

SAFETY CULTURE AND HUMAN ORGANIZATIONAL FACTORS IN THE ITALIAN RAILWAY NETWORK: A SURVEY AS A TOOL FOR MONITORING AND IMPLEMENTING THE AUDITING PROCESS

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1. BACKGROUND

The role that human and organizational factors (HOF) and safety culture (SC) play in the processes of improving both safety levels and the well-being of workers in the various work environments is increasing in many high-risk sectors including railways, in accordance with legislation. At the European level, the 4th Railway Package (4RP) introduced some interesting innovations for safety management systems (SMS), recommending greater attention to these aspects as system requirements in safety and organization management.

ANSFISA's interest in HOF and SC derives from these aspects' central role in applying the 4th Railway Package (4RP).

Attention to these aspects is not new in the railway system. However, differently from the past, it is becoming systemic, structural, and not random, highlighting the role that HOF and SC play in improving safety levels, the well-being of workers, and efficiency in the various work areas.

The most recent approaches on the subject analyse the professional environment from a socio-technical point of view and try to understand how the entire railway system interacts with the behaviour of individuals.

However, it is clear that individuals are responsible for performance, work, and safety, so it would be limiting not to consider that how they think and act is also influenced by other factors within the company, such as training, colleagues, equipment used, tasks performed, environment and organization. These factors that influence performance can help or hinder work: the challenge that can no longer be postponed for a mature company is to consider these elements systemically in managing the organization's safety and not as a stand-alone entity, with a view to continuous improvement of the quality of work.

2. OBJECTIVE

From these premises, ANSFISA, within its supervision activities, wanted to verify and check the effectiveness of the SMS implemented by the railway operators, especially regarding the integration of HOF and SC in SMS, two years after the entry into force of the 4RP.

Due to the Covid-19 pandemic, ANSFISA has revised and adapted its activities to comply with the limitations imposed.

In 2020 and 2021 ANSFISA supervision activities were mainly carried out "remotely" and, to achieve satisfactory and reliable results, new tools have been developed *ad hoc*.

A survey was developed as a tool for supervising the level of integration of HOF and SC in SMS.

The assumptions, limits, results and further developments of the survey are illustrated in this paper.

3. METHODS

3.1. Questionnaire on HOF and SC as a data collection tool

To acquire the state of the art and to obtain a general picture of the state of integration of HOF and SC in the SMS, ANSFISA has prepared a specific set of questions with the aim of collecting helpful information for identifying structured criteria for the planning of future supervision activities and to monitor the implementation process.

The questionnaire, based on the indications of the ERA *Guideline on the requirements of the safety management system for safety certification or safety authorization*, is structured to identify the main elements of the SMS. The questions were formulated for the fulfilment of the expected requirements, building a path of reflection and verification of the requirement analysed and its compliance with the Common Safety Method (CSM).

The survey was designed to satisfy several different needs of ANSFISA, with short-, medium-, and long-term goals.

Firstly, it allowed ANSFISA to verify, as part of its supervision activities, the state of implementation of HOF and SC in SMS in railway organizations.

Furthermore, as a tool for the collection of quantitative and qualitative data, the questionnaire allowed, through the self-assessment of the railway operators, to have a broad overview, simultaneous and updated, of the strengths and weaknesses of the implementation process of HOF and SC in SMS and was considered a valid tool for achieving the objectives set.

In addition, the questionnaire provides, where necessary, the "documentary evidence" of the activities carried out by the organizations, allowing, in broad terms, also an objective evaluation of these activities and an initial verification of performance.

The survey's results are currently used as baseline assessments on HOF and SC, and they provide a useful benchmark while conducting on-site audits to verify both the implementation level (comparing what was declared by the railway organizations in the questionnaire with the evidence collected on-site) and the effectiveness of the

implementation strategy, verified through a semi-structured interview administered to organization's staff (leaders, middle-managers, and operative staff) during the on-site audit. In addition, the results collected during the on-site audits allow for updating the "picture" provided by the railway organization at the time of the administration of the questionnaire.

When all the railways' organizations are audited, a second version of the questionnaire might be released, and the collected information might be used to compare the results with those from the initial questionnaire and repeat the process cyclically.

Ultimately, with the questionnaire it has been possible also to facilitate the dissemination and implementation of HOF and SC.

3.2. Drafting the questionnaire

The questionnaire was drafted by the internal staff of ANSFISA, and it has been developed following the same rationale that was adopted in Regulation (EU) 2018/762 for the development of the requirements relating to HOF and SC (in this respect, no questions were asked about the "Context of the Organization"). The questionnaire contains 29 questions (pre-filled single or multiple-choice answers) and two final considerations. Many questions allow the operator to fill in the free text space box (open answers) to allow for the provision of additional information.

The questionnaire was distributed in September 2021 to all railway organizations authorized to operate in the Italian railway system as "Infrastructure Manager" or "Railway Undertaking".

The total of 63 organizations are divided between: Passenger railway undertakings, n = 15; Freight railway undertakings, n = 21; Shunting railway undertakings, n = 4; Passengers and Freight railway undertakings, n = 3; Regional Infrastructure Managers, n = 12; Operators of Networks functionally separate from the rest of the network, n = 7; and National Infrastructure Manager, n = 1.

All organizations received and returned the questionnaire with the documentation relating to the required evidence, replying within the foreseen time frame. Furthermore, it is notable that all questionnaires were fully completed with detailed responses to open questions.

4. RESULTS

4.1. Overview of principal analysis of the questionnaire

Question 1 of the section on Leadership is related to the signing of the ERA Safety Culture declaration.

The ERA document contains a series of principles that allow an easier introduction of HOF and SC in SMS: its signature indicates a substantial commitment by leadership to achieve the set objectives, recognizing safety as the main engine of the efficiency and reliability of railway services, making the necessary resources available, proposing the principles of a culture based on trust and above all choosing safety in the event of a conflict between different company objectives.

In Question 1, 73% of organizations (n = 46) indicated that they had signed the ERA document demonstrating "... the commitment of the leaders and European authorities of

the entire railway sector in raising awareness and promoting a positive culture of safety. A positive safety culture reinforces the effects of a safety management system, improving its effectiveness and efficiency."

Question 2 in the Leadership section *“Have the principles relating to the analysis of human and organizational factors been explicated and the need to consider the values of the culture of safety in the organization?”* provides further information relating HOF and SC.

Most organizations have introduced the requirements of HOF and SC by making them explicit in the SMS documents (n = 60). The three operators who answered "no" (2 IMs and one RU) indicate that it is "Under implementation."

Question 3 aims at verifying the activities within the organization regarding the promotion of a positive SC.

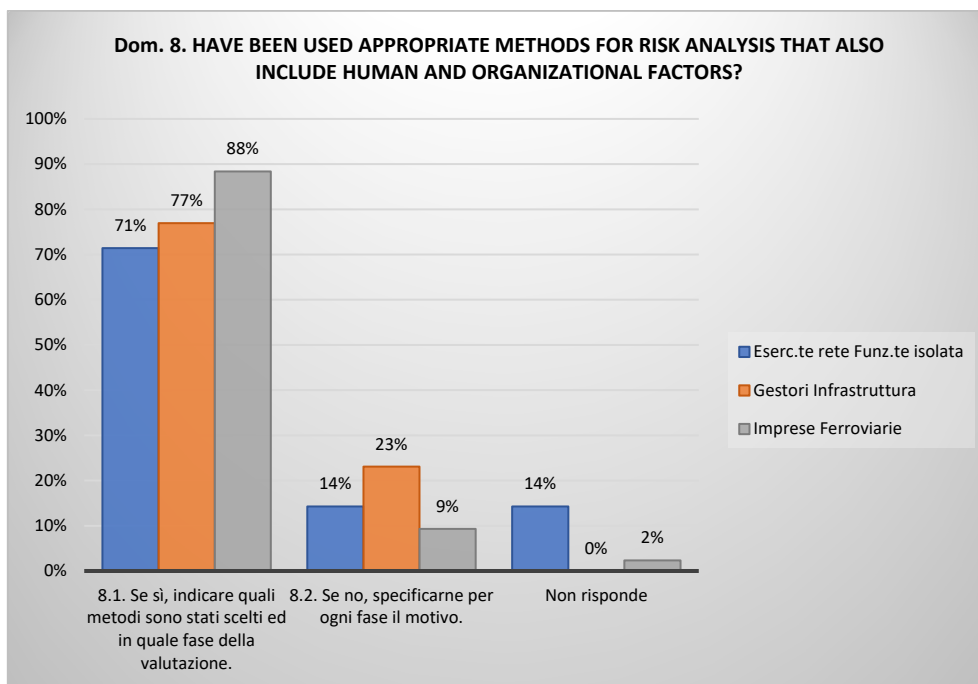
In the responses to Question 3, 95% of the railway organizations promoted various activities and initiatives, as indicated in detail in other parts of the questionnaire.

Question 8, part of the Planning section, enters the specifics of the methods and techniques used, differentiating the responses based on the three stages of risk assessment.

In case of a negative answer, organizations were asked to specify the motivation.

Figure 1 highlights some differences in the distribution of responses to Question 8, grouped about the type of service of the organization. Notably, 88% of the railway companies which have adopted SMS for several years responded positively. On the other hand, almost a quarter of infrastructure Managers answered negatively, and for Operators of functionally isolated networks 14% responded negatively and 14% did not answer the question.

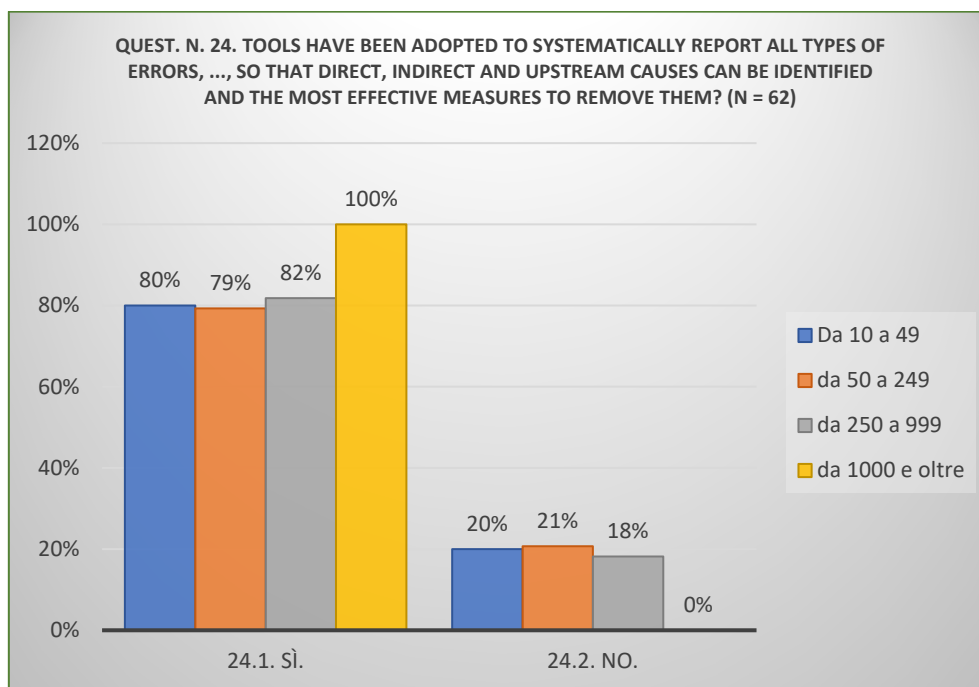
Figure 1



Question 24 in the Improvement section, “*Tools have been adopted to systematically report all types of errors, "near miss", deficiencies and inconveniences also due to failures, incidents, as well as ways to classify and analyze the data communicated from point of view of Human and Organizational Factors and Safety Culture, so that direct, indirect and upstream causes can be identified and the most effective measures to remove them?*” revealed that most railway operators (n = 51) have complied with the regulatory requirement. This result is not surprising as there is awareness that in the Italian railway system, there has always been a great deal of attention to the analysis of accidents and "near misses."

Responses to Question 24 provide support for the belief that large railway organizations have, for some time, been equipped with tools to report and manage reports relating to railway problems (See Figure 2). Although almost 80% of all categories of operators indicated compliance, operators with more than 1000 employees (n = 10) all indicated compliance.

Figure 2



As regards the methods used for reporting, the details on the type of staff report are given below.

"Written and verbal communications"; "Personnel reports, whether in anonymous format or not, are transmitted and analysed by the Safety function. ... "; "Shared and analysed database (...); "By mail via rail management support"; "The classification and analysis of data from the point of view of human and organizational factors and the culture of safety are currently under study"; "The mailbox dedicated to voluntary reports has been created, also doc. (...) dedicated to the collection of operational safety reports: the latter will be implemented in a systematic information flow "; "Form for reports also

anonymously (...), indicators fed by staff through software and digital forms, reviews with management to report any observations on the activities (or stocks to operating staff performed)".

4.2. Preliminary considerations on survey's results

Overall, it is possible to state that the sector has reacted well to introducing HOF and SC.

From what has been seen so far, the need to plan the integration of HOF in a systemic perspective emerges, involving every phase of the management system life cycle: from the identification of business objectives to the verification of the results obtained; from the analysis and design of tasks to the creation of the workplace and related operating procedures; from the commissioning of vehicles and structures to their withdrawal from service. The realization of what has been described involves the definition of a specific strategy for integrating HOF within all activities, explicitly setting objectives, expectations, and responsibilities for safety-related behaviours at all levels of the organization.

The awareness of the operators about the steps that must be taken to achieve the objectives indicated above was expressed precisely by the operators in terms of *"active commitment of the management"* aimed at knowledge through *"training and involvement activities,"* adopting *"tools of effective reporting,"* *"encouraging the participation of all by removing the fear of disciplinary actions,"* illustrating *"best practices and returns of experience."*

From the information analysis collected by the questionnaire, the railway sector is at the forefront in the field of transport, concerning critical elements in terms of safety; among these, there is undoubtedly the importance dedicated to "Leadership," understood as a commitment to address issues relating to HOF. The direct involvement of Leadership is therefore understood as a proactive element of this cultural change, to create cohesion on the objectives and verify their achievement, reducing the risk of delays and failures. Other areas in which the survey reveals a good level of development are the lessons learned from accidents and re-examination, probably the result of experience gained and consolidated over time.

However, it is essential to focus attention on the broader meaning of "leadership", understood as senior management, and the related decisions it is called upon to make, such as setting goals, defining vision and mission, and resolving potential conflicts between corporate objectives and safety. Furthermore, leadership must encourage the involvement of all actors, from intermediate roles to front-line operators. At the same time, it emerges how essential it is to maintain active participation, involving, talking, and listening to workers.

It is therefore essential that the SC is considered as the engine of organizational change and, above all, the harbinger of a new interpretation of the concept of safety itself, which must be perceived as a substantial value widespread among workers and not as an impediment or the fulfilment of a purely formal duty. Organizational performance based on the safety objectives achieved and the culture of trust spread throughout the organization are just some of the many change initiatives implemented in the new European railway safety landscape.

Likewise, the collection of confidential information, the analysis of operating problems, and lessons learned are ways to learn about the various parts that make up the work. Having as much information as possible about the work as it is carried out and comparing

it with the work as planned helps to understand the nature of the intervening deviations and consequently prevent accidents.

The results also show awareness on the part of the operators that, in some respects, further commitment is necessary, including:

- 1) the introduction of suitable tools for the analysis and assessment of risks related to human and organizational factors
- 2) the widespread diffusion within organizations of a positive and trusting culture
- 3) the involvement of partners and external parties in general for the achievement of shared awareness of HOF
- 4) the availability of adequate skills within organizations to support the implementation of HOF and SC.

From the answers to the questionnaire, in the section dedicated to the final considerations, some of these elements are identified: *"Extent and capillarity of the issues connected to human and organizational factors"; "resistance to change"; need to introduce "new methods of process analysis and work for an organization"; the need for a long time required by the "cultural change, not feasible in a tight time frame"; and again due to the difficulty of dealing with other operators in the sector due to "difficulties in finding case studies, examples, evaluations and practical considerations deriving directly from the railway sector."*

One of the survey's goals was to establish a constructive dialogue with the railway organizations on HOF and SC. In particular, participants took the opportunity provided by the survey to pose some questions and issues to ANSFISA, e.g., to *"work to facilitate the sector by organizing specific training courses"* with the aim of *"providing operational tools useful for the integration of human factors in organization"*, or to encourage in-depth analysis with *"the sharing of practical examples or reference application models"*. The strong involvement of ANSFISA on these issues is confirmed by the commitments made over time on several initiatives: with the organization of the national "Safety Culture Days" (2018 and 2021), the constant activities of supervision and dissemination.

Finally, the information collected with this innovative survey methodologies, provides practical and structured elements to plan the following Supervision activities in a targeted manner.

4.3. The survey's results as a baseline for planning supervision activities

In 2022, ANSFISA is carrying out an ongoing specific supervision campaign to verify the effectiveness of the processes adopted by the railway operators in the field. This campaign, starting from the survey's results, will complete the activity started with the questionnaire.

Among the organization's selection criteria to be audited, the levels of implementation of HOF and SC declared in the questionnaire by the railway organizations have been considered.

The supervision set three main goals to achieve:

- 1) assessing the effectiveness of the implementation actions for HOF and SC of the railway's organization;

2) verifying the evidence of the implementation strategy for HOF and SC of the railway's organization;

3) verifying eventual “pending issues” about HOF and SC related to the safety certificate.

To assess the effectiveness of the implementation actions for HOF and SC of the railway's organization, in this new phase, a semi-structured interview was drafted. In the interviews have been involved the organization's staff at different levels: leadership (e.g., CEO or a representative on their behalf), middle-management (e.g., head of depots, control room manager), and operative staff (selected randomly from the personnel on shift during the supervision). In this way it is possible to collect the opinions and perceptions of the operative staff regarding the safety policy and the implementation strategy of HOF and SC set by the leadership in SMS.

The result of this supervision part is an implementation index (Ii) obtained combining the following sub-index:

- Icv = implementation index HOF related to the Involvement level of personnel;
- Icp = implementation index HOF related to the Awareness level;
- Ics = implementation index HOF related to the Safety Culture level;
- Im = implementation index HOF related to the Improvement level.

These sub-indices are valued and combined in the arithmetic mean:

$$I_i = (I_{cv} + I_{cp} + I_{cs} + I_m) / 4$$

Implementation Index Ii (and related sub-indices composing it) reports to the numerator the answers' sum evaluated by the auditors as “positive” and the total number of interviewees was assigned to the denominator. This indicator is between zero and one.

This procedure allows the conversion of a qualitative evaluation into a quantitative (and comparable) result, being aware that the outcomes are limited to the sample interviewed.

The topics analysed concerning the level of implementation for the opinions expressed and the relative index described above refer to the following requirements of the Delegated Regulation (EU) 2018/762:

- The organisation shall facilitate the consultation of staff by providing the methods and means for involving staff, recording staff’s opinions, and providing feedback on staff’s opinions (involve the staff – requirement 2.4.2);
- Top management shall ensure that they and their staff having a role that affects safety are aware of the relevance, importance, and consequences of their activities and how they contribute to the correct application and the effectiveness of the safety management system, including the achievement of safety objectives (see Safety objectives and planning) (awareness – requirement 4.3.1);
- Promoting continual improvement of the safety management system (safety culture-requirement 2.1.1. (j)).
- Ensuring that safety is considered when identifying and managing the organisation’s business risks and explaining how the conflict between safety and other goals will be recognised and resolved (safety culture – requirement 2.1.1. (i)).
- The organisation shall use information relating to the investigation to review the risk analysis and evaluation (see 3.1.1. Risk assessment), to learn with the aim of

improving safety and, where applicable, to adopt corrective measures and/or improvement measures (see 5.4. Management of change) (improvement – requirement 7.1.3);

- The organisation shall provide means to motivating staff and other interested parties to be active in improving safety as part of its organisational learning. (improvement – requirement 7.2.2)
- The organisation shall provide a strategy to continually improve safety culture, relying on the use of expertise and recognised methods to identify behavioural issues affecting the different parts of the safety management system and to put in place measures to address these. (improvement – requirement 7.2.3).

A specific part of ANSFISA’s supervision strategy is dedicated to verifying the evidence for implementing HOF and SC. This activity focused on verifying the documentation submitted by the railway organization with the questionnaire on HOF and SC and on any additions that have occurred subsequently.

This activity allows the definition of a second index, called the Concordance Index (Ic), obtained from the verification of the concordance between the activities foreseen in the strategy for implementing the HOF and the positive SC and the activities actually carried out (activity concluded or nearing conclusion), verified on-site by the auditors.

The index Ic (range 0-1) reports the numerator values' sum between zero and one of the activities carried out among those foreseen by the implementation strategy. The denominator shows the numerical quantification of the above-mentioned activities foreseen by the implementation strategy.

For example:

$$Ic = x_1 + x_2 + \dots x_N / N$$

Where: $x_1, x_2, \dots x_N$ represent the valuations of the activities carried out among those foreseen by the HOF implementation strategy.

Based on the three on site supervision activities finalised so far, the following preliminary considerations can be made:

- 1) Risk evaluation. Even if some initiatives on the topic can be found, there was no evidence of clear identification, analysis, and mitigation process of HOF in the railway organisations audited.
- 2) Overlapping with Safety and Health Directives. There was evidence (especially in the operative staff, through the semi-structured interviews) of misunderstandings and overlapping between the Health and Safety at work Directive and the SMS, having as a consequence difficulty identifying the risks related to the operative role.
- 3) Involvement of experts. While relying on external experts (usually Organizational psychologists) seems to be a frequent practice adopted by railway organizations, demonstrating the selection methods, competencies, and expertise in railways and risk analysis seems not uniform.
- 4) Involving third/external parties. Most organisations plan to involve external parties in the HOF and SC implementation process, but evidence of actual activities on the topic is still missing.

5. CONCLUSIONS

HOF and SC are essential and critical issues for transport safety. However, while their importance is increasingly recognized, there is awareness among the field's experts of the practical and procedural difficulties in monitoring and evaluating these issues, and that *ad-hoc* tools are needed. Furthermore, these tools need to be validated and standardized, allowing a combination of qualitative and quantitative evaluation.

The introduction of a questionnaire based on the ERA *Guidelines on the requirements of the safety management system for safety certification or authorization* to monitor the implementation of HOF and SC among operators proved to be a practical tool in many ways. The survey made it possible to overcome the difficulties and limits imposed by the pandemic period and to collect helpful information for planning future supervisory activities.

ANSFISA is currently monitoring this innovative method of supervision, and when most railway organizations are audited, a second edition of the questionnaire may be published. During this first process, which could become cyclical, the main objective is to test and validate the *ad hoc* procedural tools developed, such as semi-structured interviews (to management, middle-management, and operational staff), the Implementation Index (Ii) and the Concordance Index (Ic).

ANSFISA will continue to support the Italian railway system for an ever-greater integration of HOF and SC into SMS, to achieve the common safety goals with railway organizations, and where possible, continuously improve safety.