# Integrating TSI OPE (operations), Human & Organisational Factors and Safety Management Systems

## How to do this in practice?

Karen Davies

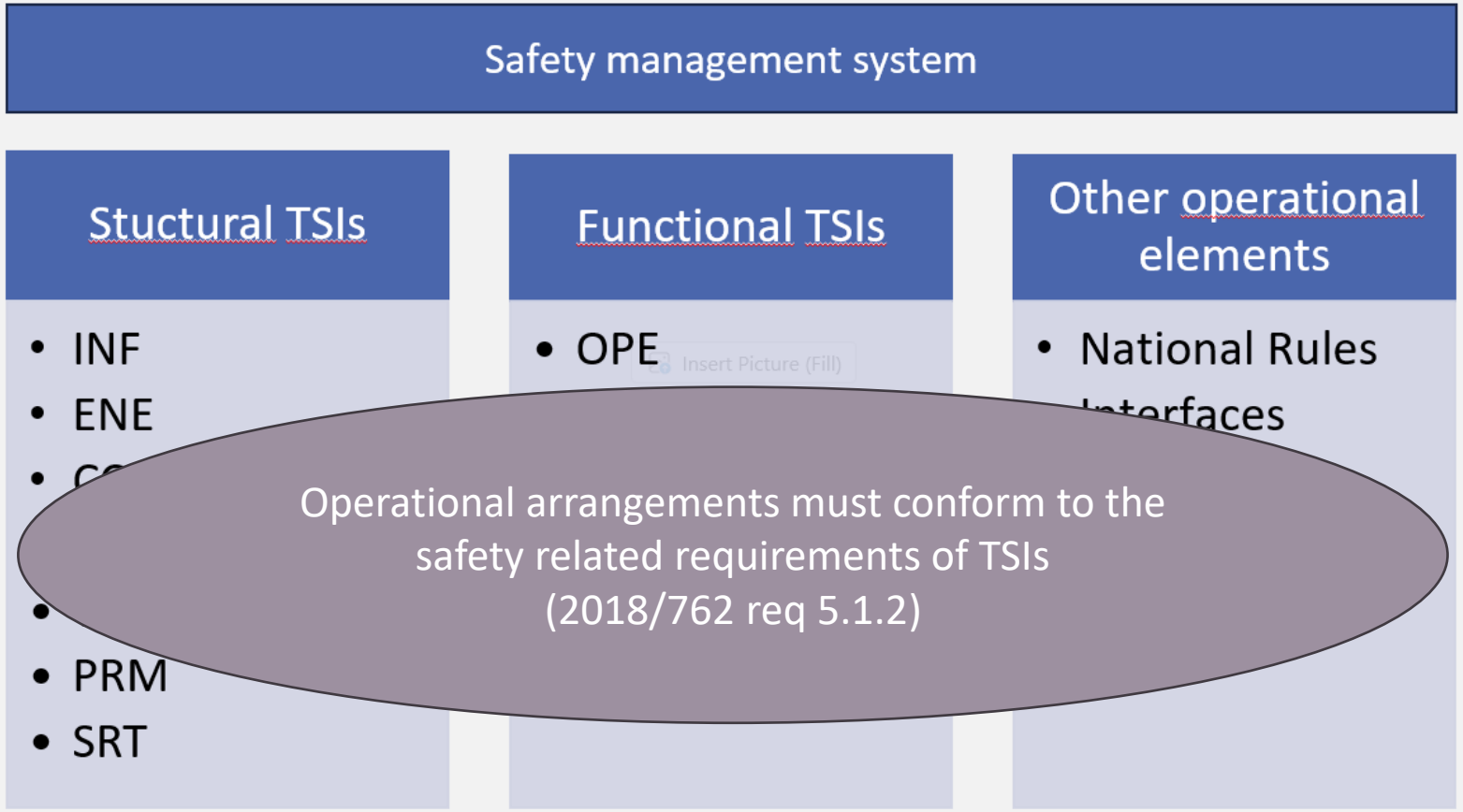
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# Managing Structural and Functional TSIs Through the SMS




**The SMS integrates technical, operational and human factors requirements across the railway system lifecycle.**

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# Railway operation: TSI OPE

- The TSI OPE is the framework for operations
- It is an interface Regulation which is directly applicable to all RUs and IMs.
- This means that the requirements must be applied when developing route and rule books and any other operating instructions.
- These must not contradict the requirements in the TSI which are set at EU level to ensure interoperability.
- The RU or IM may add additional route, risk and operational detail to the requirements based on information from their operational risk assessment, but these must not deviate from the TSI.
- Compliance is assessed through the SMS.

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# What Is Railway Operations?

"Railway operations are the coordinated **processes, rules, decisions and communications** required to plan, prepare, check, execute, monitor and improve train movements and related operational activities, ensuring **safe and coherent operation** of the railway system under normal, degraded and emergency conditions"








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# Risk assessment requirement

***EU Regulation 2018/762 - Articles 3.1.1.1***

3.1.1.1. The organisation shall:




(a) identify and analyse all operational, organisational and technical risks relevant to the type, extent and area of operations carried out by the organisation. Such risks shall include those arising from human and organisational factors such as workload, job design, fatigue or suitability of procedures, and the activities of other interested parties (see 1. Context of the organisation);

(b) evaluate the risks referred to in point (a) by applying appropriate risk assessment methods;

(c) develop and put in place safety measures, with identification of associated responsibilities (see 2.3. Organisational roles, responsibilities, accountabilities and authorities);

(d) develop a system to monitor the effectiveness of safety measures (see 6.1. Monitoring);

(e) recognise the need to collaborate with other interested parties (such as railway undertakings, infrastructure managers, manufacturer, maintenance supplier, entity in charge of maintenance, railway vehicle keeper, service provider and procurement entity), where appropriate, on shared risks and the putting in place of adequate safety measures;

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# Risk Assessment process




- **Risk identification**
  - Spotting the problem
- **Risk analysis**
  - Measuring the problem
  - Understanding the risk and identifying the hazards and what could go wrong
- **Risk evaluation**
  - Judging the problem
  - What is acceptable or not acceptable and how could it be controlled
- **Risk control**
  - Doing something about the problem
  - Removing, reducing or managing the risk (hierarchy of controls)

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# Railway operation: SMS HOF references

***EU Regulation 2018/762 - Articles 5.1.4, 5.1.5 and 5.1.6***

5.1.4. To control the allocation of responsibilities where relevant for the safety of operational activities, the organisation shall identify responsibilities for coordinating and managing the safe running of trains and movements of vehicles and define how relevant tasks affecting the safe delivery of all services are allocated to competent staff within the organisation (see 2.3. Organisational roles, responsibilities, accountabilities and authorities) and to other external qualified parties when appropriate (see 5.3. Contractors, partners and suppliers).

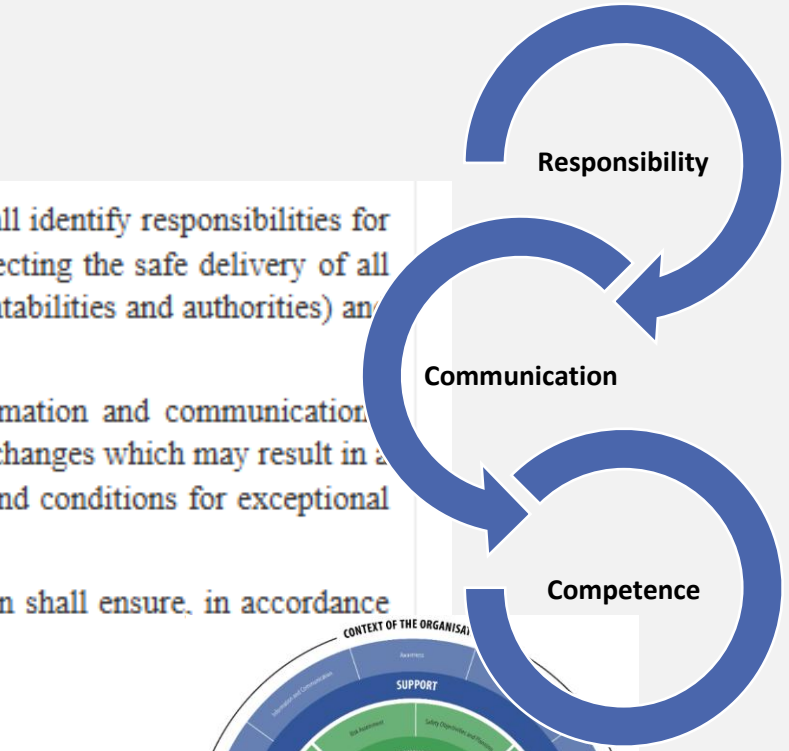
5.1.5. To control information and communication where relevant for the safety of operational activities (see 4.4. Information and communication), relevant staff (e.g. train crews) shall be advised of the details of any specified conditions of travel, including relevant changes which may result in a hazard, temporary or permanent operational restrictions (e.g. due to specific type of vehicles or to specific routes) and conditions for exceptional consignments, where applicable.

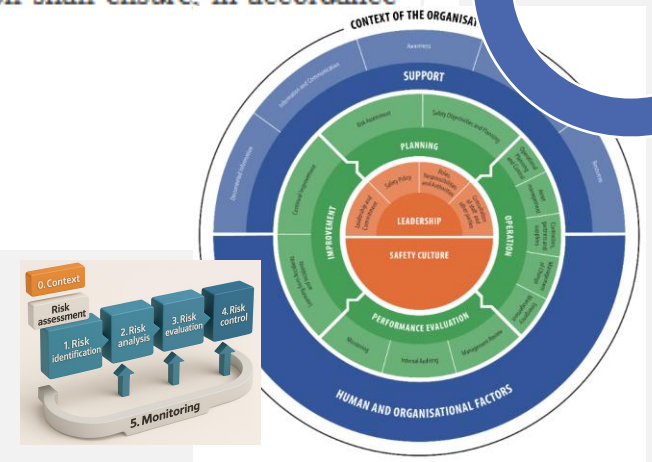
5.1.6. To control competence where relevant for the safety of operational activities (see 4.2. Competence), the organisation shall ensure, in accordance with applicable legislation (see 1. Context of the organisation), for its staff:

(a) compliance with their training and work instructions, and corrective actions are taken where required;

(b) specific training in case of anticipated changes affecting the running of operations or their task assignment;

(c) adoption of adequate measures following accidents and incidents.



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# The need for Operational Rules

- **Safety and Risk** – Controls operational hazards and reduces risk.
- **Interoperability** – Enables safe operation across networks, organisations and countries.
- **Consistency** – Promotes standardised operational practice.
- **Compliance** – Ensures conformity with regulatory requirements.



RU Rule book

IM Rule book



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# From Risk Assessment to Operational Rules




- **Risk Assessment** – Operational rules should be based on identified hazards and the control measures needed to manage operational risks.
- **Human Performance** – information from the RA should reflect how work is actually performed and take account of human capabilities and limitations.
- **Practical Application** – HOF helps ensure rules are clear, usable and can be applied effectively under operational pressures.
- **Error Prevention** – Well-designed rules reduce the likelihood of human error and support safe decision-making.
  - Operational rules also cover communication
- **Continuous Improvement** – Rules should be reviewed following operational experience, incidents, changes and feedback from staff.
  - Rules should become dynamic safety controls within the SMS
    - Continuous cycle: identify → assess → implement → monitor → improve
      - Outdated rules are a risk themselves

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# Operational risk assessment




## SPAD Risk Factors

Signal Passed at Danger (SPAD)

### Contributing Factors

**Human Factors**
Fatigue, Distraction, Miscommunication

**Technical Factors**
Brake Issues, Equipment Failure

**Operational Factors**
Complex Procedures, Poor Planning

**SPAD**
Signal Passed at Danger

### Consequences

**Collision Risk**
Train Collision, Derailment

**Damage & Delays**
Infrastructure Damage, Service Disruption

**Injury & Safety Impact**
Crew or Passenger Injuries

### RISK MITIGATION

Training & Procedures → Technical Safeguards → Effective Communication

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# Hierarchy of Risk control

Most effective

Eliminate

Substitute

Engineer control

Administrative Controls

PPE

Rely on organisation

Rely on humans

Rules

Least effective





Sidney Dekker, risk and people on the field

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# Railway operations: responsibilities

## Roles, Responsibilities and Operational Behaviour

**Safe operations depend on competent staff able to apply rules and instructions correctly under all conditions.**

### 🎯 Objective

Specifies the **roles, required behaviour, and responsibilities of operational staff**.

### 🧩 Core Elements

- **Defined operational roles**
  - Train drivers
  - Signallers / traffic controllers
  - Ground staff

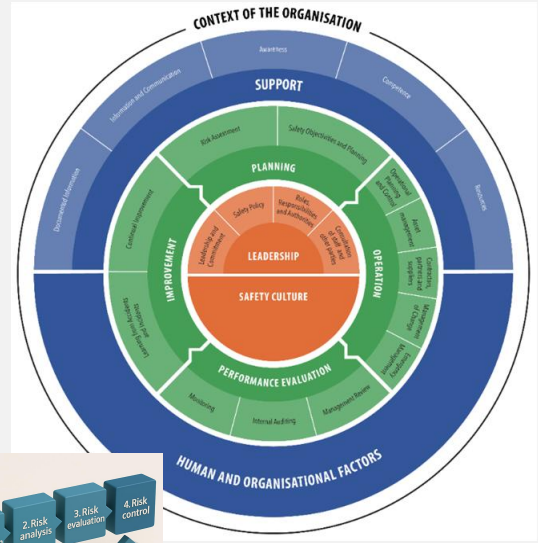
- **Accountability**
  - Each actor is responsible for **actions within their competence**.



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# Railway operations: staff

- **Professional behaviour**
  - Staff must:
    - Act with **vigilance and situational awareness**
    - Apply a **safety-first mindset**
    - React appropriately to abnormal situations
- **Decision making**
  - Based on:
    - Rules and procedures
    - Real-time operational conditions
- **Human factors**
  - Importance of:
    - Concentration
    - Fatigue management
    - Communication discipline



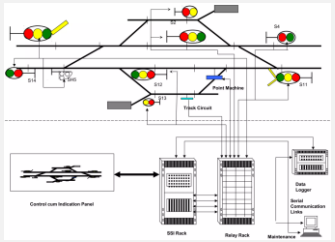



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# What Is Operational Communication?

- Exchange of instructions, warnings, confirmations

- Includes both on board systems and radio and direct driver to signaller instructions



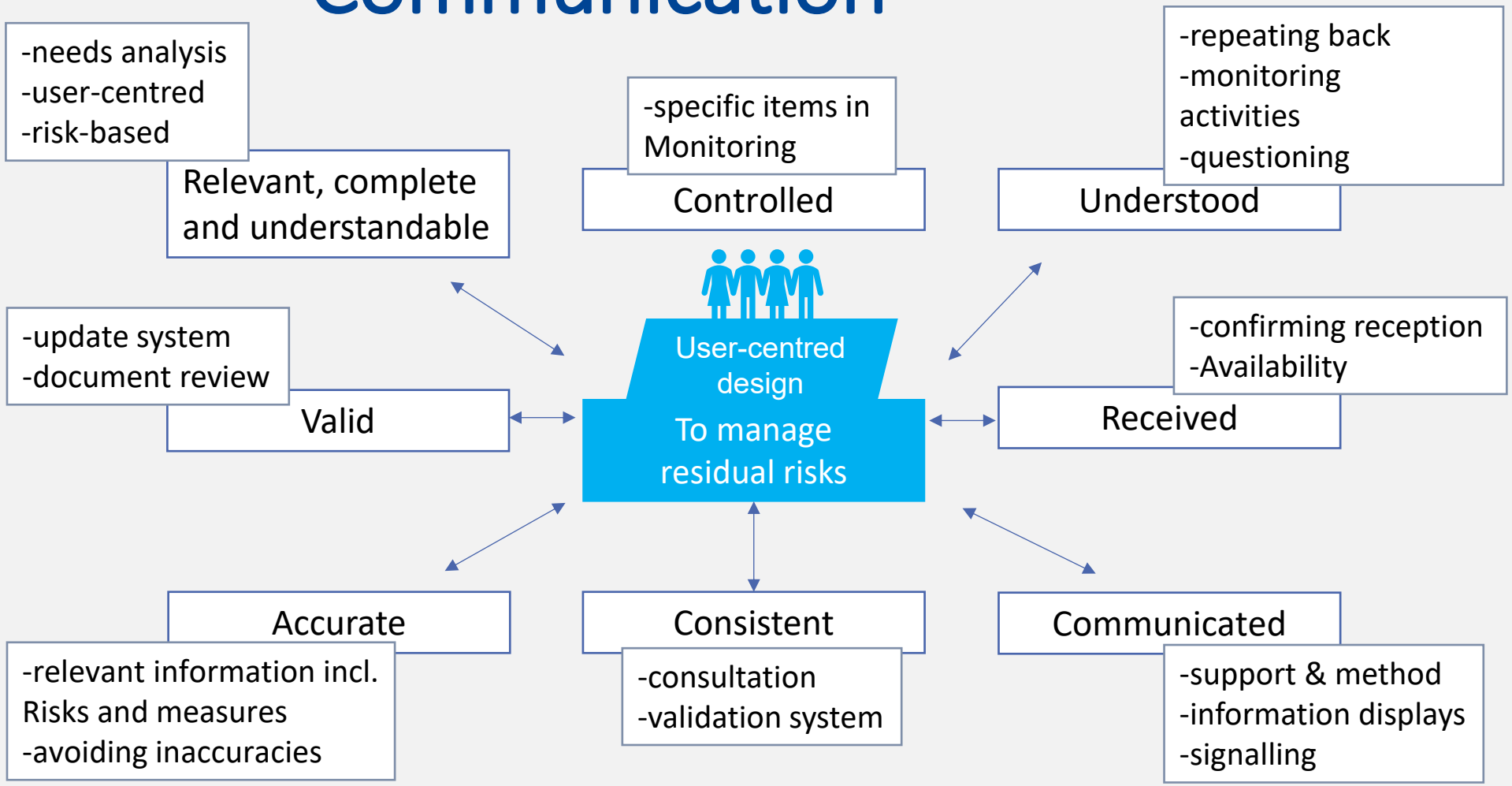
- Critical for safe train movement

- TSI OPE:
  - Rule and route book
  - Appendix C



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# Focus on Safety Information and Communication




Normal | Degraded | Emergency | Instructions | Shift communications | Change to procedures | ...

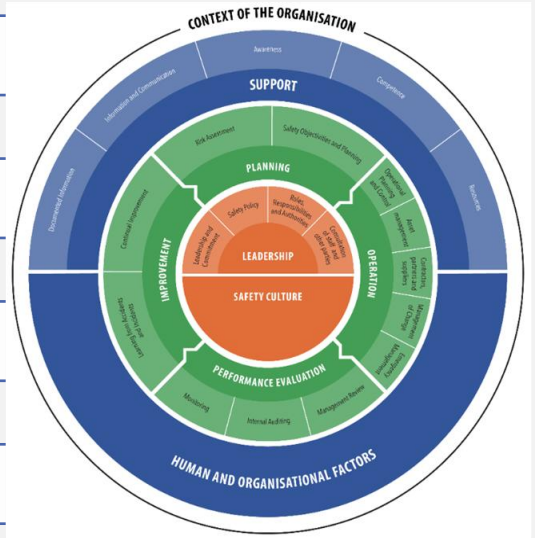
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# Railway operations: competence

## SMS Competence management system




- Identify and anlalyse tasks (including HoF)
- Select staff (including HoF)
- Train and provide instructions (including HoF)
- Check and maintain (including HoF)




**Operational rules**
Who is the instruction for and what should they do?

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# Railway operation: competence

SMS process

RU Rule book

Driver competence – signal aspects/indication, route and operational rules knowledge including degraded and emergencies etc

SMS process

IM Rule book

Signaller competence – signalling systems/ATP/train movements, degraded operation and emergencies. IM and operating and interface rules

## Why are NTS important?

Reviews of incidents and accidents in the industry have shown consistently that where NTS are lacking, the ability to prevent and mitigate errors is compromised, and so contributes to incidents taking place. NTS have been a key focus in other safety critical industries for many years. By taking a proactive approach to NTS development, and integrating NTS into competence management systems and training programmes, it is expected that safety will improve.

## Non-technical skills list

| | NTS Category | NTS Skill |
|---|---|---|
| 1 | Situational awareness | Attention to detail |
| | | Overall awareness |
| | | Maintain concentration |
| | | Retain information (during shift) |
| | | Anticipation of risk |
| 2 | Conscientiousness | Systematic and thorough approach |
| | | Checking |
| | | Positive attitude towards rules and procedures |
| 3 | Communication | Listening (people not stimuli) |
| | | Clarity |
| | | Assertiveness |
| | | Sharing information |
| 4 | Decision making and action | Effective decisions |
| | | Timely decisions |
| | | Diagnosing and solving problems |
| 5 | Cooperation and working with others | Considering others' needs |
| | | Supporting others |
| | | Treating others with respect |
| | | Dealing with conflict / aggressive behaviour |
| 6 | Workload management | Multi-tasking and selective attention |
| | | Prioritising |
| | | Calm under pressure |
| 7 | Self-management | Motivation |
| | | Confidence and initiative |
| | | Maintain and develop skills and knowledge |
| | | Prepared and organised |

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# Railway operations: safety and HOF

## Interface between technical systems and people






### Safety emerges from interaction, not from one component alone

| | |
|---|---|
| People | Capabilities, limitations, competence, fatigue and teamwork |
| Technology | Controls, indications, alarms, radio, automation and failure modes |
| Task & procedure | Sequence, complexity, timing, exceptions and usability |
| Environment | Layout, visibility, weather, noise and simultaneous activity |
| Organisation | Resources, planning, interfaces, supervision and safety culture |

**ASSESS THE INTERFACES: information • control • feedback • recovery**

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# Train operation lifecycle











Planning

Train preparation

Train operation

TSI OPE

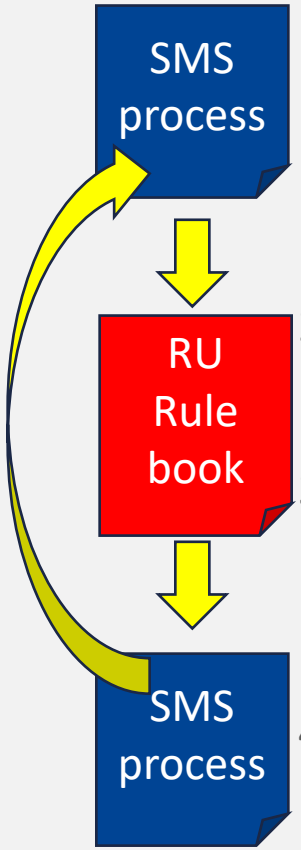
Degraded operation

Monitoring

Learning and improvement

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# Train operation: four stages




1. Train planning before the train commencing operation which includes the route capability check, information from RINF and IM and ERATV, technical and local inspections. Any exceptional transport requirements
2. Preparing the train for operation which includes train composition, train preparation, tests and checks before departure and data entry.
3. Executing the operation which should cover all aspects of normal and degraded operation and emergency planning, evacuation and dealing with the actual situation. **WHO AND WHAT?**
4. Reporting any issues, defects or problems after operation, specifically learning lessons, investigating and ensuring that the problem does not occur again.

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# Train operation and HOF

RU Rule book

SMS process HOF

Preparing the train for operation which includes train composition, train preparation, tests and checks before departure and data entry.

Executing the operation which should cover all aspects of normal and degraded operation and emergency planning, evacuation and dealing with the actual situation. **WHO AND WHAT?**

- Competence management
- Task Design and Task Analysis
- Procedures and Documentation
- Human machine interface
- Communication and co/ordination
- Working environment
- Error management

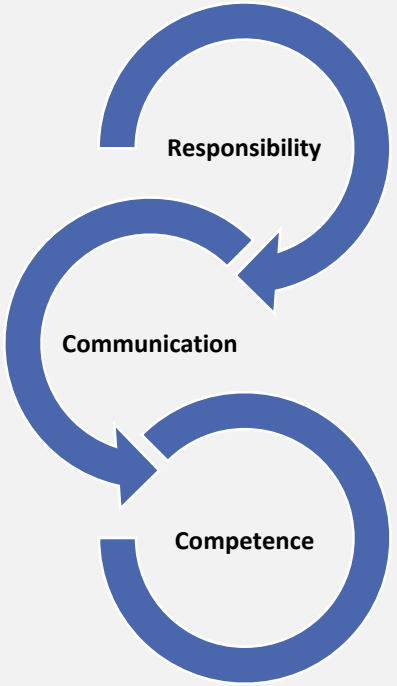
- NTS (situational awareness/decision making/communication and team work)
- Workload and Stress management
- Emergency preparedness and response
- Management of degraded operations

- Competence who? – train driver, signaller, onboard staff, train preparer etc

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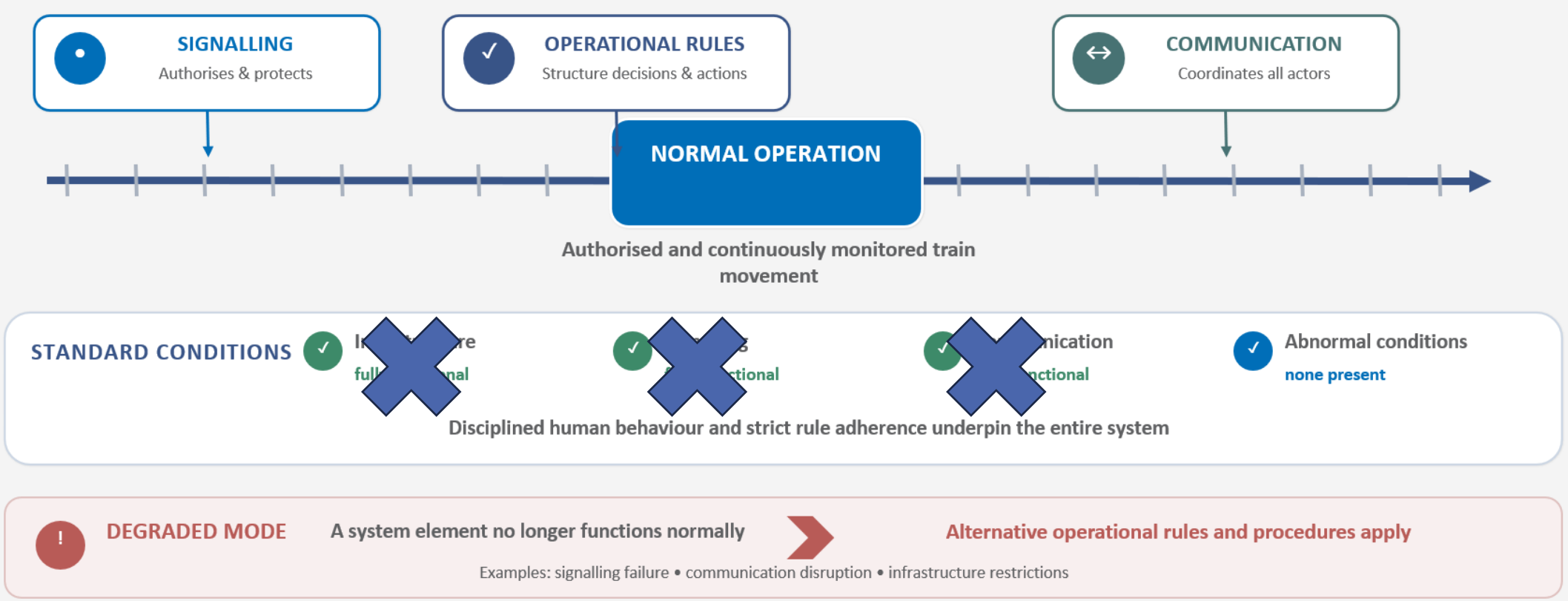
# Railway operations: normal, degraded and emergency

| | |
|---|---|
| Normal conditions including operations | Planned operation that provides the normal delivery of train services |
| Degraded conditions including operations | Operation resulting from an unplanned event that prevents the normal delivery of train services. Abnormal but controlled by system and competent staff |
| Emergency conditions including operations | An unplanned event that prevents or stops the normal delivery of train services and requires urgent actions |



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# Railway operations: scenerio



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# Railway operations: integrating HOF

**Normal conditions including operations**

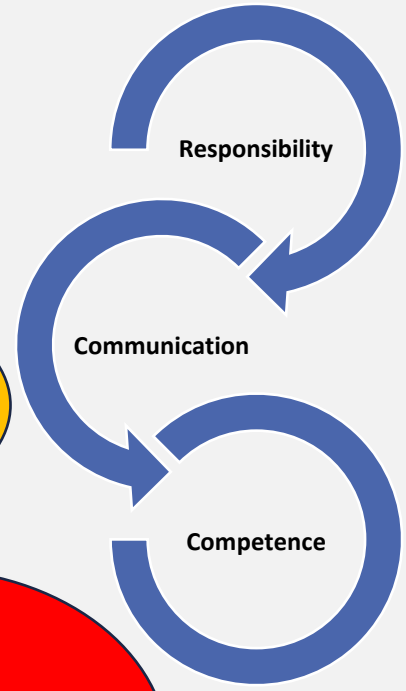
Tasks are defined and sequential
Roles and interfaces are understood
Communication is standardised
Workload is managed

**Degraded conditions including operations**

Detection, diagnosis and actions
Clear procedures including decision making requirements are defined
Communication channels and escalation are clear
Co-ordination with control/other roles is defined

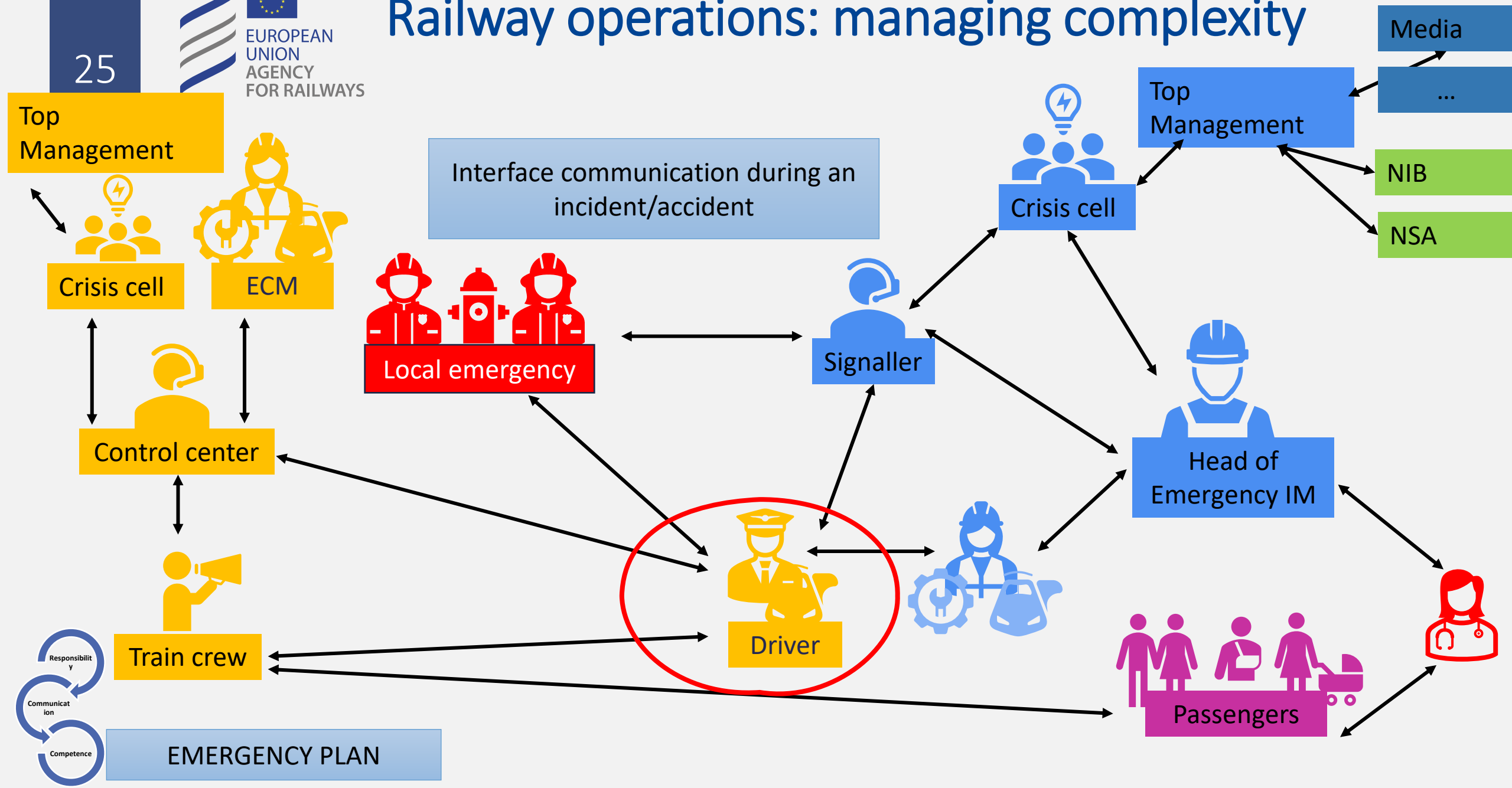
**Emergency conditions including operations**

Immediate actions are simple and unambiguous
Roles and responsibilities are clearly defined
Communication is prioritised and is robust
Interfaces with emergency services is defined
Stress and human performance are considered
Post incident actions are defined



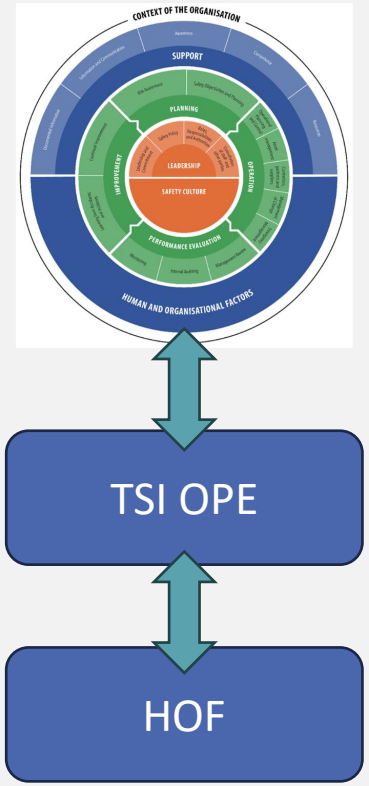
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# Railway operations: managing complexity



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# Railway operations: managing complexity




🧠 **Situational Awareness**

- Ensure staff understand what is happening, where, and the potential consequences.
- Provide timely and reliable information.

🗣️ **Communication**

- Use clear, concise and unambiguous communication.
- Reduce the risk of misunderstandings between operational actors.

👥 **Roles and Responsibilities**

- Clearly define who does what during an emergency.
- Avoid uncertainty, duplication or gaps in response actions.

📋 **Decision-Making Under Pressure**

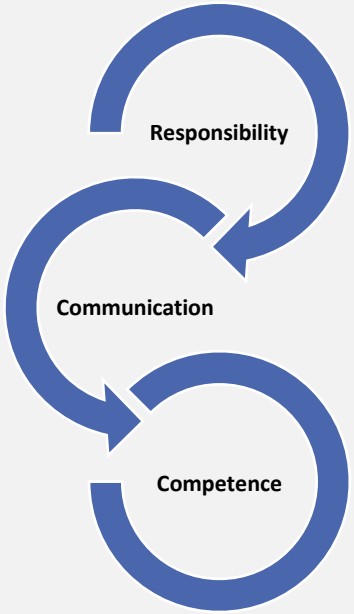
- Procedures should support rapid and effective decisions.
- Allow staff to adapt safely to unexpected circumstances.

🤝 **Coordination Across Interfaces**

- Effective cooperation between IMs, RUs, emergency services and contractors.
- Shared understanding of priorities and actions.

🔄 **Learning and Improvement**

- Capture lessons from exercises, incidents and real emergencies.
- Use feedback to improve preparedness and resilience.



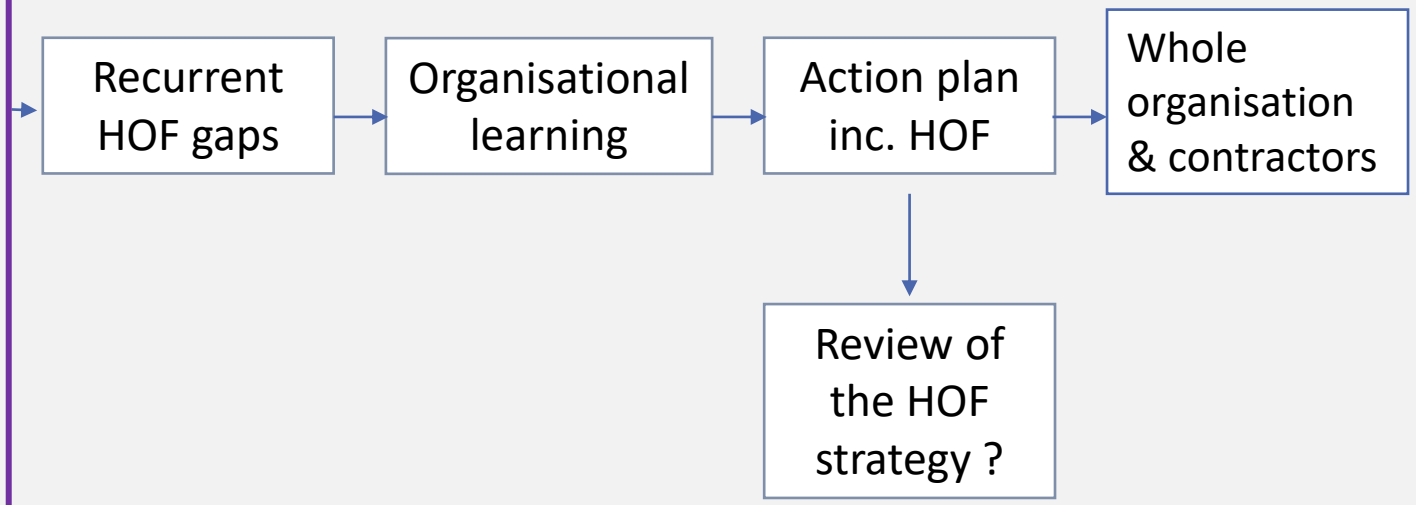
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# Railway operations: monitoring and integrating HOF

**Example of items to be integrated**:

- HOF corrective action plans
- Human performance indicators
- Staff competencies
- Staff non-technical skills/behaviours/attitudes
- Staff awareness
- Safety communications
- Information from operational data including defects
- HOF in incident and accident analysis
- Information from operational data including defects
- HOF in relevant internal and external operating experience
- Staff adherence to procedures
- Use of new equipment/tools
- Application and review of procedures integrating HOF in operational safety …

Specific HOF competencies (CMS)






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# Summary

1. **Safe operations are achieved through the integration of TSI OPE, the SMS and Human & Organisational Factors (HOF).**
   - None of these elements work effectively in isolation.
2. **Rules and procedures are necessary but do not guarantee safety alone.**
   - Understanding how people actually perform work in operational environments is essential.
3. **A mature SMS must actively manage human and organisational performance and take into account operational safety.**
   - Competence, communication, decision-making, workload, leadership, learning and improving all influence safety outcomes.
4. **TSI OPE provides the operational framework, but HOF helps ensure it works in practice.**
   - Effective implementation depends on designing systems that support people to perform safely and reliably.
5. **Continual improvement requires learning, monitoring and adaptation.**
   - Safety is maintained by understanding risks, monitoring performance, learning from experience and managing changing operational environment proactively.

# THANK YOU

Moving Europe towards a sustainable and safe railway system without frontiers.




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