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Human factors as a philosophy and practice to renew Vision Zero

Anna-Maria Teperi, PhD, Finnish Institute of Occupational Health

Keywords

HF, implementation, safety culture, safety management, resilience

Abstract

Vision Zero (VZ) is a prevention and commitment strategy for safe work without fatal or serious occupational diseases or accidents. National and international actions have been the sharing of good practices through networking. Simultaneously, the latest safety research has raised a new view (Safety-II), which focuses on human variety and success behind safety. However, VZ has been criticized for causing a risk of hiding incident data while targeting 'zero'. According to some, Safety-II has produced a good philosophy, but has lacked practical implications. This study shows how interventions applying the holistic Human Factors (HF) perspective in 2000-2019 have facilitated a more analytical understanding, a positive view of safety as human action and more open discussion at workplaces, making Safety-II more concrete. Applying HF with the Safety-II view may further concretize and renew Vision Zero, and best utilize its potential in international networks.

Introduction

Vision Zero (VZ) began as a prevention and commitment strategy for safe work with no fatal or serious occupational diseases or accidents. Its original aim was to communicate a clear message to companies that accidents are preventable and that striving for zero accidents is ethical business. A clear link has been built to productivity and quality in industrial companies. One form of action has been sharing good practices through networking in national and international forums to improve safety levels. (Zwetsloot et al., 2013).

However, VZ has focused on pragmatic needs and discussion, and lacks a clear, solid theoretical basis due to limited scientific evidence. Some recent safety debates have criticized the aims and means of VZ, even regarded it as 'a religion' or as causing opposite results, causing risks of hiding incident data while targeting 'zero' or 'no harm' (e.g. Sherratt, 2014; discussion at Policy and Practice in Health and Safety, 2017).

At the same time, the latest safety research has introduced resilience and Safety I-II paradigms to show the difference between traditional and new safety thinking (Hollnagel, 2018). Safety-II has

pointed out the need to see issues working well, and to understand the human variability and limited resources behind safety cases. Its aim is to help individuals and organizations anticipate, cope, recover and learn from operations. In contrast, traditional safety thinking (Safety-I) has focused on calculating risks and finding technical issues or individual errors as reasons for accidents, leading to incorrect conclusions and narrow corrective actions, as well as a lack of commitment and motivation for safety management among operative personnel. For some time, Human Factors (HF), as a multi-scientific discipline, has aimed to support overall system performance, efficiency, safety and well-being among those working in systems. However, HF has also been defined as using narrow aspects and findings and fragmented results, concluding in individual- and error-based assumptions (Teperi et al, 2015; 2017; 2019). The new era of HF sees humans as a positive capacity in systems (Dekker, 2017). The move from the 'old to the new view' in HF (Dekker, 2017), as well as in safety management (Hollnagel, 2018), is summarized in Figure 1.

Figure 1. Evolving paradigms of safety management and HF perspective

The challenge is how to synthesize the 'original good purpose' of Vision Zero, to align it with the new view of 'human- and organizational-centred safety', and how to find concrete actions to realize the new safety view, utilizing Vision Zero's networking potential.

This study presents interventions which apply a holistic HF perspective with a theoretical framework and concrete tools in 2000–2019, aiming to focus on safety from the human side.

Execution

In safety critical fields, applying HF to safety management is mandatory. Industries also face increasing social-ethical pressure. Moreover, the new ISO 45001 demands more active implementation of human-centred actions at workplaces.

The following case studies summarize interventions from 2000–2019 which are also based on the need to renew safety culture by better mastery of HF, i.e., to better understand the human performance behind operations and incidents. All the interventions used the HF Tool ™ framework and practical tools, originally designed in aviation (Teperi, 2012) and further modified in research and development interventions by FIOH (Teperi et al, 2017a,b; 2019). The tool consists of 4–5 levels: individual-, work-, group- and organizational level, as well as system level. The HF Tool™ provides toolkit to raise HF competence and awareness, and includes basic training, the HF trainers' program, introduction for top management, investigation tools and suggestions for corrective actions. For example, it uses a 'positive timeline' to focus on positive factors during the operations and incidents.

The interventions were research projects with a workplace development orientation. Table 1 summarizes the actions, material and methods.

Table 1. Application of HF in safety management; research data and findings during last 18 years in safety critical fields.

Field, years	Air Traffic Management (ATM), 2000–2012	Nuclear energy industry, 2015–2018	Maritime sector, 2016–2017	Aviation maintenance, 2016–2017	Railway sector, 2015–2019	Construction industry, 2017–2019
Actions and aims	Design of original HF tool. Implementing HF in SMS (basic, refresher and trainers' training, incident reporting and investigation, risk assessment). Participation of all organizational levels in HF tool use.	Modifying HF tool for nuclear energy industry. Using it to analyze operational experiences in nuclear power plants; training safety experts. Improving mastery of HF with concrete toolkit.	Modifying HF tool for maritime. Testing it with seafarers, safety experts and managers at workshops, to assess and develop maritime safety culture. Participation of partners from different positions in maritime system (regulator, companies).	Modifying HF tool for aviation maintenance. Using HF as a framework to define safety critical parts of aviation maintenance work processes, and to renew occupational health practices. Participation of all organizational levels.	Modifying HF tool for railway sector. Implementing HF in training and incident investigations, to develop safety culture. 60 HF trainers trained, who further trained 1000 personnel. Participation of all organizational levels.	Modifying HF tool for construction industry, including the fifth 'system' level.
Data and methods	Interviews (n=21) Surveys (n=142, n=155) Open questions for safety and quality groups of airports (n=46) Analysis of incident reports (n=3163)	Interviews (n=20) Document analysis Intervention material of workshops	Interviews (n=20) NOSACQ-survey (n=427) Intervention material of 4 workshops	Interviews (n=27) Work process analysis models from 6 tasks in 3 units Brain work index (n=379) Work observation of most critical tasks	Interviews (n=9) Intervention material workshops with three companies from airport operations, ATM and railway). Indicators for HF efficiency. Data collection in progress.	Study protocol article published, intervention results in progress.
Detailed original scientific article	Teperi, 2012; Teperi, Leppänen, Norros, 2015	Teperi, Puro, Ratilainen, 2017	Teperi, Puro, Lappalainen, Perttula, 2019	Teperi, Asikainen, Ala-Laurinaho, Valtonen, Paajanen, 2019	To be published in 2020 www.ttl.fi/prohf	Nykänen, Puro, Tiikkaja, Kannisto et al., 2019

Findings

The main findings of the interventions are summarized as follows. In ATM, although several hindrances were recognized during the ten years of HF implementation, the organization adopted the HF tool in their safety management system (and it is still in use). According to results, it helped units learn and analyse both positive and negative HF-related causal factors of incidents, enabling ATM operators to reflect their work. The benefits of the HF tool were its visuality, user-friendliness and the congruence of its contents with existing HF tools. The lessons learnt revealed the need for continuous training and more active communicating of the corrective actions based on the HF tool use (Teperi et al., 2015).

In nuclear power plants, the study revealed that currently, the reporting and analysis of operative events focuses mainly on technical and risk aspects, and HF is not very concrete. The new HF tool offered a more accurate picture of the analysed events, including the successes, thus offering a path for Safety-II type of safety management. The users found the HF tool clear and easy to use, and useful for investigation, training and self-evaluation, and monitoring safety trends. HF competence and implementation still needs to be concretized in the nuclear sector. (Teperi et al., 2017a).

We found that maritime organizations had no similar kind of HF tool in use. The tool was regarded as an opportunity to involve the operative personnel in reporting and analysing incidents and understanding human performance. Use of the HF tool could help root a positive safety culture in the maritime industry. (Teperi et al., 2017b).

In aviation maintenance, the HF tool offered a holistic framework for co-operation of all organizational levels. By combining with other methods, the safety critical demands and features of the work process from a human point of view were defined, for better mastery in everyday operations and also by occupational health care personnel (Teperi et al., 2018).

In the railway sector, preliminary findings indicate that HF application has supported the renewal of safety culture. After four years of implementation, risk awareness has been complimented with a focus on successes and issues that go well. Incident analysis is seen as more analytic, including human variability with a holistic view. Corrective actions have been more accurate and slow systemic moves have been accepted instead of ’quick fixes’. Workers better understand their own and others’ errors, with a deeper view to operative reality. Top management followed the HF programme with interest. Improved quality of communication and openness of discussion were also mentioned.

To sum up, HF applications in safety management have realized Safety-II and new HF view aims. The reported benefits are better understanding of human variability behind operations, and moving the focus from errors and risks to the positive potential of people. A more analytical evaluation and learning of human contribution not only as individual actions, but also at work-, group-, organizational and system levels are recognized, especially at incident investigations. Several organizational levels and system partners are committed to HF actions in safety management activities, supporting open discussions and trust as a key to anticipation. HF thinking and the toolkit have provided an understanding and a reflection on human performance as a part of a system.

Conclusions

This paper aimed to show how applying a holistic HF perspective as a philosophy and practice in the last 18 years has promoted Safety-II thinking and offered concrete tools to transform it from scientific debate to practice. The HF perspective, in its modern, broad definition, may give further potential to enrich Vision Zero. Whether through Vision Zero's seven golden rules or the Safety-II perspective, we need practical programmes, processes, practices and tools, to realize good targets. Exploration of the efficiency of HF actions are needed, too. Based on our research, at least five aspects are needed for proper implementation of safety improvements: anticipation, a participative approach, a focus on factors that work well (successes), commitment at all organizational levels, and systemic, collaborative orientation. Dedication, motivation and competence are needed as well as tough, long-term work, and coping with tensions at different development phases. These 'tensions' may be utilized to combine HF research and practice with the Safety-II perspective and Vision Zero's international networking potential. The aim is not to have conflicting paradigms and parallel paths, but to compliment and synthesize these.

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