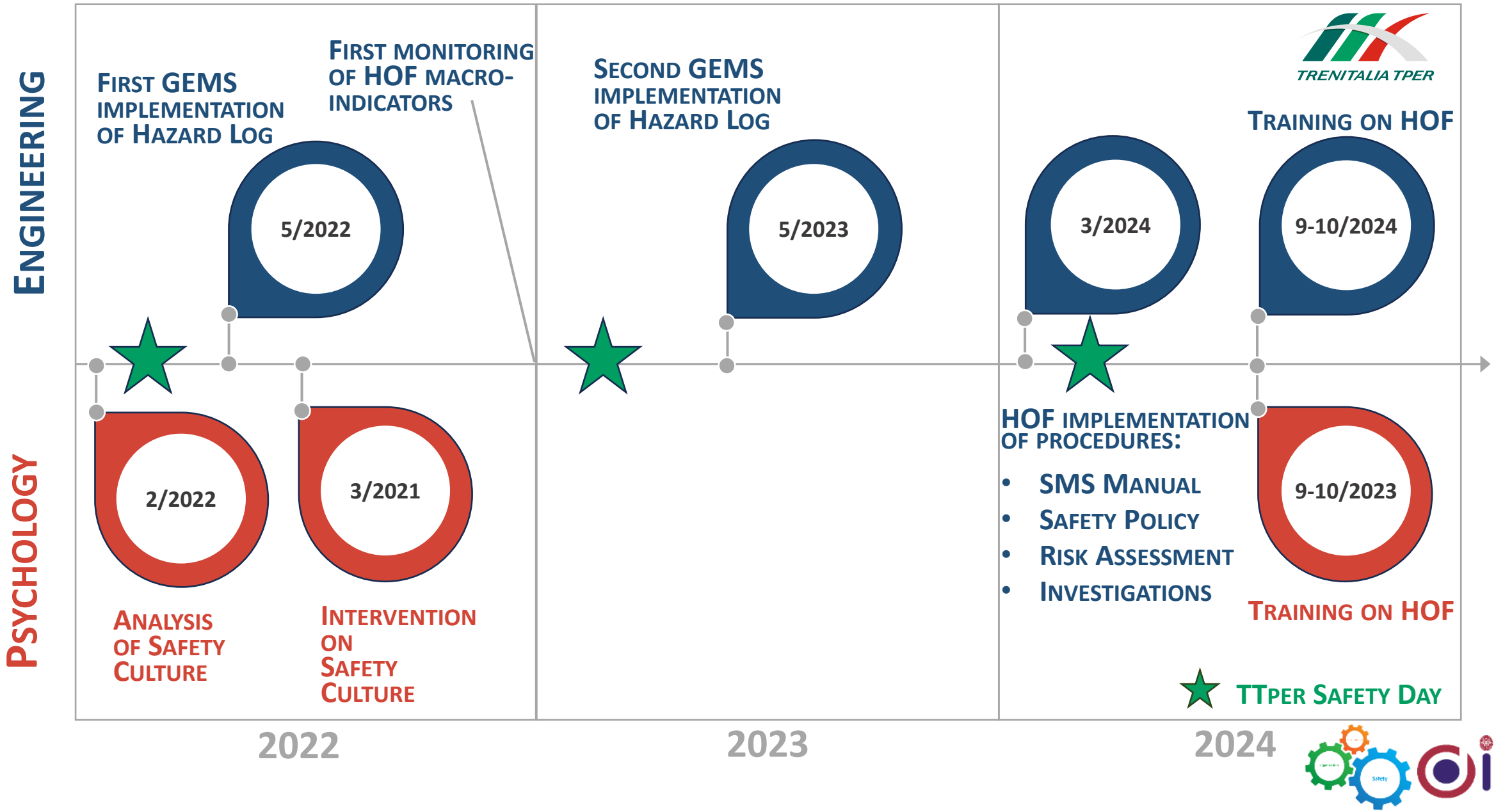
After SEW application



The mean value is 3/5:

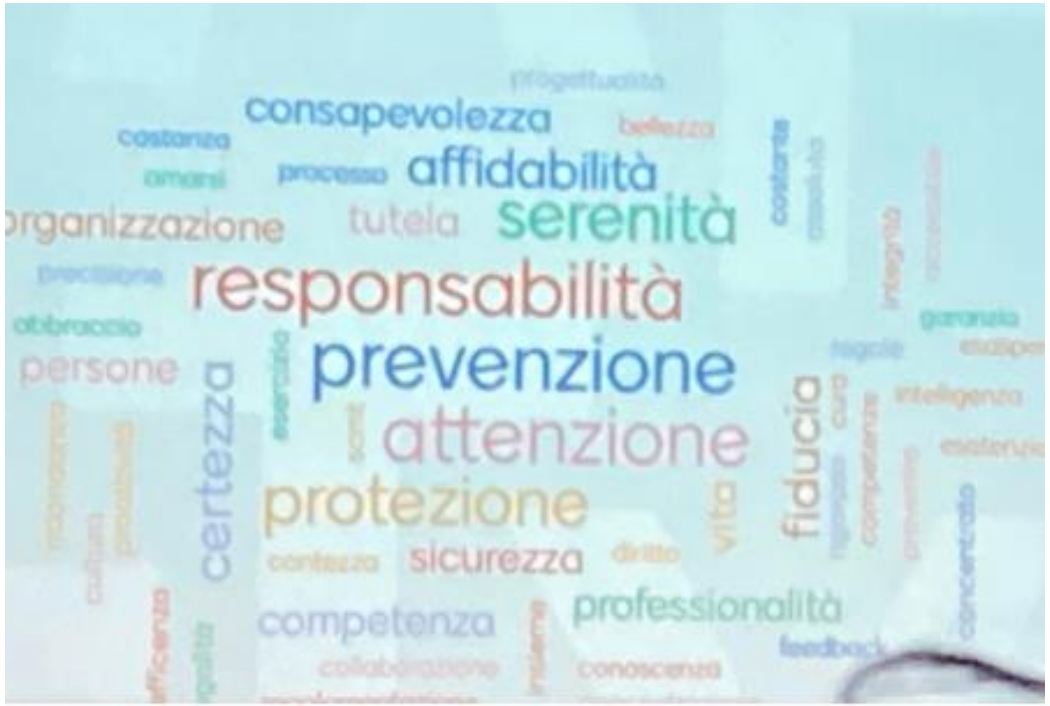
Maturity Level: CONSISTENT

SEW implementation timeline on TTper



TTper Safety Day

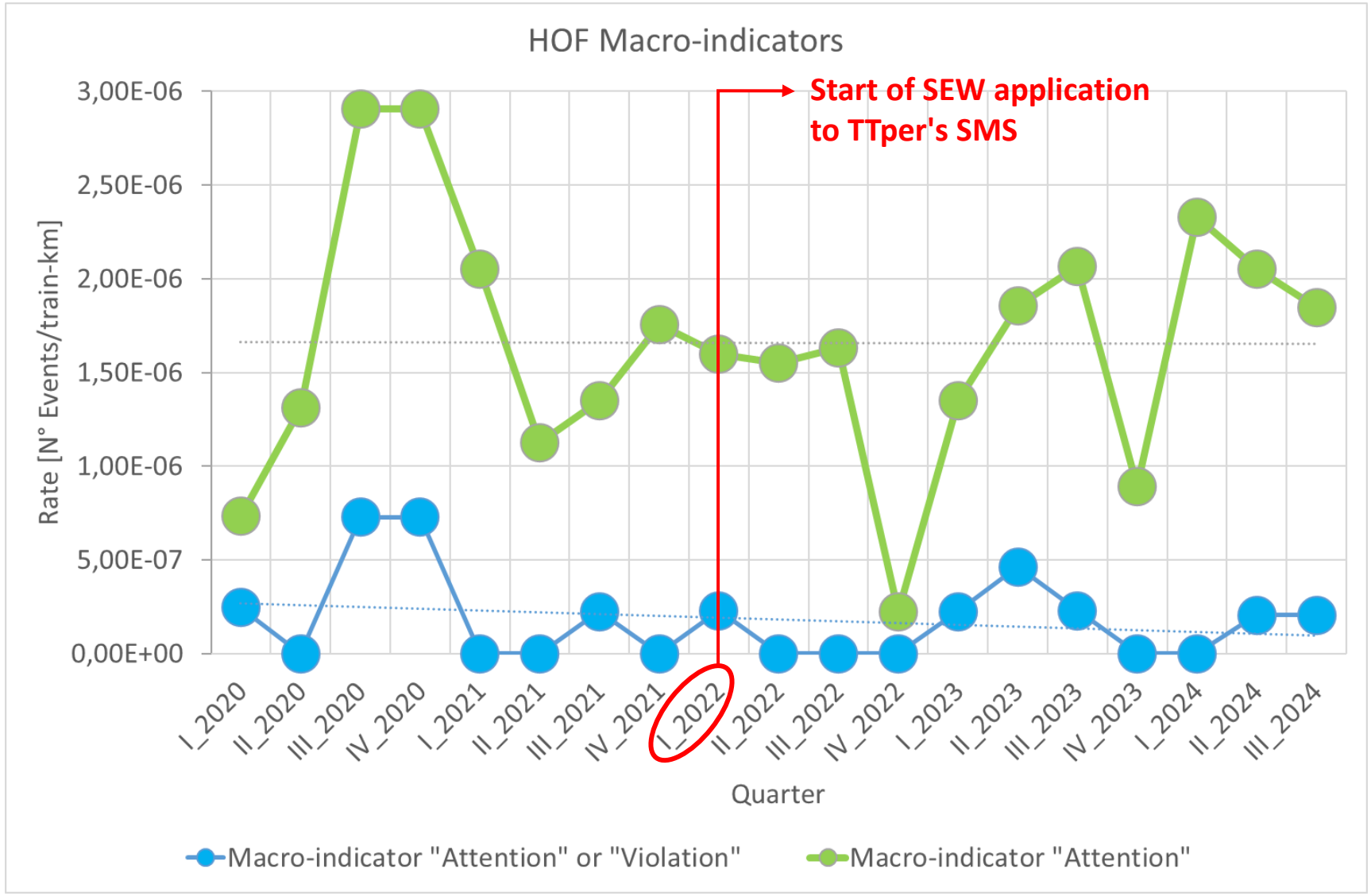
Beyond SEW



…but sharing with SEW Safety vision & Safety path

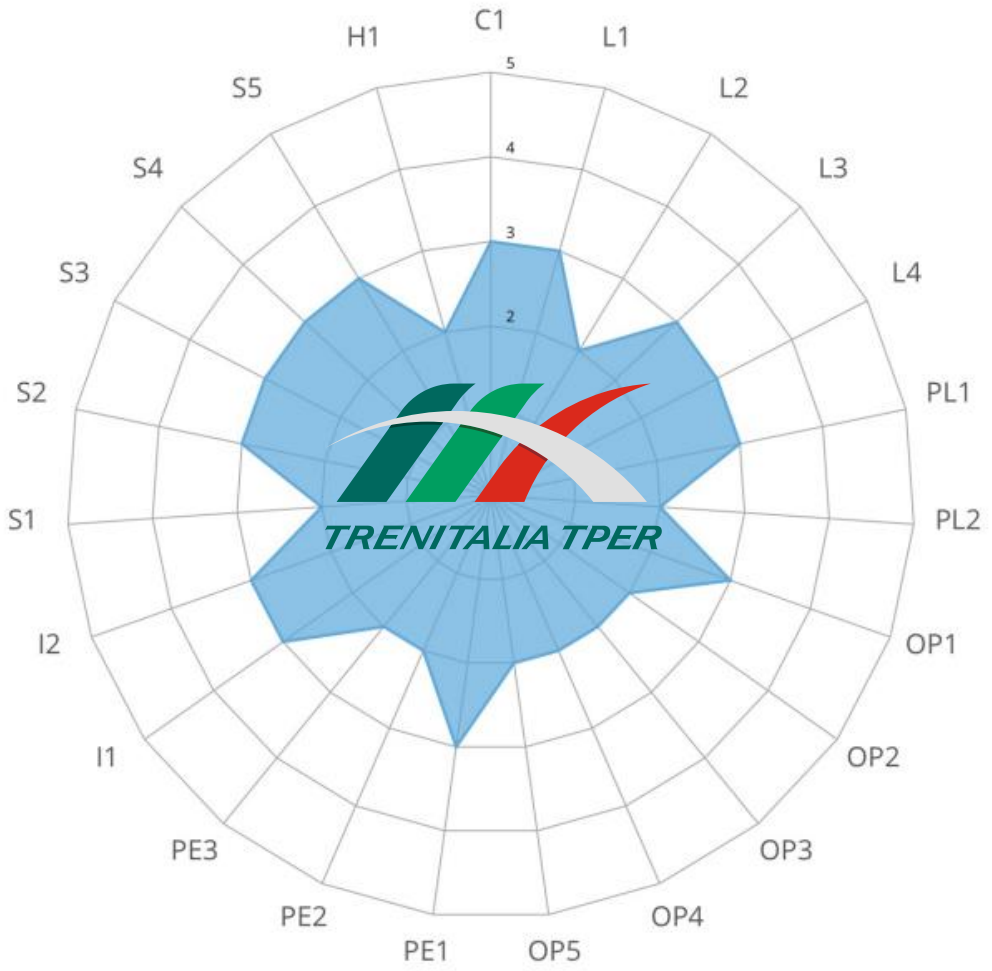
Regardless of SEW

TTper: monitoring on HOF macro-indicators

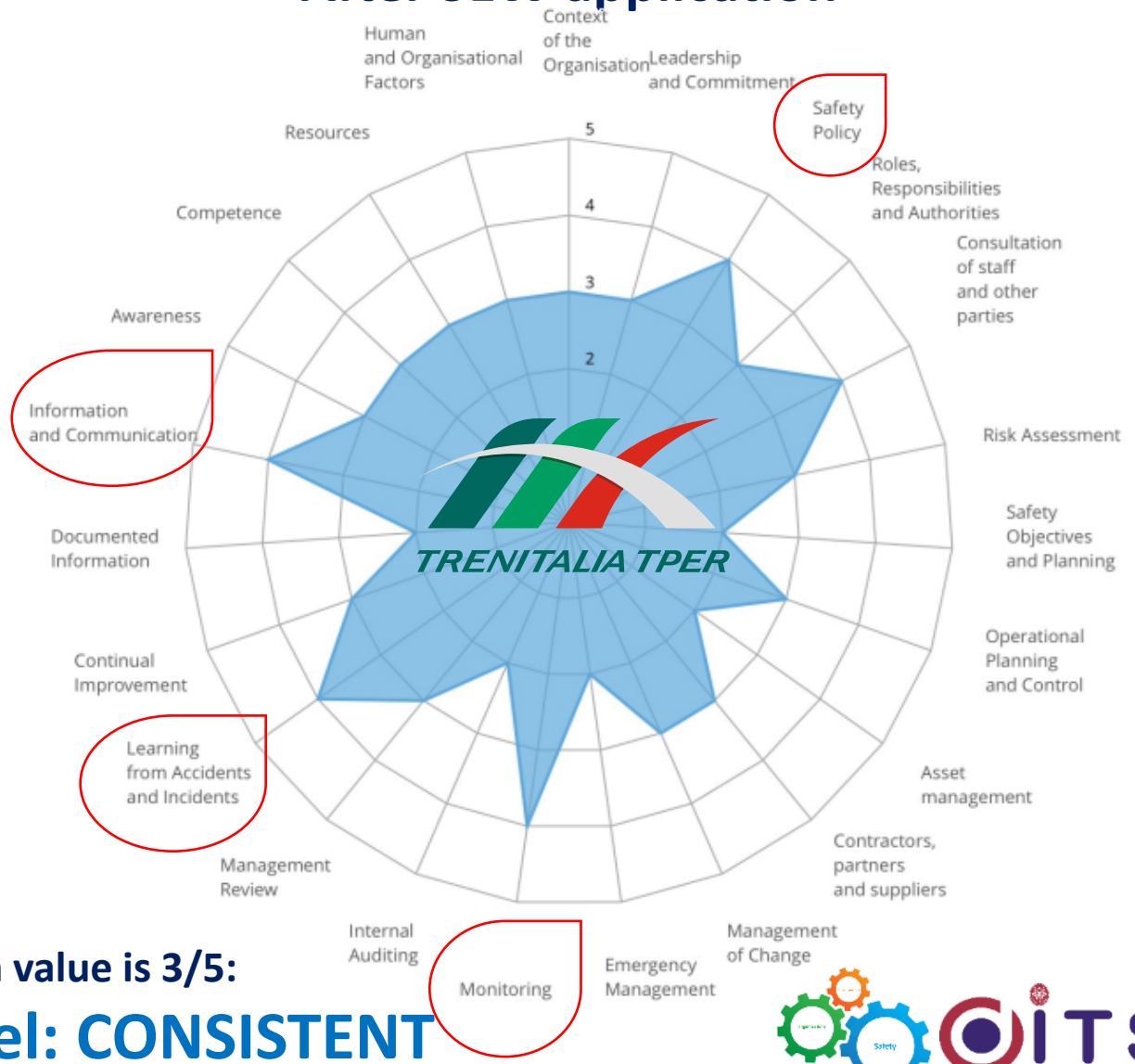


The «Maturity» of TTper SMS

Before SEW application



After SEW application



The mean value is 3/5:

Maturity Level: CONSISTENT

SEW perspectives

Dissemination of the Method

SEW is a shared value of the railway sector

	Call	Start of Open Drafting	End of Drafting
SEW Theory of Technique	15 December 2024	15 January 2025	31 May 2025
Guide to the Application of the SEW Protocol	15 December 2024	15 March 2025	31 May 2025

Free publication: June 2025

Development & Innovation
in Transport Systems

www.dits-roma.it

www.sew.cloud

Thank you for your attention

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EUROPEAN UNION AGENCY FOR RAILWAYS

HOF Conference

Human & Organisational Factors

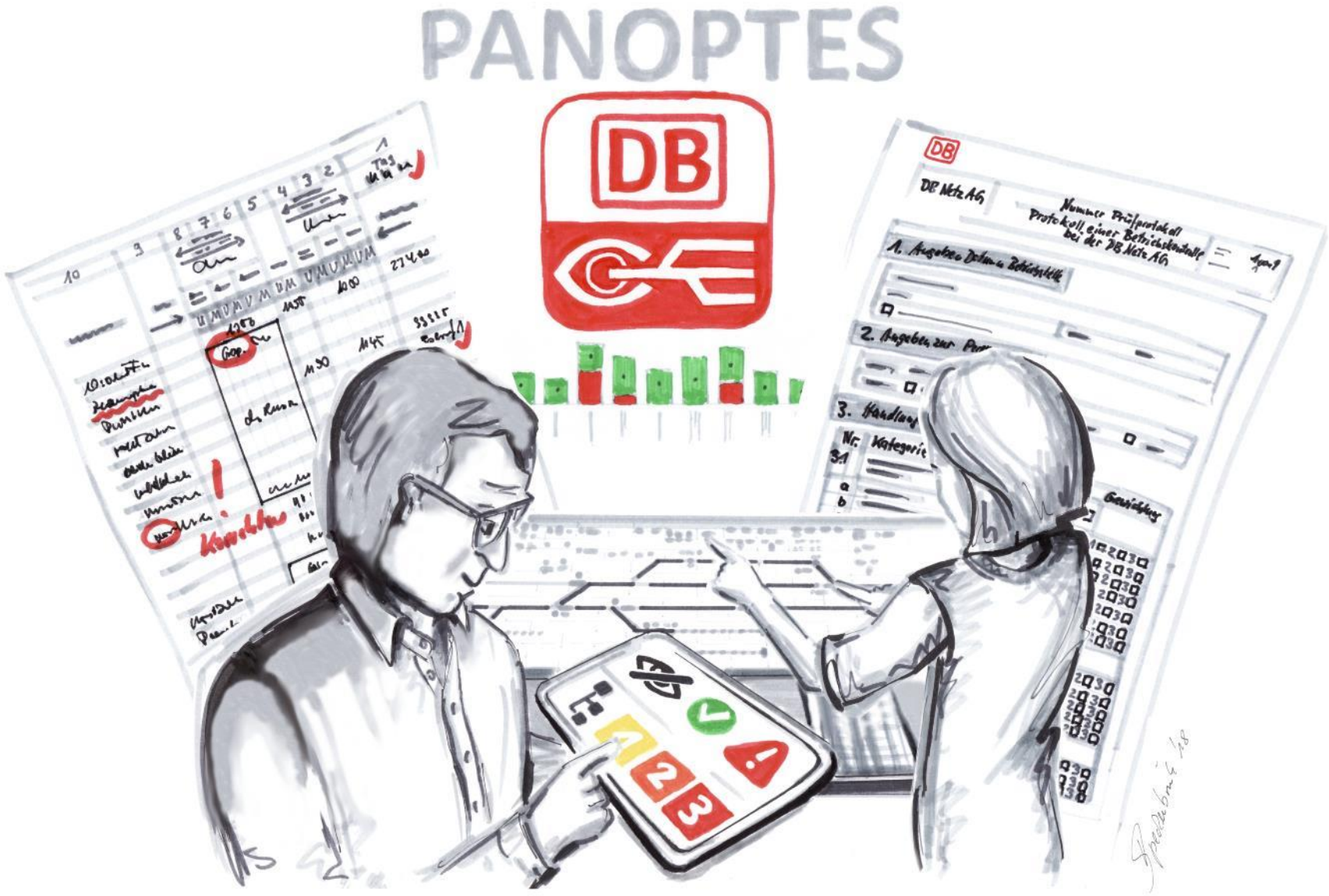
22-23 October 2024 - Valenciennes, France

era.europa.eu

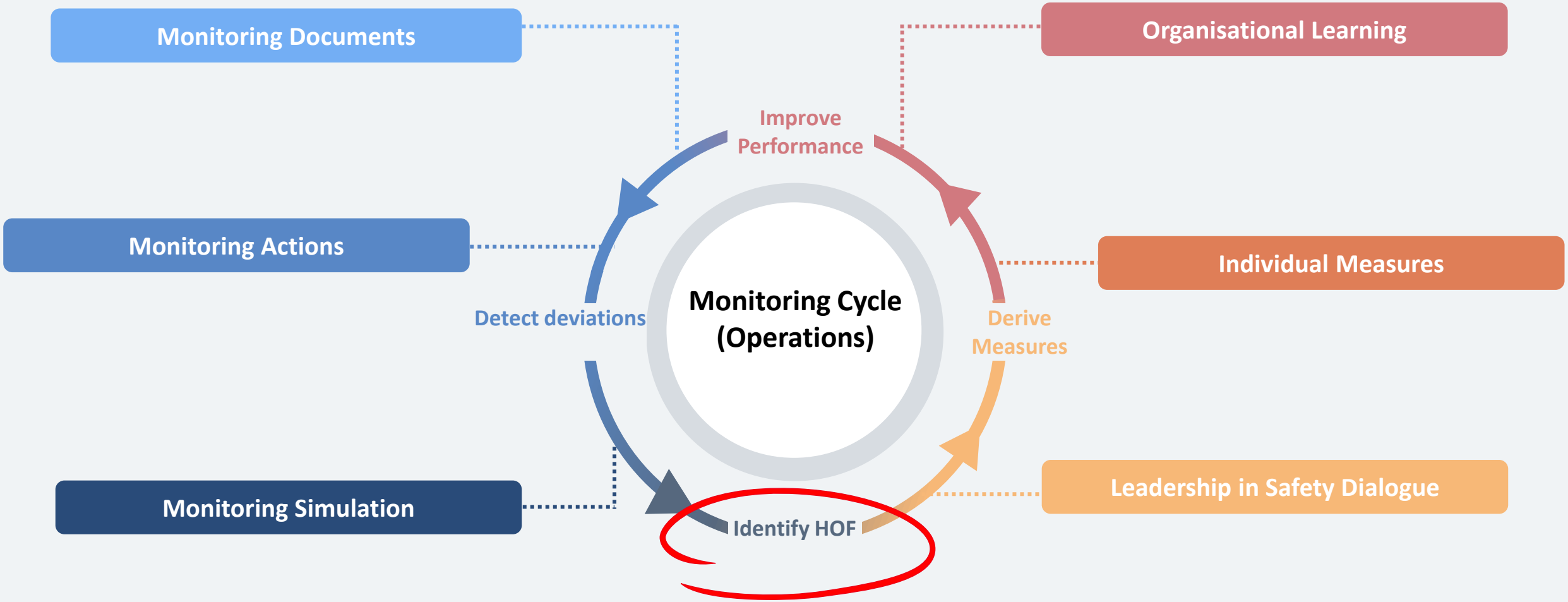
Human and Organisational Factors in Monitoring

23.10.2024 | Dennis Jeckel (I.IDT 34), Dr. Marcus Arenius (I.IBB 31) | HOF in Risk Management Conference 2024 | Valenciennes

Monitoring of rule compliance



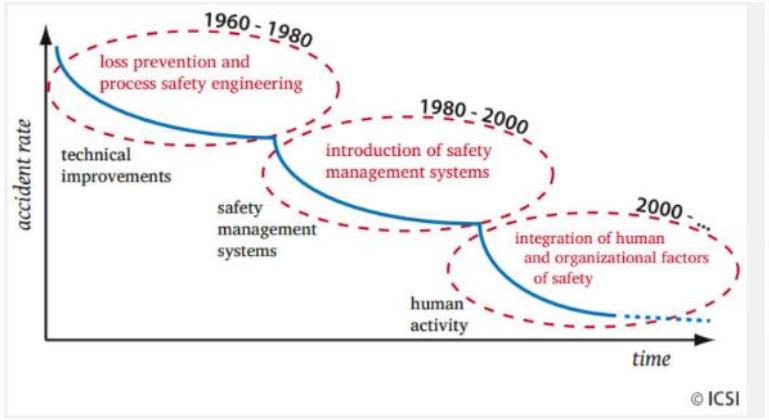
Change:
Stronger focus on HOF by continuous organisational learning



HOF: Targeting the contributing factors behind deviations to improve measure effectiveness

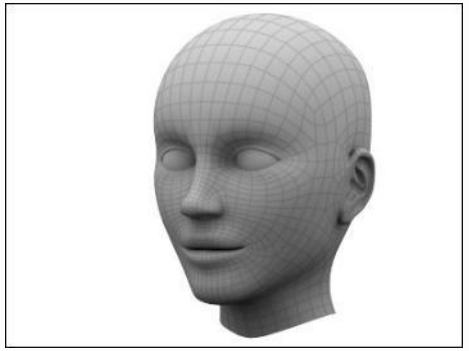
New perspective on rule violations

1. Errors are not committed intentionally.
2. The erroneous outcome of an action becomes obvious „after the fact“
3. Since errors are not committed intentionally, (negative) HOF that contribute to the unwanted outcome have to be identified and targeted with measures.



Measures become effective if they target the contributing factors (HOF) behind rule violations

Rule violations are the **starting point** and **not the conclusion** of the analysis



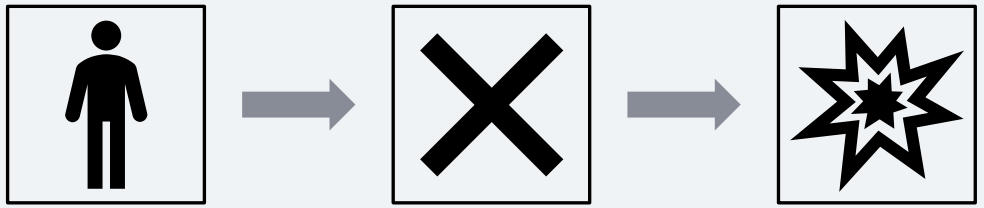
https://mipro.fi/en/media/blogi/human-and-organisational-factors-hofs-as-part-of-risk-and-safety-management/

Human Error: Old and new view on rule deviations

Old View: Human Error

„Inattentiveness, Negligence, (lack of) Knowledge,…“

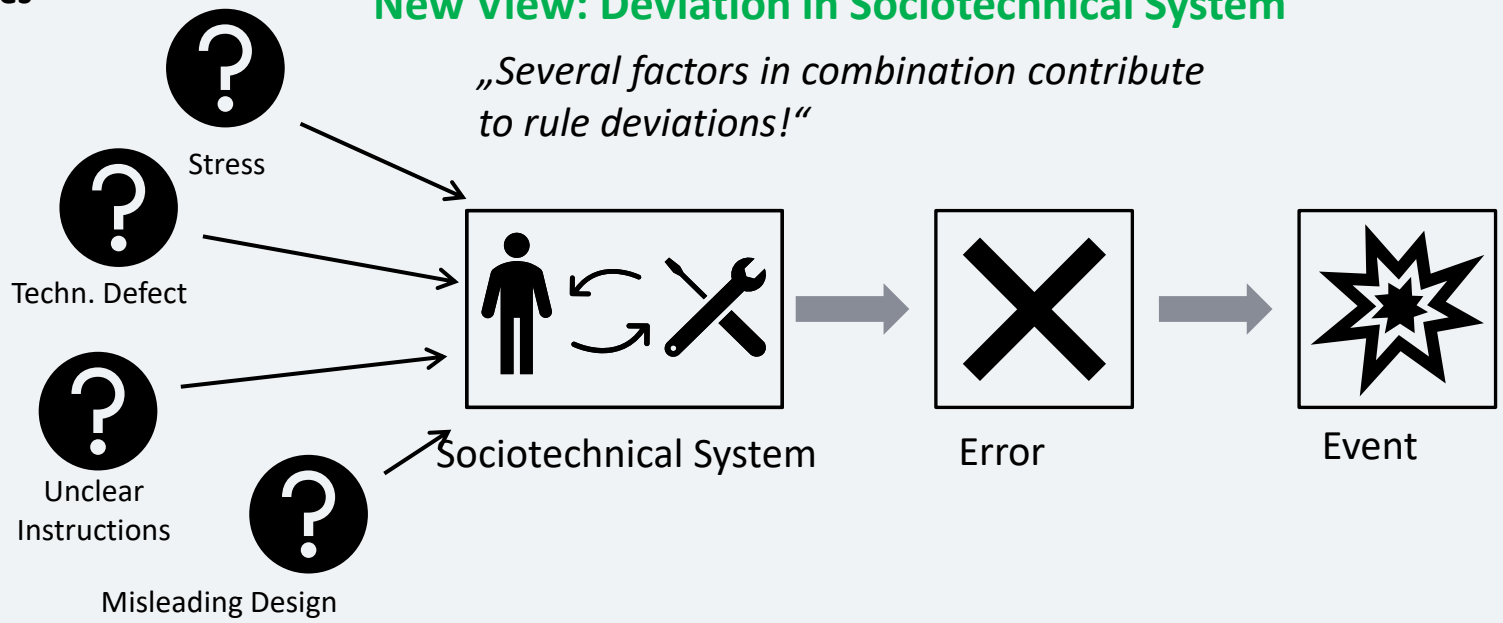
Measures
- Training
- „Punishment“



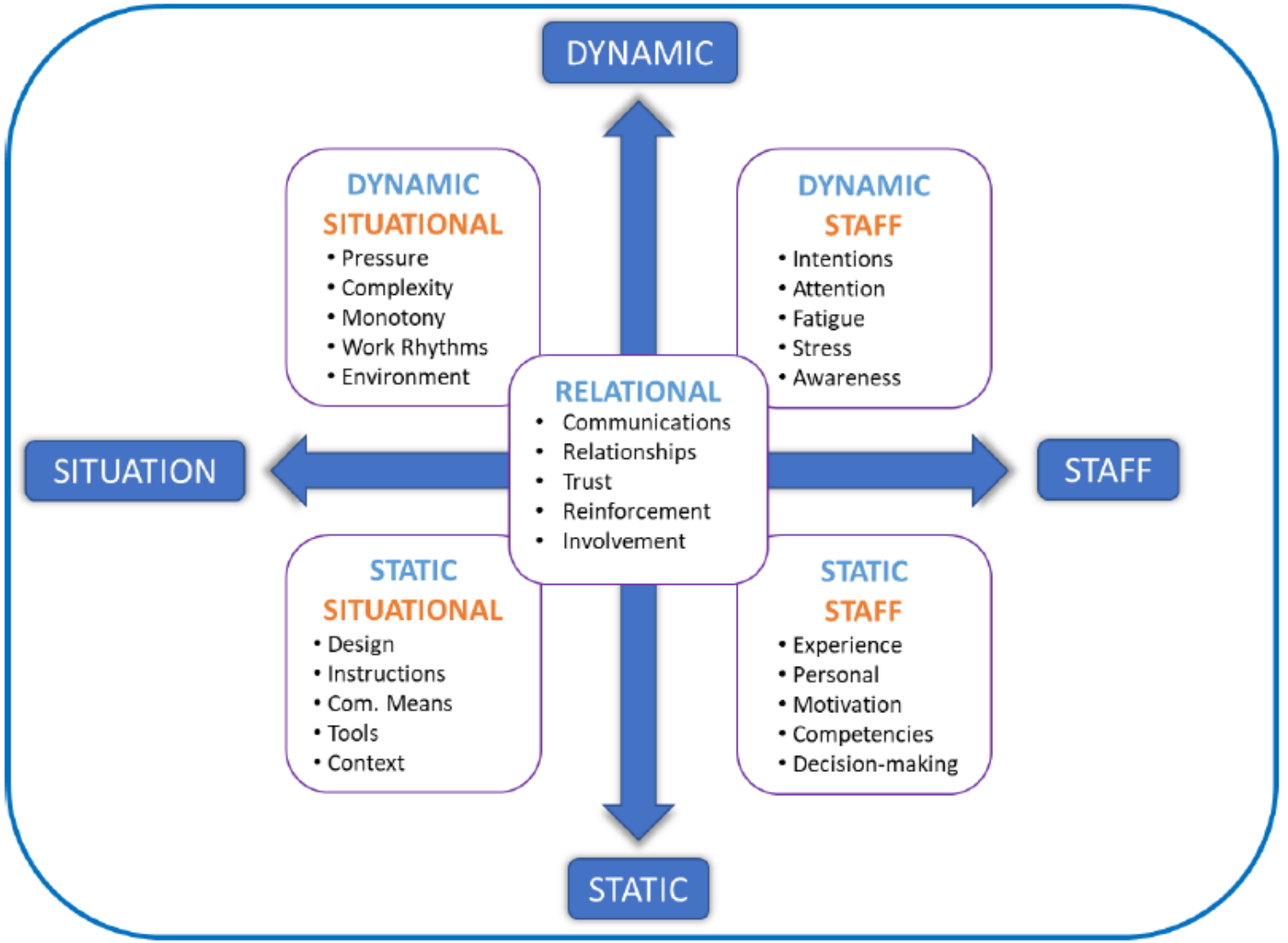
Measures

New View: Deviation in Sociotechnical System

„Several factors in combination contribute to rule deviations!“

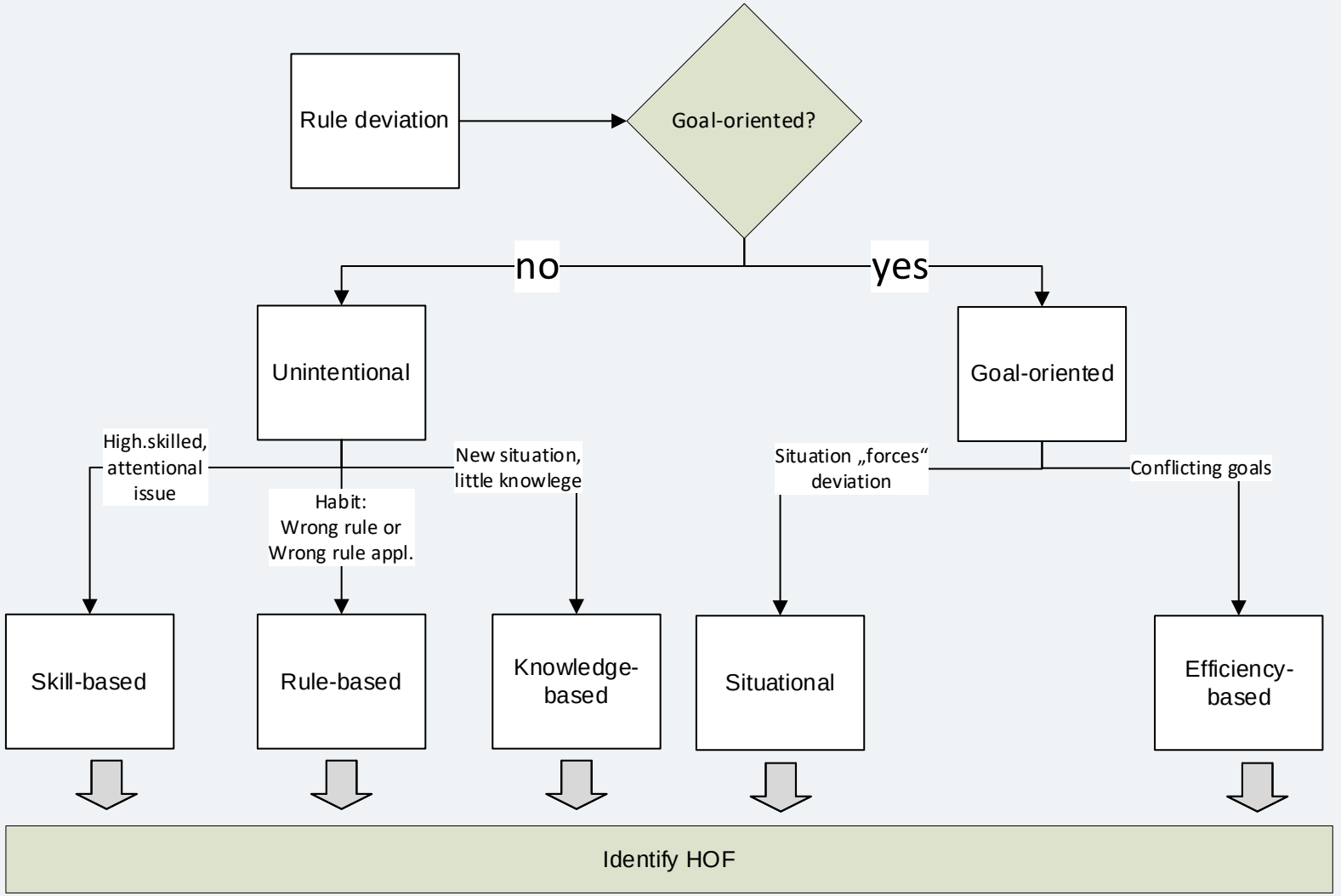


Rule deviations can be explained through the 5 x 5 model



https://www.era.europa.eu/domains/safety-management/human-and-organisational-factors-hof_en

Rule deviation classfication supports HOF-identification



Integrating the identification of HOF for rule deviations

Deviation detected

Safety-relevant

Combined with

Classification: Unintentional / Goal-oriented?

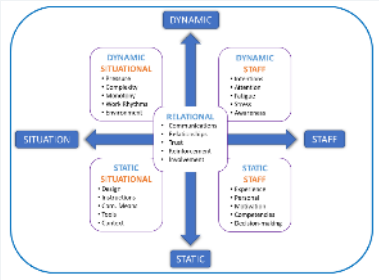
Un-Intentional Mistake	▪ (subconcious) **Skill**-based – e.g. „Flüchtigkeitsfehler" ▪ Unintentional **Rule**-based – e.g. wrong rule ▪ Unintentional **Knowledge**-based – e.g. lack of knowledge
Goal-Oriented Violation	▪ **Exceptional / Situational** – Situation „forces" deviation ▪ **Efficiency**-based – Conflicting goals

Preselection HOF facilitates analysis

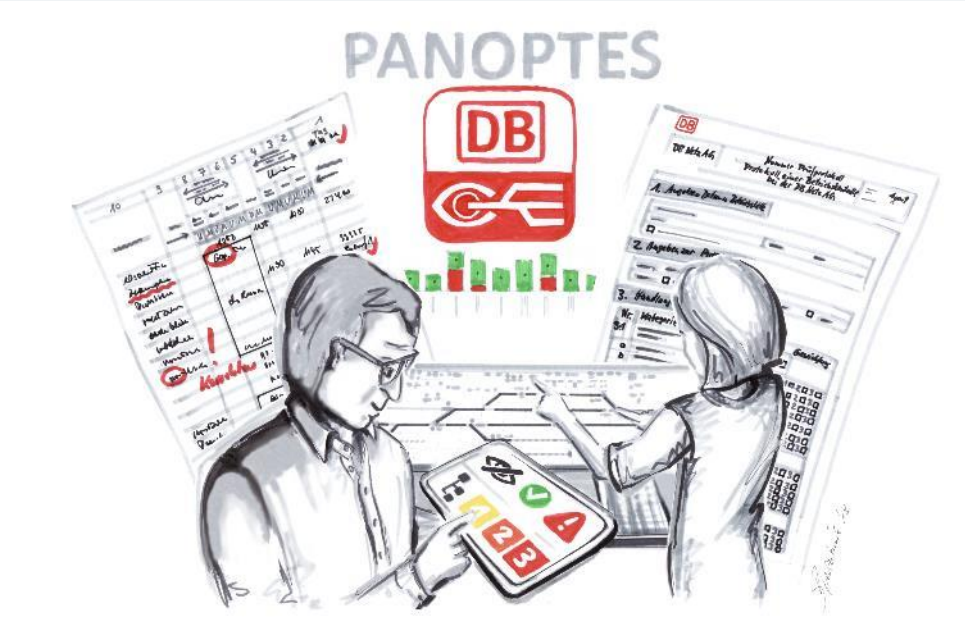
Developed with operational experts

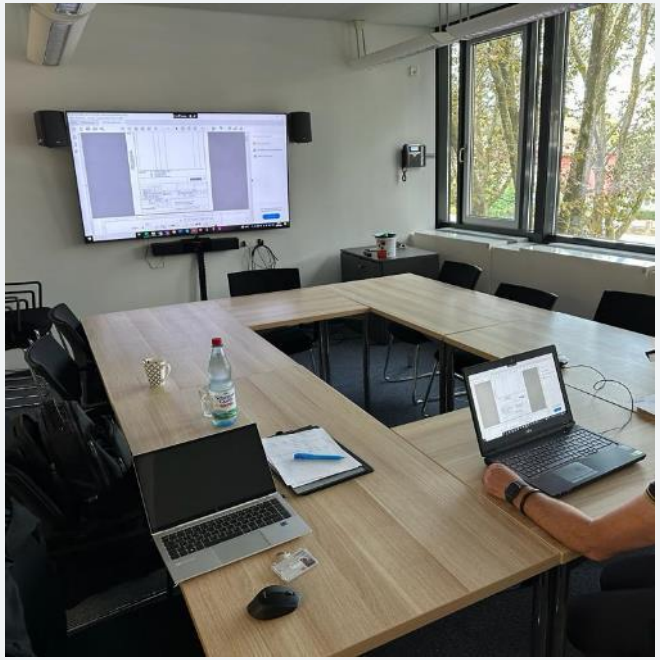
Combined with

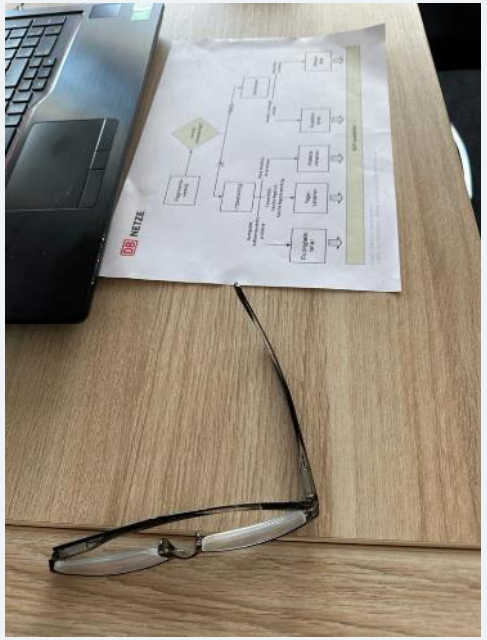
…Identify contributing factors (HOF)?



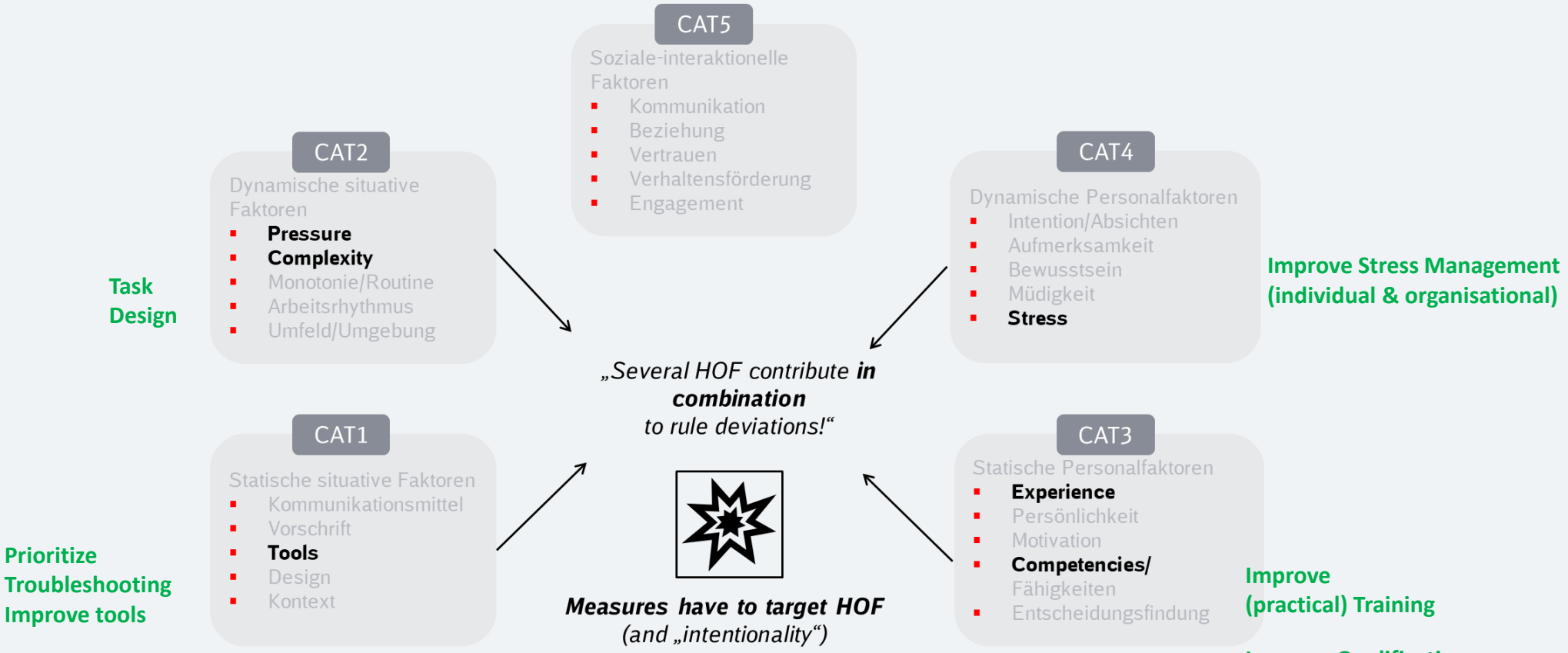
Glimpse: Safety Dialog







Organisational Learning through HOF analysis



Measures targeting conflicting goals:
Improve **safety** and consider impact on efficiency jointly (performance variability)

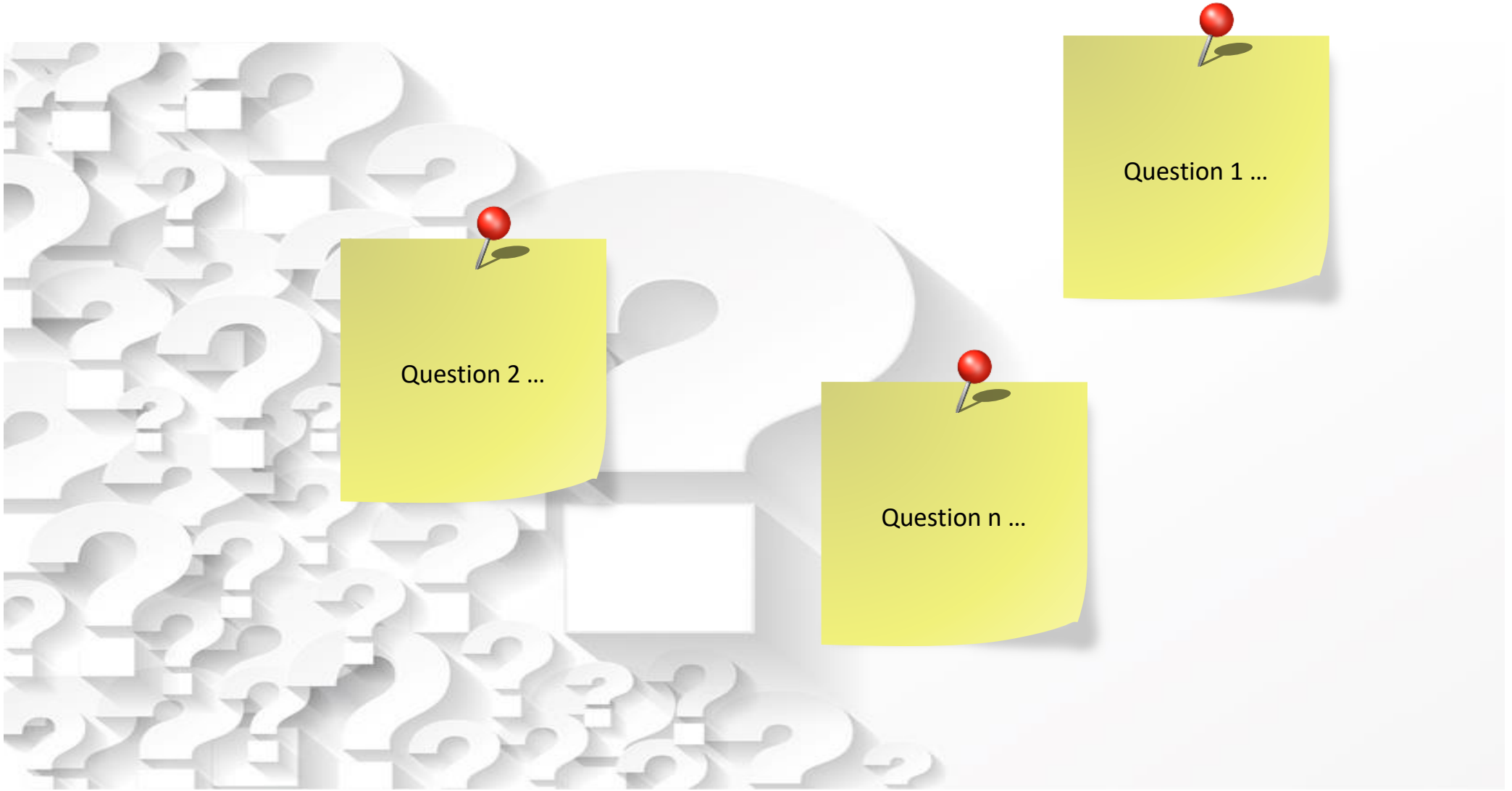
Conclusions for HOF-Integration

HOF-Analysis in Monitoring brings a new perspective on rule deviations:

- Rule deviations can result from **multiple contributing factors** (HOF), e.g. Stress, Tools, Time Pressure, etc.
- Rule deviations are not **causal** to an erroneous action
- HOF affect the **sociotechnical system**, not only the human operator e.g. organisation, complexity of rules or tools
- **HOF** contribute **jointly** to rule deviations

➢ **The inclusion of the operator violating a rule in analysis is essential for HOF identification and deriving measures**

Thank you for your attention – questions ?



Human & Organisational Factors (HOF) Conference

Coffee break

22-23 Oct 2024 Valenciennes, France

era.europa.eu

From human behaviour understanding to improved safety at Pedestrian Tracks Crossing (PTC)

Yanna CARLI (Railenium)

Elise GRISON (SNCF)

Contents

Context

RAILENIUM RAIL RESEARCH & INNOVATION
SNCF
Université Polytechnique HAUTS-DE-FRANCE
SCLE
SNCF RÉSEAU

The initial issue

Context

Pedestrian **T**racks **C**rossings (PTC) are installed in around **900** train stations in France.

But, accidents at PTC regularly occur

The main reasons identified are **behavioural.**

50%

Safety instructions have not been seen or passengers did not paid attention.

Users performing several tasks (smartphone, headphones, etc.), effects of time pressure, social influence...

50%

Situation / information have not been understood or taken into account.

Safety system in place is misinterpreted.
Users feel that the train will come to a stop in time.

How to improve safety?

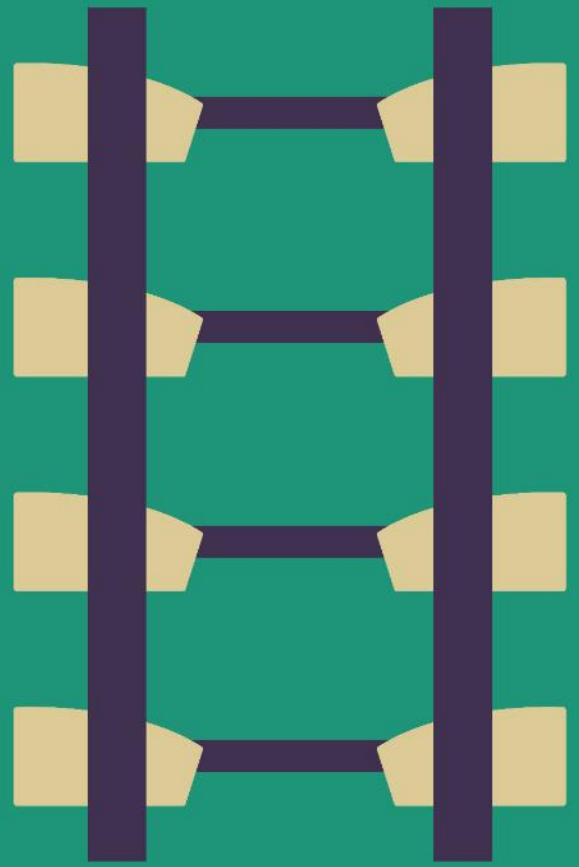
Classical approaches method

Development of prototypes and tests in real-life conditions

Limited number of new devices that can be evaluated considering the investment

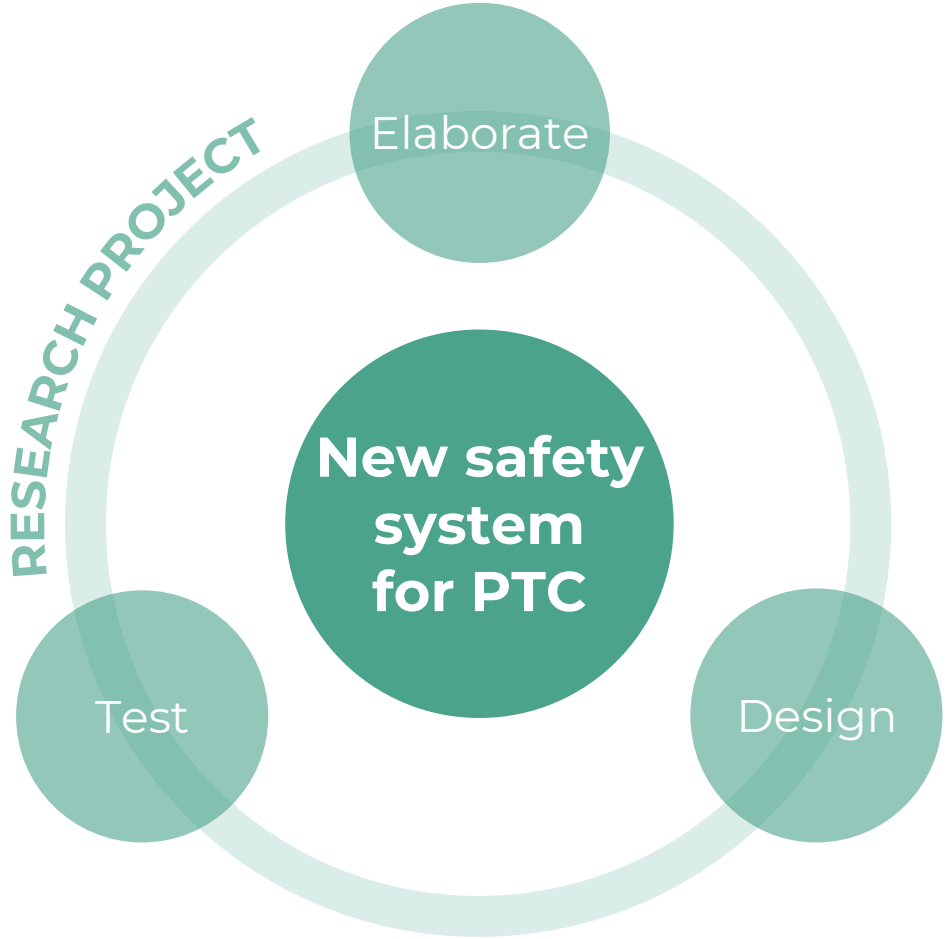
Lack of control of evaluation situations (weather conditions, participants profile, contextual factors)

Analyses, conclusions and decisions making are often difficult to achieve



The request

From SNCF Réseau (Safety, Security and Risk Direction)



Project overview

RAILENIUM RAIL RESEARCH & INNOVATION
SNCF
Université Polytechnique HAUTS-DE-FRANCE
SCLE
SNCF RÉSEAU

Objectives of the project

Develop a new generation of PTC based on human understanding

UNDERSTAND

human behaviour (cognition and biomechanics) at PTC

DEVELOP & TEST

new safety systems inspired by human understanding and measure objectively their efficacity

REDUCE

risky behaviours and the number of accidents

A cognitive approach

Towards a new vision of industrial safety

Develoment of safety concepts based on :

Tackling causes of the risk to reduce it

Partners of the project

Launched in January 2023 for an expected completion in mid-2026

Cognition and experimental studies

HOF and qualitative studies

Biomechanical studies

Technical development and tests

5 **industrial** and **academic** partners involved

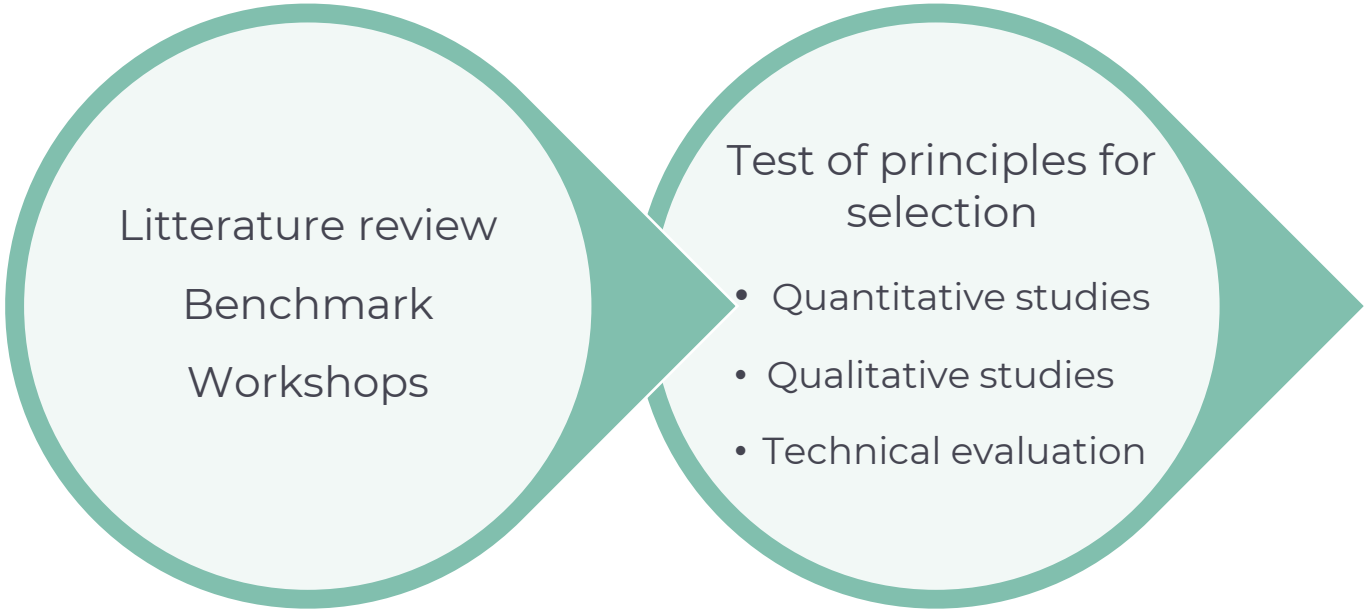
Overview of the project

4 phases from research to development

6 principles to
build concepts

Overview of the project

4 phases from research to development

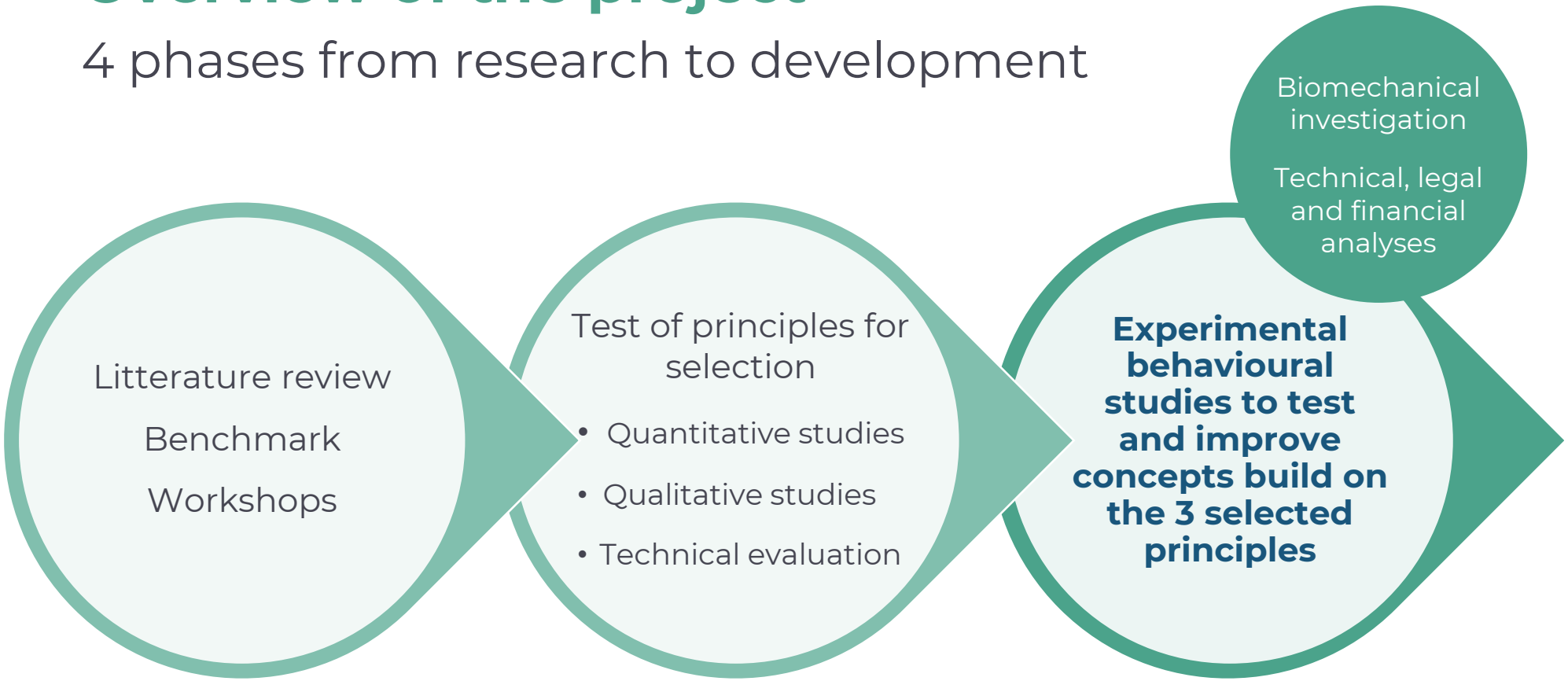


6 principles to build concepts

Selection of the **3 best principles** and conceptualisation

Overview of the project

4 phases from research to development



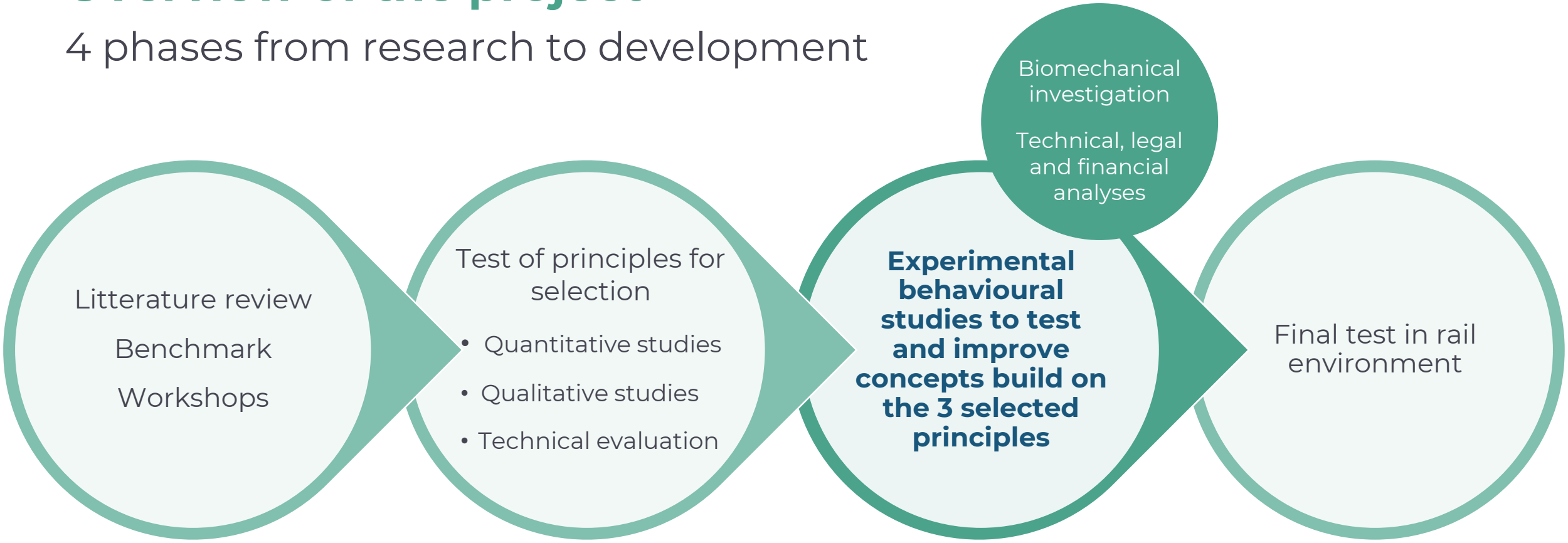
6 principles to build concepts

Selection of the **3 best principles** and conceptualisation

Decision matrix integrating behavioural, technical, legal and cost indicators for **selection of best concepts**

Overview of the project

4 phases from research to development



6 principles to build concepts

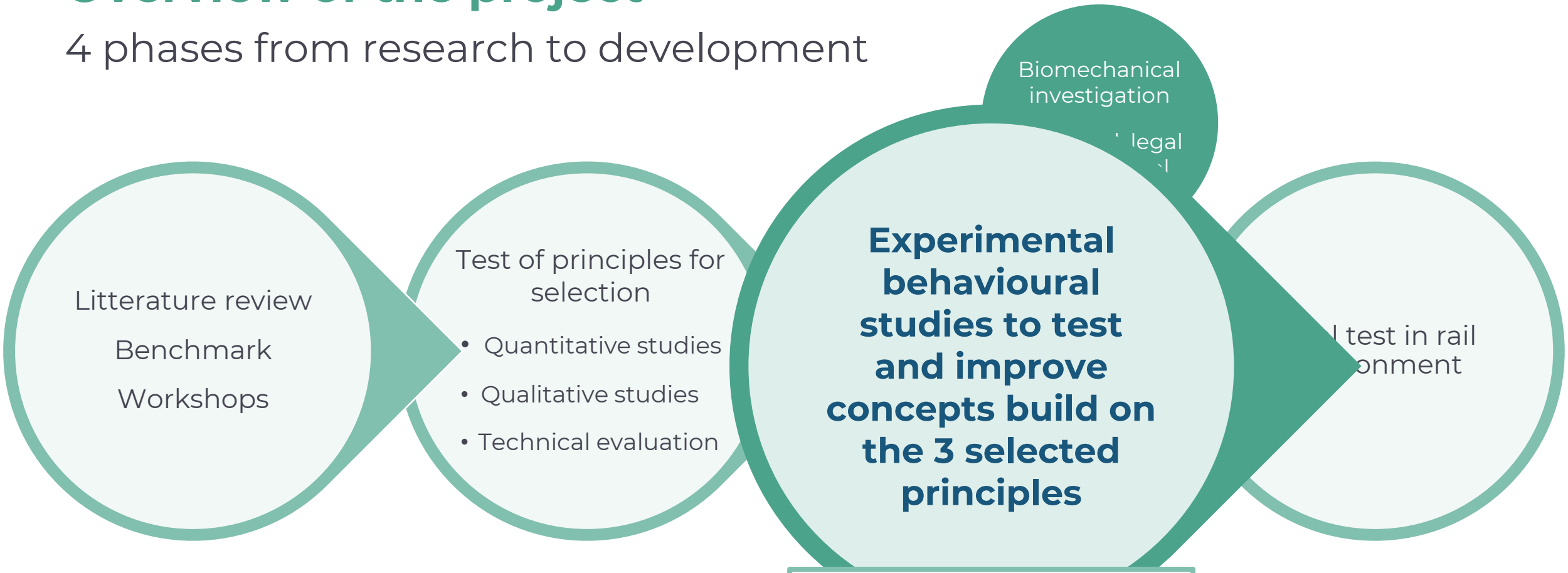
Selection of the **3 best principles** and conceptualisation

Decision matrix integrating behavioural, technical, legal and cost indicators for **selection of best concepts**

New generation of PTC

Overview of the project

4 phases from research to development



6 principles to build concepts

Selection of the **3 best principles** and conceptualisation

Decision matrix integrating behavioural, technical, legal and cost indicators for **selection of best concepts**

New generation of PTC

Behavioural studies

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SCLE
SNCF RÉSEAU

Methodological choice

Field studies do not allow for an obje lled evaluation of concepts.

Subjective data

Few

ed meters

Participants' safety

Mixed reality

Mixed reality = Strong realism + Objective data − Field studies constraints

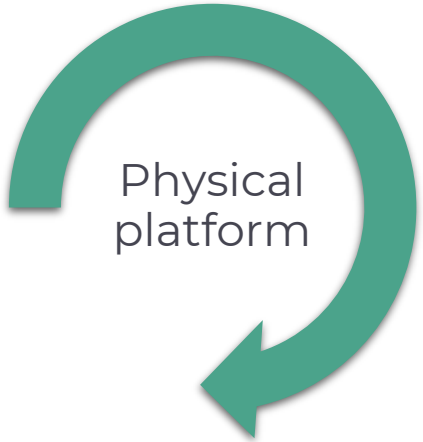
The testing platform

Re-create realistic behaviour

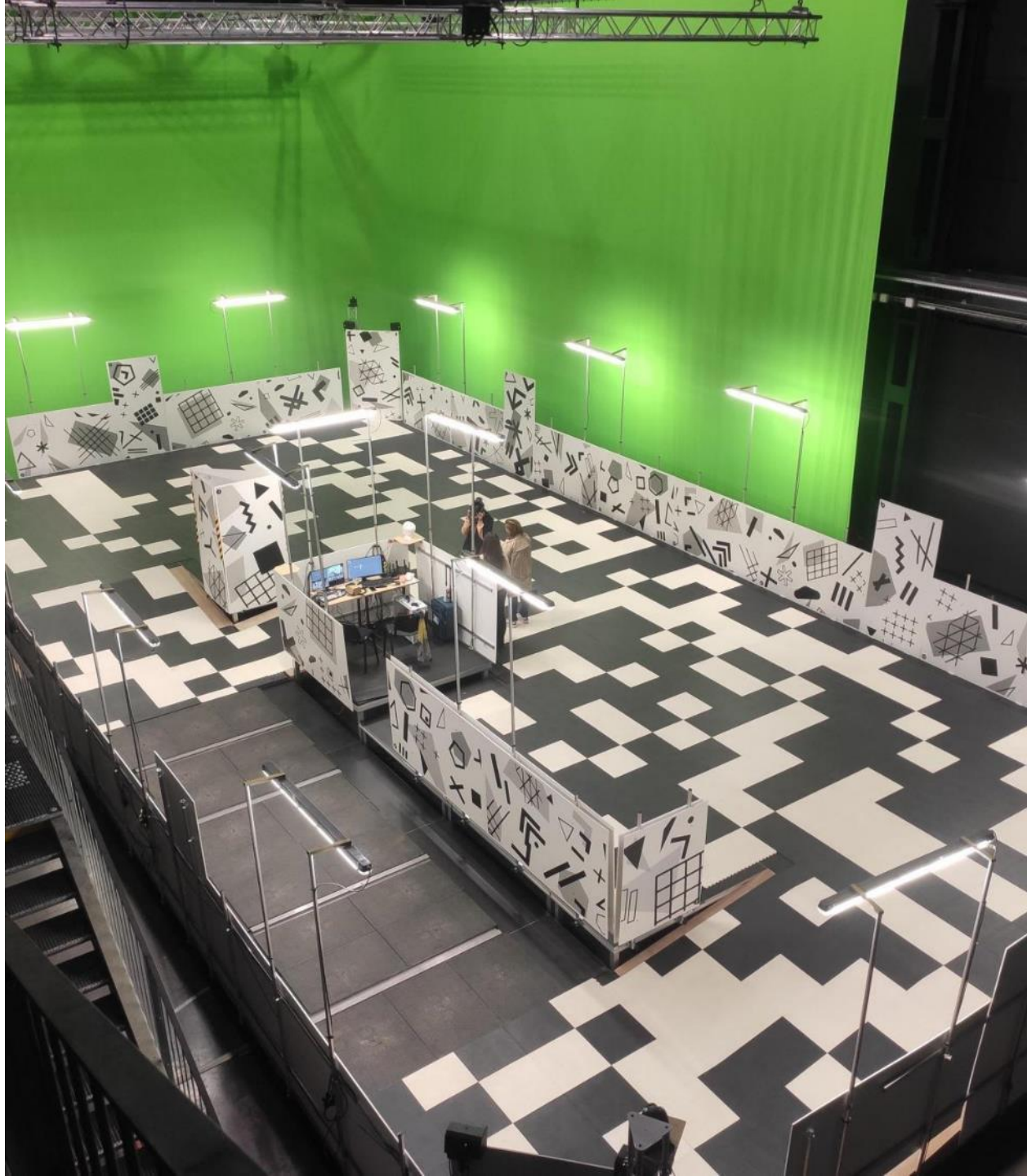
2 platforms,

1 portion of a double-track railway,

1 PTC



True-to-scale (1:1)



The testing platform

Re-create realistic behaviour

2 platforms,

1 portion of a double-track railway,

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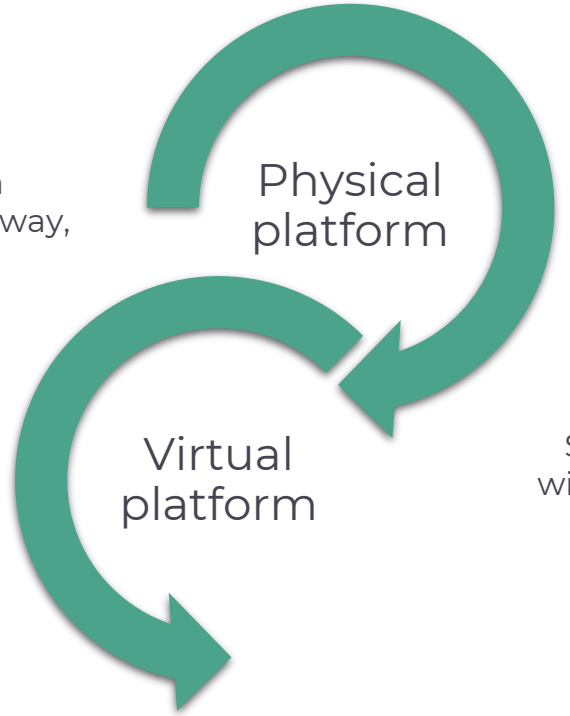
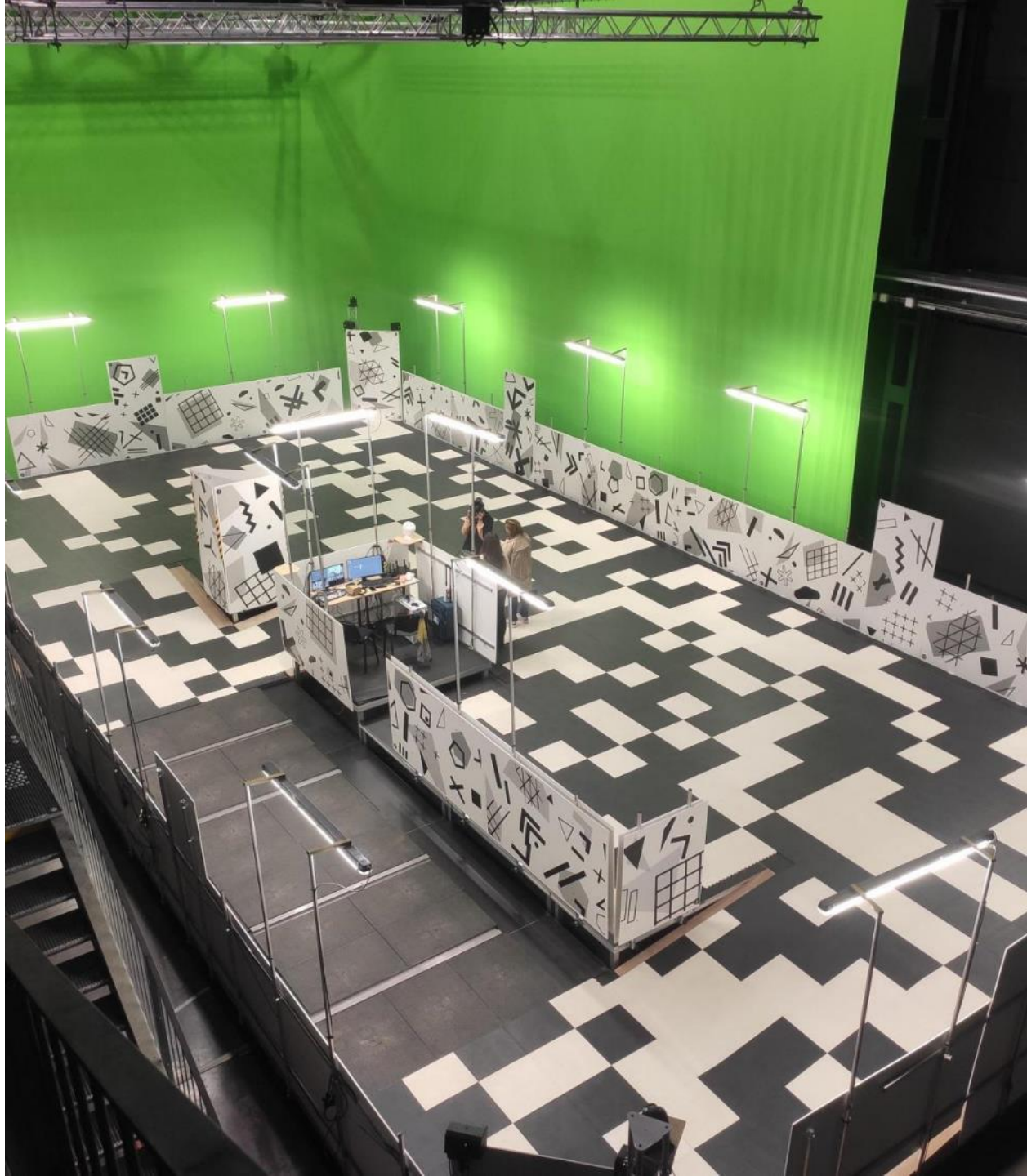


True-to-scale (1:1)

Detailed station features

Synchronised with the physical environment



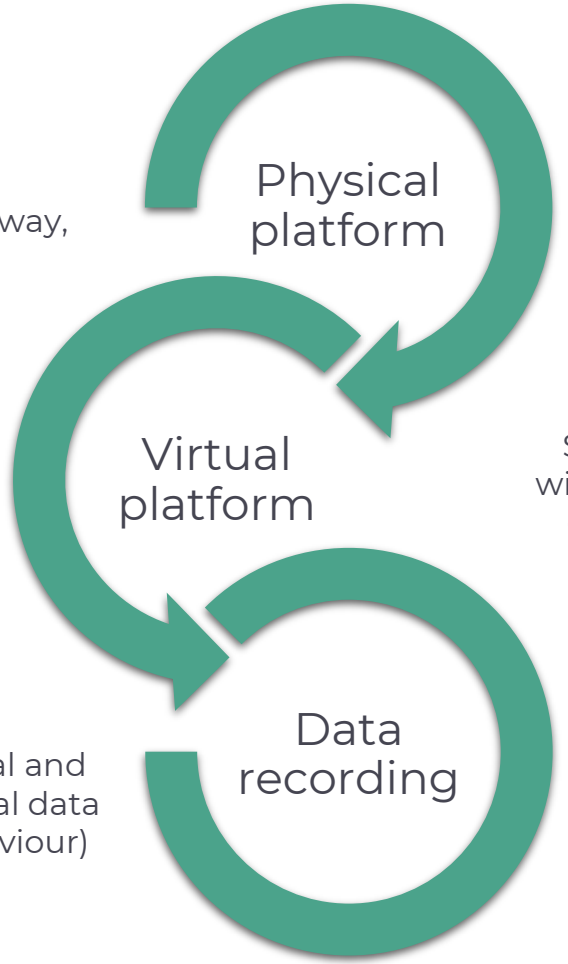
The testing platform

Re-create realistic behaviour

2 platforms,

1 portion of a double-track railway,

1 PTC



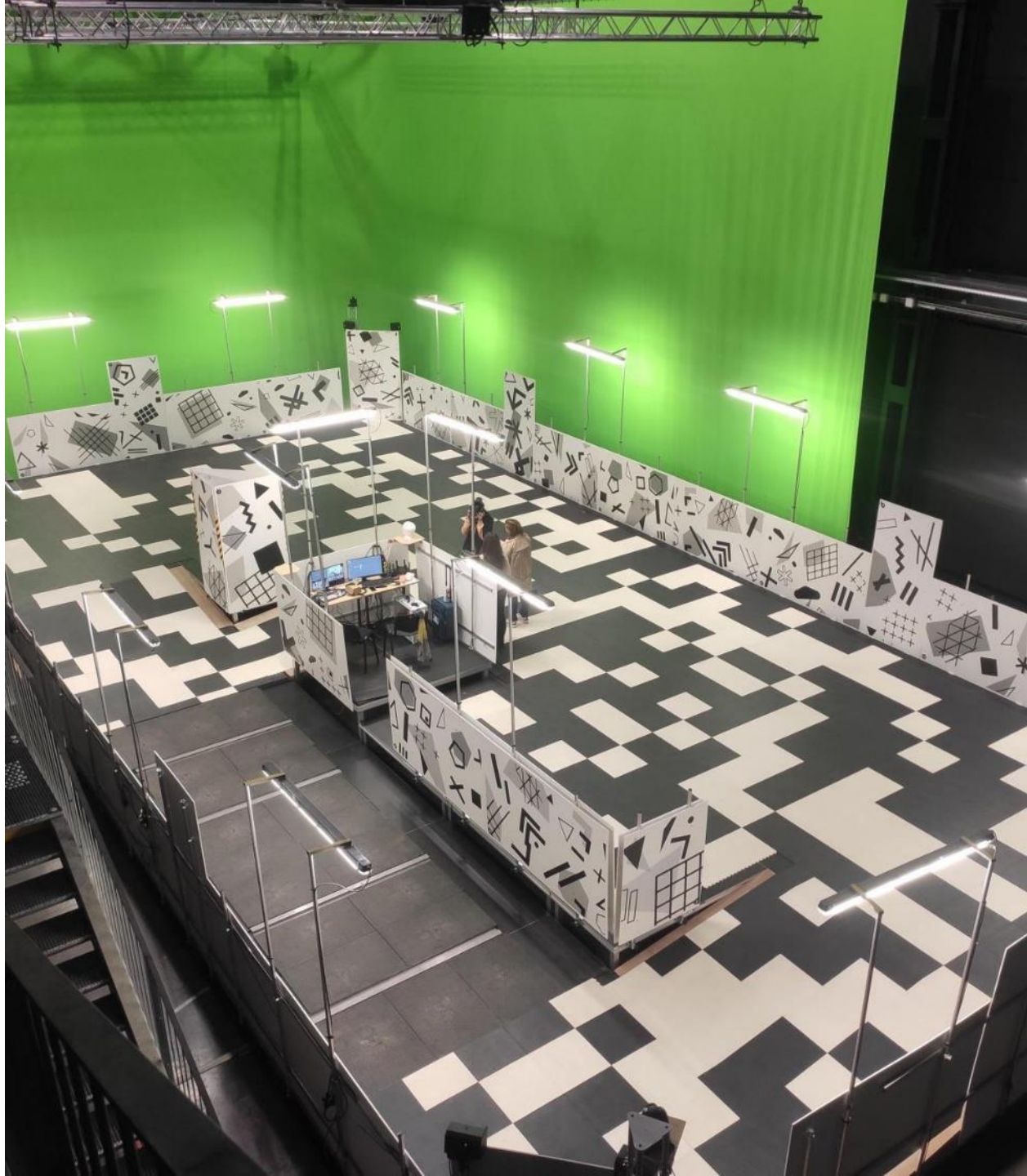
True-to-scale (1:1)

Detailed station features, train movements

Synchronised with the physical environment

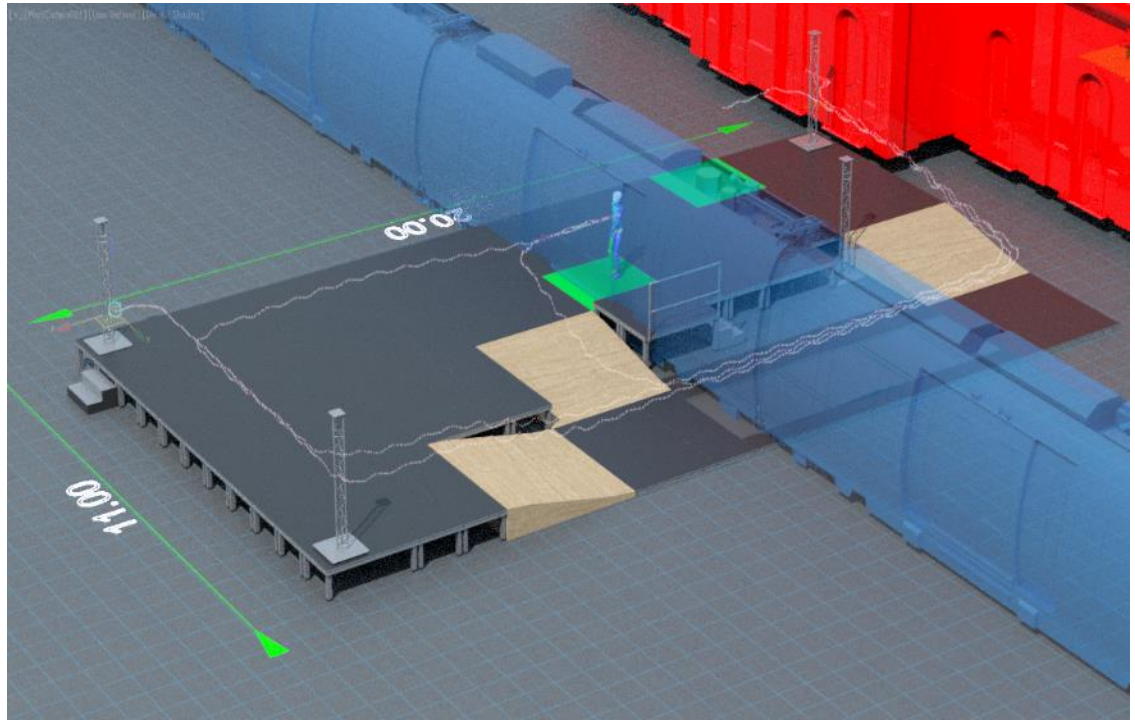
Behavioural and physiological data (gaze behaviour)

Kinematics (accelerations, decelerations, head movements)



Mixed-reality

Virtual and physical environment are synchronised to propose realistic scenarios



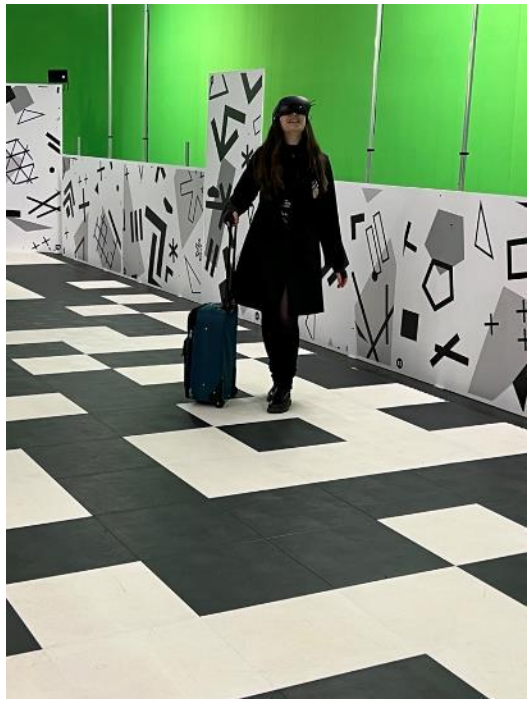
General principles of the behavioural studies

Immersive scenario

Moving around the train station

Evaluation of various **services**

Participants **not informed** of the purpose of the study



Risk factors

Distracting elements
music, smartphone or carrying a piece of luggage

Environment
lighting
trains movement
influence of other passengers

Safety systems

Comparison of various **safety systems** with each other and with the baseline (no safety system)

Measures

16 crossings are registered for each participant

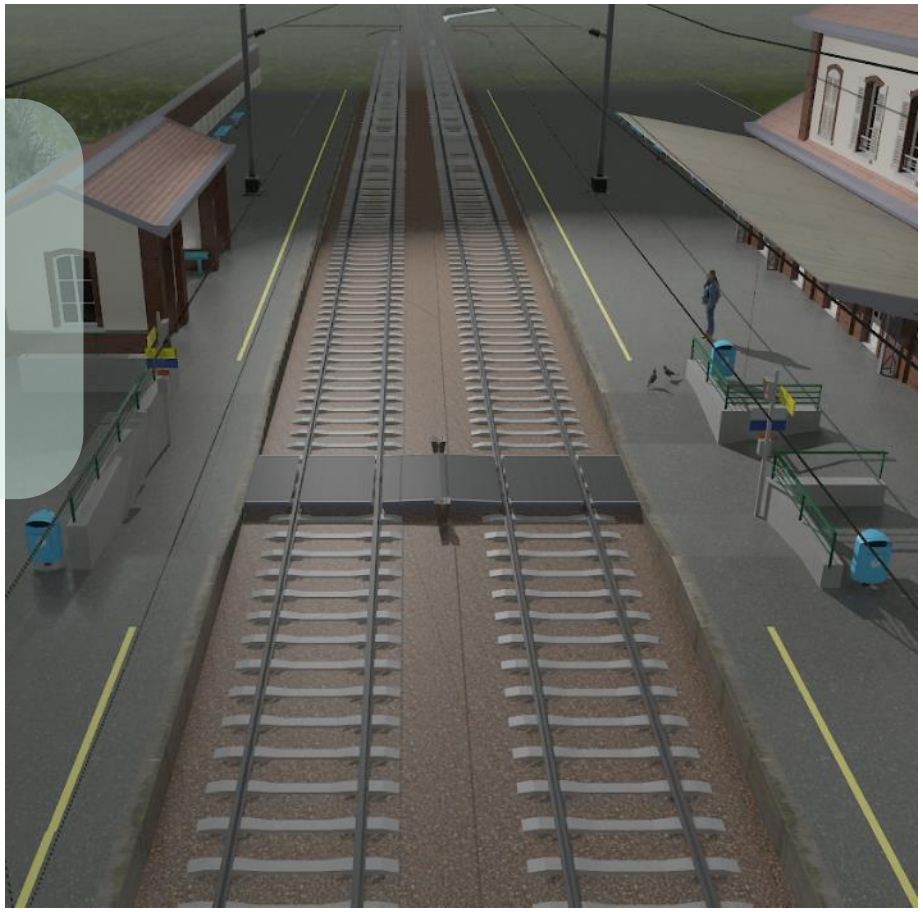
Behaviour, eyes movement and **kinematics** are recorded

Storytelling

Designing a meaningful task without drawing attention to crossings

Context given to the participants

*« In this study, we are interested in travellers' **movement strategies** inside train stations, with an aim of **rating newly available equipment**. The idea is to acquire new knowledge to better understand people's movement strategies in the train station environment and to understand the travellers' potential needs in terms of service and equipment offering. »*



Scenarios

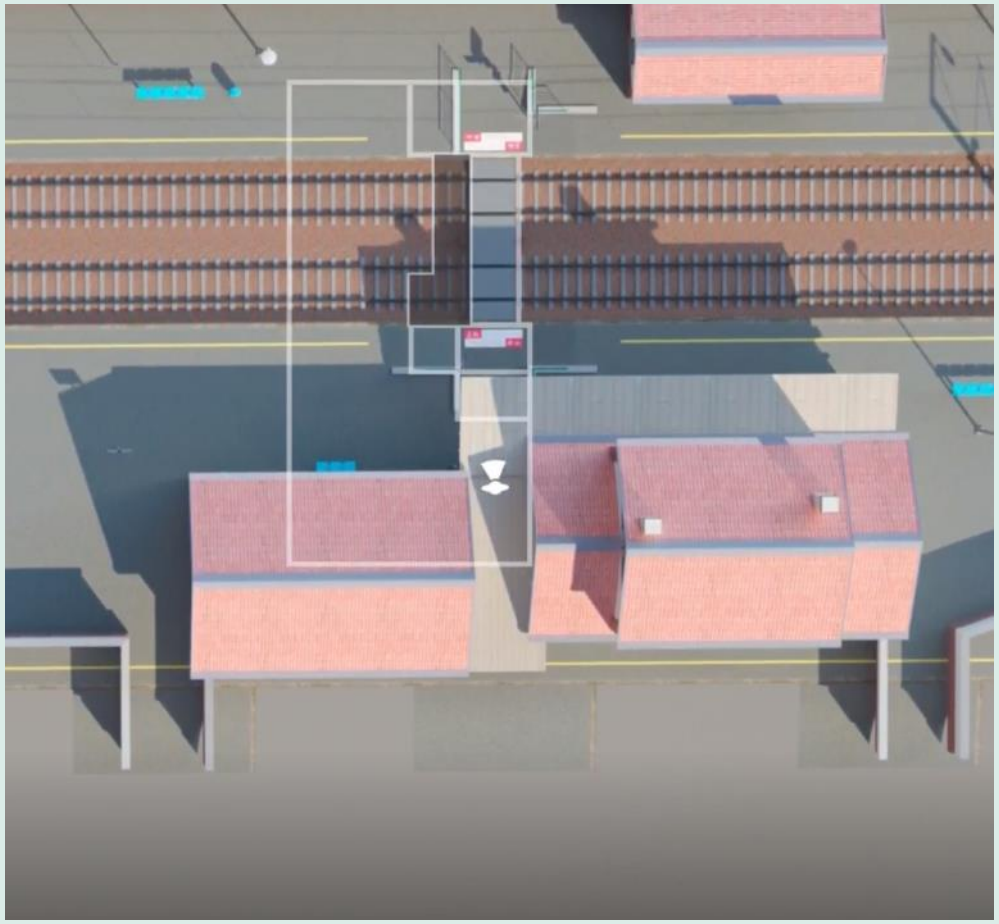
Week-end break

Outward and return journey

Defined goals to achieve in train stations

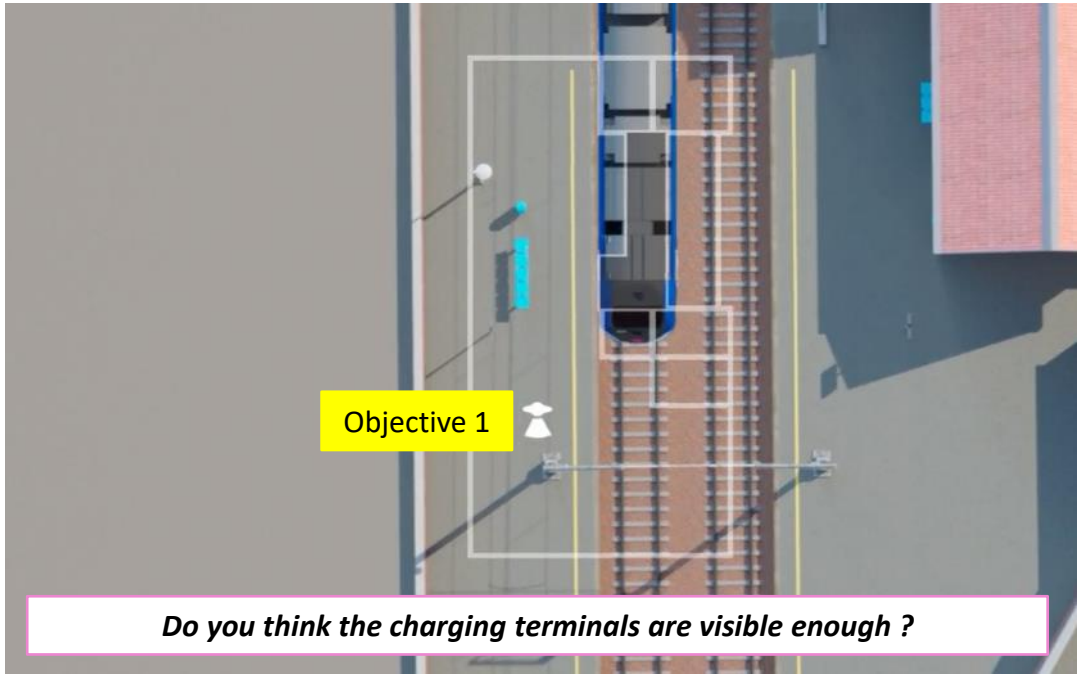
Opinion on new equipment

Goals and movements



Objective 1

Charging terminals *have been installed. Go and have a look to this new piece of equipment on the opposite platform, then give your opinion.*



Dependant variables

Measures

- Walking speed (m/s)
- Time for crossing (ms)
- Number of risky behaviours: collision, acceleration (m/s^2)
- Stopping distance from the PTC edge (cm)
- Eyes movement (fixations and saccades)
- Head orientation (degree)

Three studies

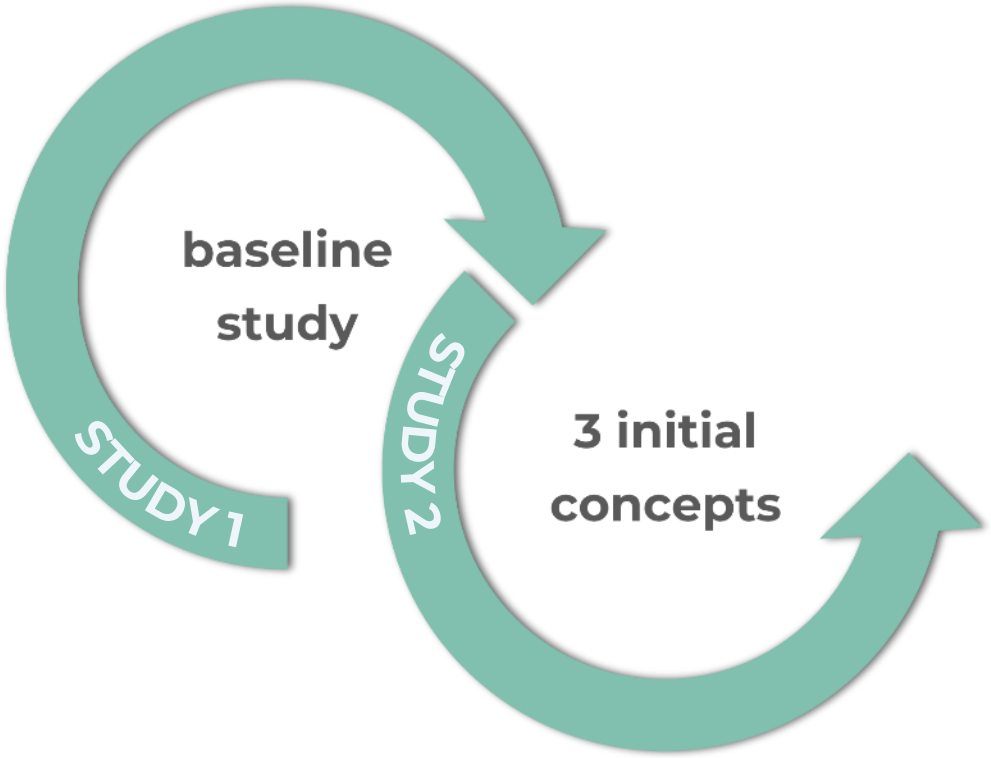
To develop, test, improve new concepts in regard to their effect on behaviour

spring / summer 2024

Three studies

To develop, test, improve new concepts in regard to their effect on behaviour

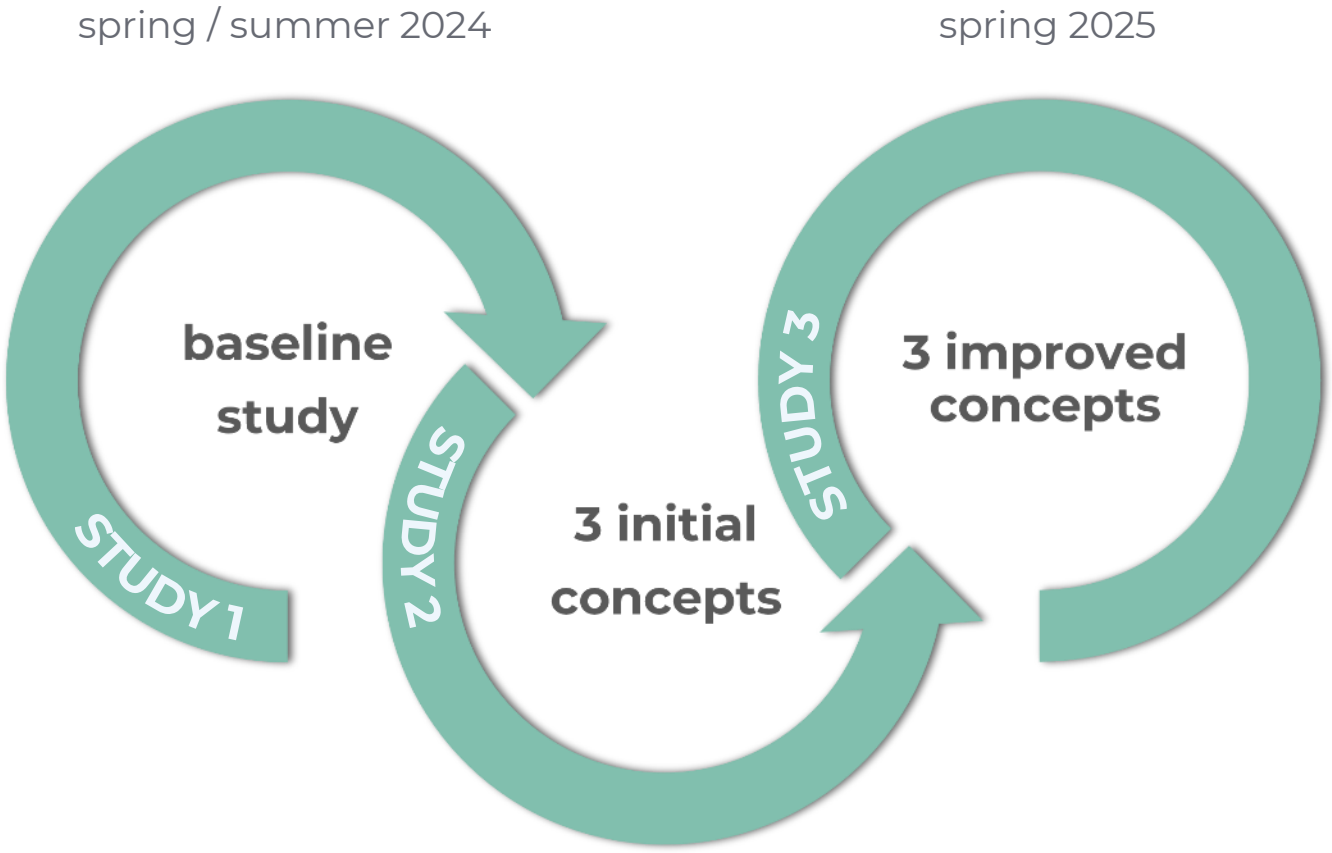
spring / summer 2024



end of 2024

Three studies

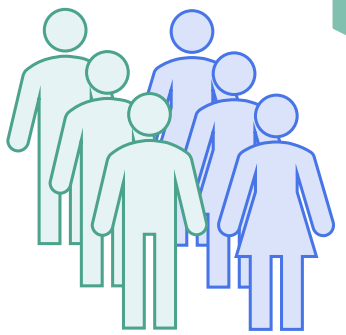
To develop, test, improve new concepts in regard to their effect on behaviour



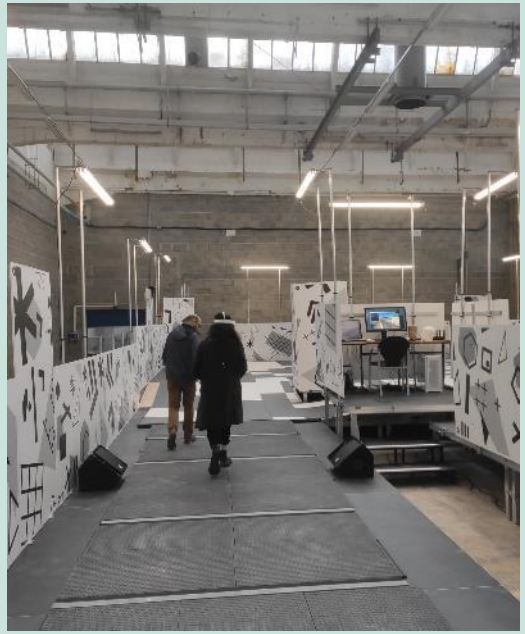
100 participants / study

Participants in Study 1

Inclusion criteria



- N = 100 50% women / men
- Fluent French speakers
- 18 to 60 y.o.
- Normal or corrected vision
- Normal walking (with no aid)
- No virtual reality sickness



Factors analysed in Study 1

3 main factors

Safety system

Current system

No system (Baseline)

Trains movement

Stopping train

Passing train

Second passing train

No train

Distraction

Visuo-cognitive task

Auditivo-cognitive task

Motor task

No distraction

1 additionnal factor

PTC location

At the middle of the platform

At the end of the platform

Distracting elements

Recreate the effect of headphones, smartphone or luggage carrying

Visuo-cognitive task
Counting target words

Auditivo-cognitive task
Counting target words

Motor task
Carrying a piece of luggage

No distraction

Questionnaires

Demographics and travelling habits

Socio-demographic data (age, sex)

Travelling habits (mean of transport, use frequency, walking frequency, driving licence)

Pedestrian Behavior Scale (self-evaluation)

Pedestrian Behavior Scale (PBS) (Moyana Diaz, 1997) : evaluating behaviour relative to violations (11), errors (4) and lapses (2)

French version used (Granié et al., 2013)

Safety systems evaluation

Collection of subjective and qualitative information about the safety systems encountered at PTC to complete quantitative behavioural data already collected

Movement in a virtual environment set to evaluate safety systems

Collection of participants' feelings (immersion, difficulties, potential strategies) while moving around in the VR environment

Experimental sessions

Example of an experimental session

Conclusion

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The cognitive approach help us to

Develop a model of human behaviour at PTC, based on a scientific method.

Understand and **characterise the impact of risk factors on behaviour** (distraction, weather conditions, train movements).

Develop new behavioural indicators for the evaluation of safety systems, including not only risky crossings but also gaze behaviour patterns, body movements, etc.

Integrate behaviour, just like other technical indicators, **in strategic matrixes to help decision makers in the selection of safety systems** for future industrial developments.

Thank you for your attention

CONTACT

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COMMISSION FOR RAILWAY REGULATION

User Worked Level Crossings :
A Human Factors Problem !

ERA HOF Conference

22-23 October 2024

Anthony Byrne, NSA Ireland

Level crossings in Ireland

The User Worked Level crossing

This type of level crossing poses the greatest risk to railway safety

Why?

They are misused, there is no monitoring / supervision, its reliant on a competent user

Passive Level crossings are inherently risky

A Quick Quiz....

? When driving your car across a UWLC how many times do you cross the tracks?

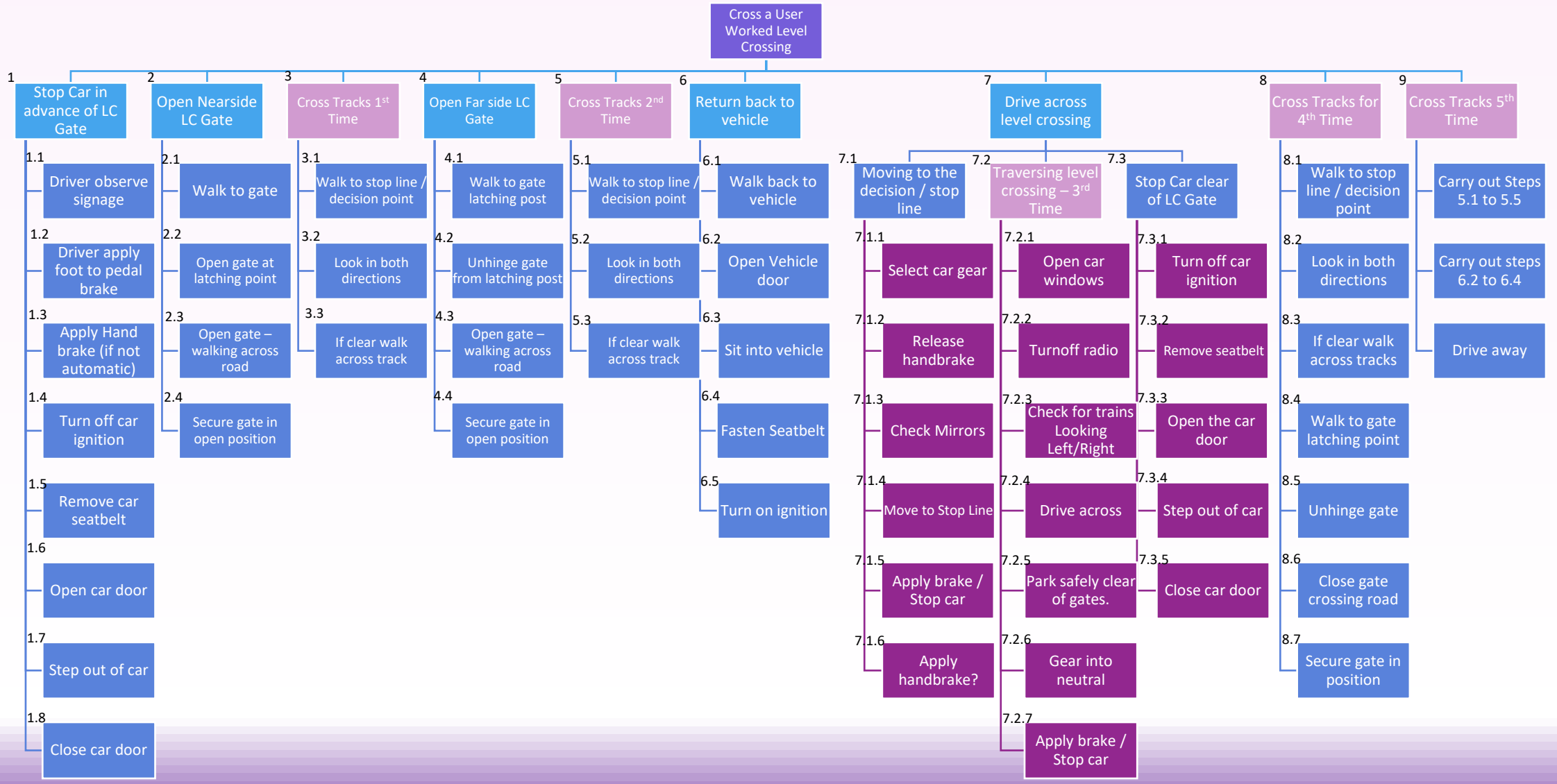
Answer: **5**

? How many discrete actions are involved with crossing a UWLC.

Is it, A: 0-20 actions; B: 21-40, C: Over 40

Answer: **C: It is over 60 discrete actions**

Hierarchical Task Analysis – Crossing a UWLC



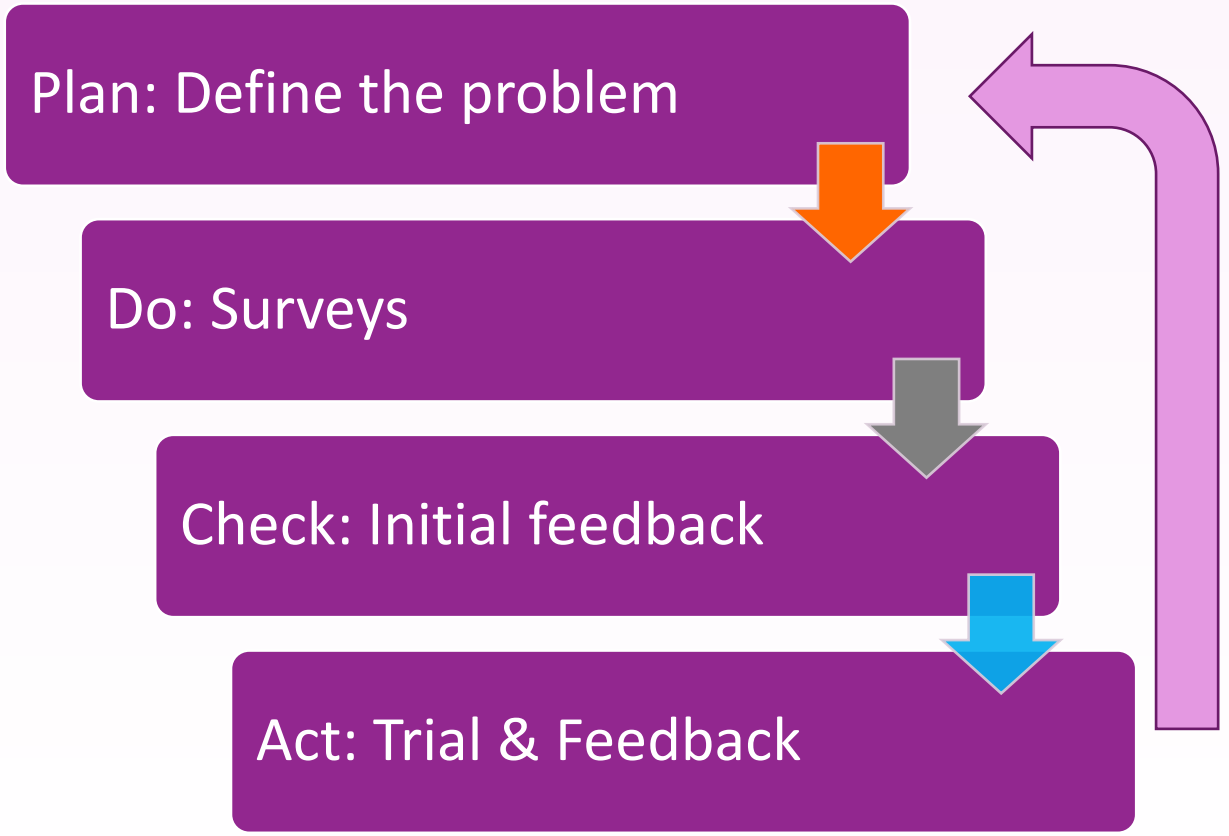
A collision at UWLC No. XM220

NIB Investigation → Findings & Recommendations → Monitoring Implementation

*DoT should **review**, in **consultation with the relevant stakeholders**, their current advance **warning signage** (W 121) with a view changing the signage to make it clear to road users that they are approaching a user operated level crossing. They should also consider the **introduction of other traffic calming measures** in efforts to encourage safe road user behaviour. Care should be taken not to inadvertently introduce new risks as a result of their proposed measures.*

Actions Taken

- Working Group established by DoT
  - DoT – Various divisions (Rail and Road)
  - Commission for Railway Regulation (CRR),
  - Iarnród Éireann – Infrastructure Manager
- Numerous Meetings held
- On-site meetings undertaken
- Site surveys conducted
- Liaised with Road Safety Authority
- Optioneering undertaken



Level crossing signage review

Sign: W121

Sign: Options

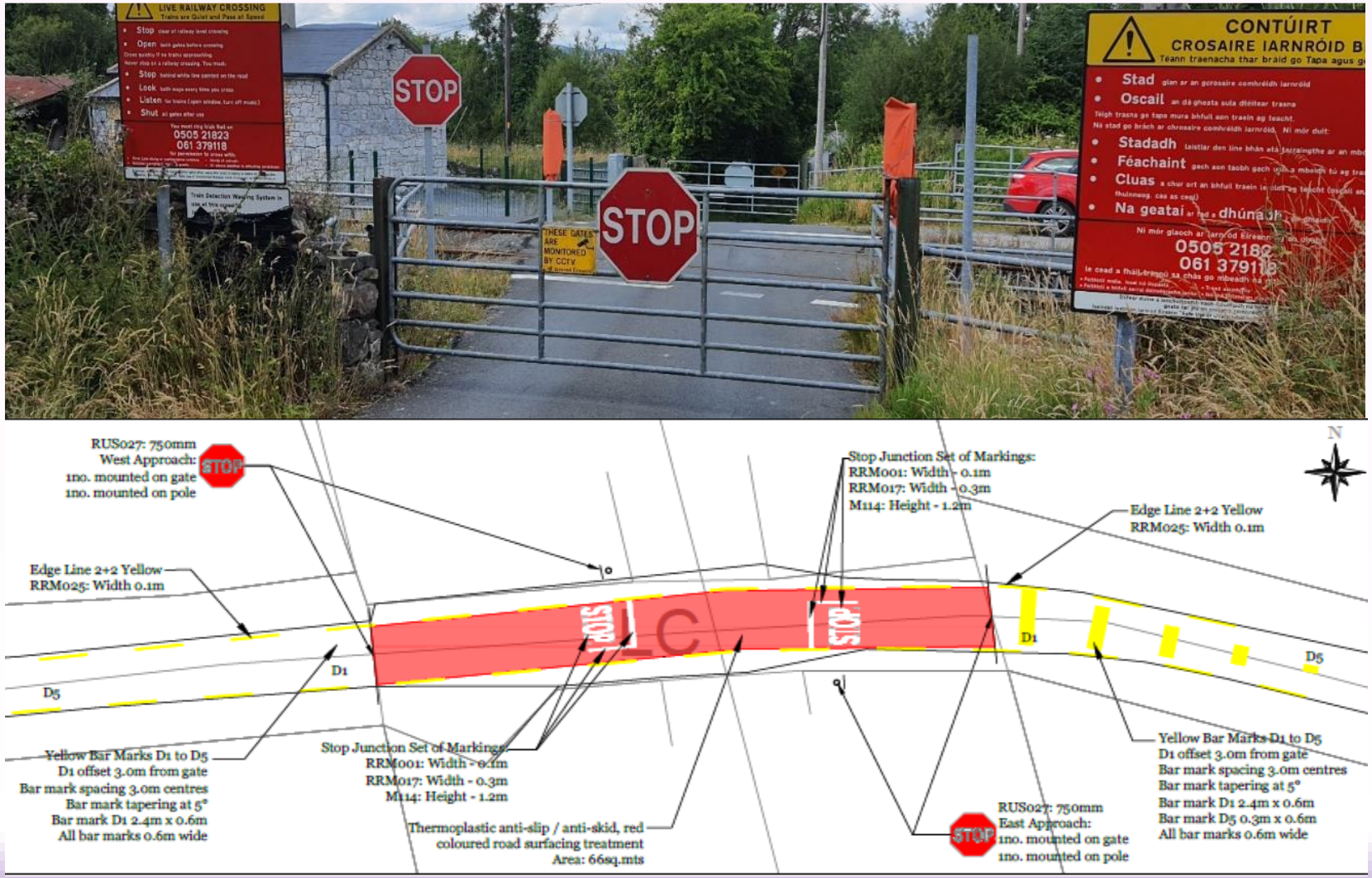
Sign: Post review

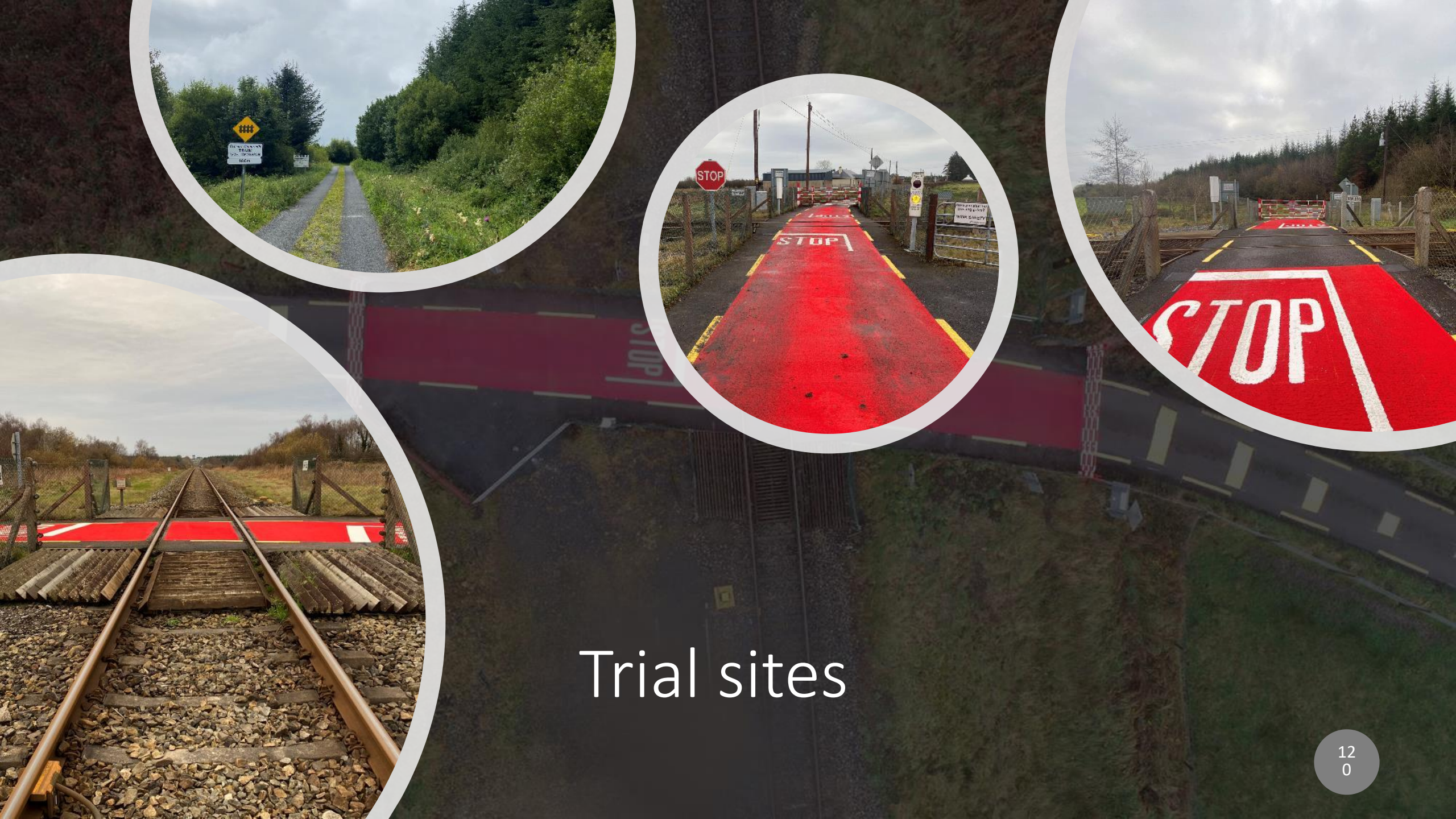
Level crossing traffic calming measures review

Options considered

Road surface treatments

So what's being trialled?





Trial sites

Trial Feedback & Next Steps

Trial sites visited and <100 users questioned on the enhancements
4 out of 5 identified the changes as being positive and said it made them slow down
Some users still felt if the level crossing was illuminated at night it would be better

Broadly positive in particular the painted gates but mixed views on the red surface in-between the track

IM to rollout to all other OP crossings over next 3 years however will trial a different warning sign on next 3 UWLCs.

Traffic signs manual to be updated on next review

Thank You.

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Panel Discussion

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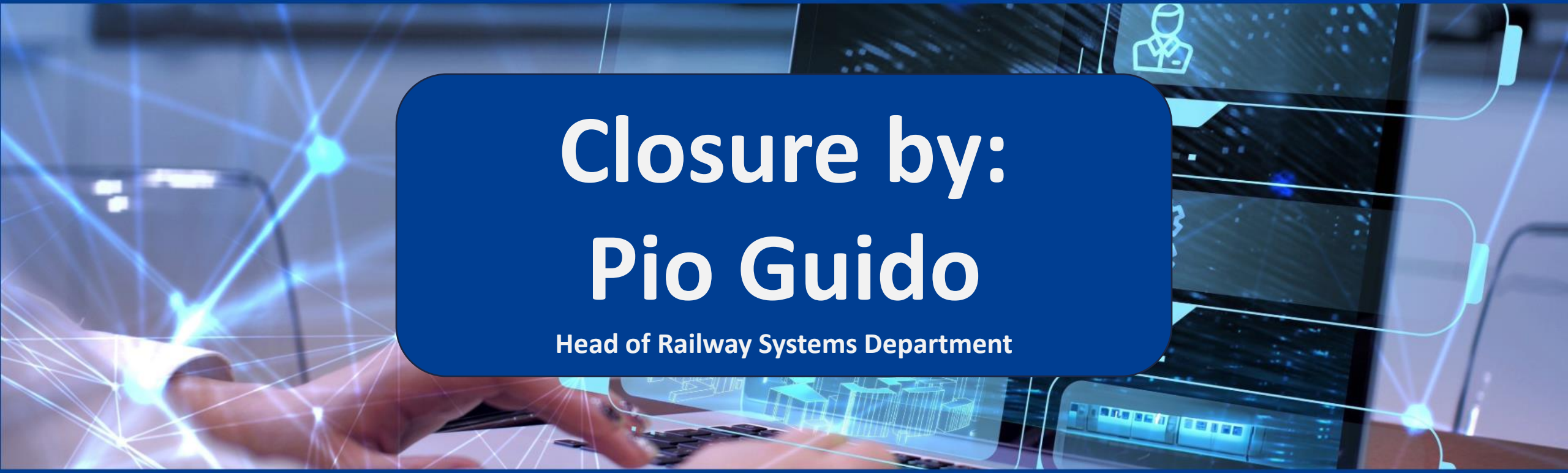

Closure by:
Pio Guido

Head of Railway Systems Department

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ERA support to Railway stakeholders

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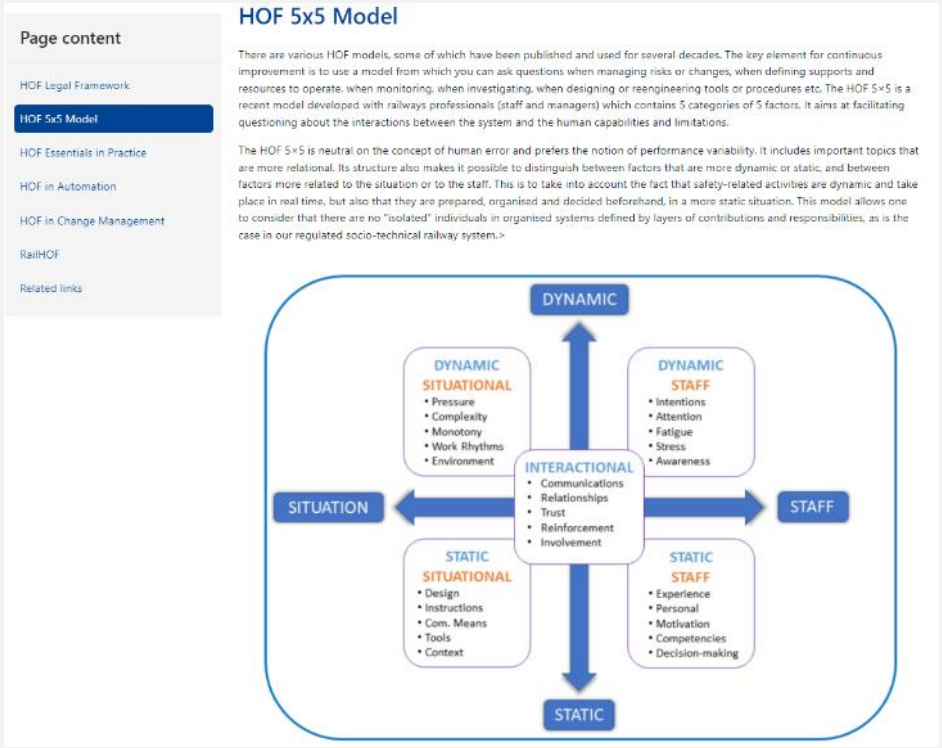

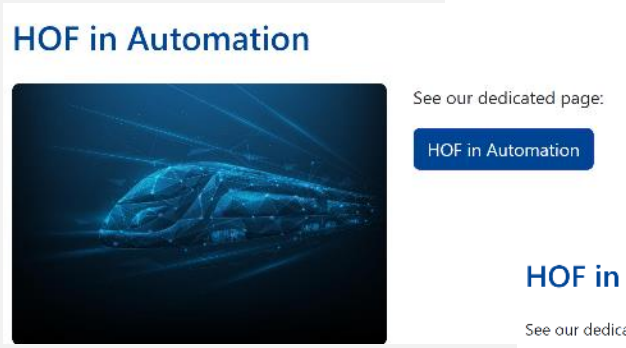

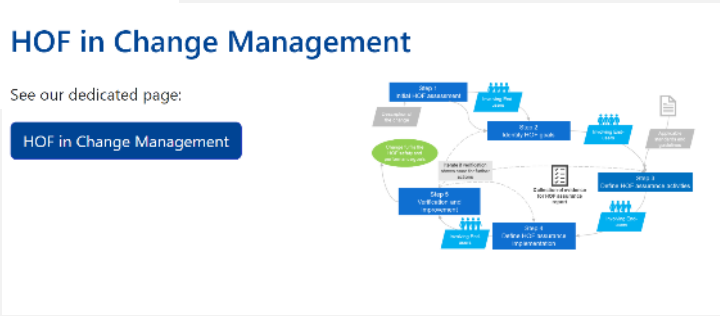

Do not hesitate to contact us:

HOF@era.europa.eu

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Next HOF in SMS Training

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Home > Event > HOF in SMS Training - March 2025

HOF in SMS Training - March 2025

Published: 04 October 2024 **Updated:** 16 October 2024

The Agency is organising a HOF in SMS training open to rail professionals and safety specialists. Register now!

Event

Page content

Date Tuesday 25 March 2025, 09:00 - Thursday 27 March 2025, 17:00 (Europe/Brussels)

Location 120 Rue Marc Lefrancq, 59300 Valenciennes, France

The Agency is organising a HOF in SMS training open to rail professionals and safety specialists. The session will be organised at the ERA Headquarters on March 25th to 27th (with an on-line follow-up session on April 10th). Training objectives and a detailed agenda are available below. The training will be conducted in English.

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Human & Organisational Factors (HOF) Conference

Evaluation form

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Thank you!

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