

System-Intelligent Human Factors for Promoting Safety in the Chemical Industry

Anna-Maria Teperi¹, Riitta Juvonen²

Aim

This study aims to create knowhow for proactive safety management in the chemical industry. The chemical industry is a typically complex sociotechnical system in which humans, technology, and organizations are constantly intertwined. This systemic interaction has already been studied and the HF approach applied in other safety-critical industries such as the nuclear and transport industries. Several accidents in the chemical industry, including that in Bhopal in 1984, have shown how critical the human contribution is to safety. Several organizational factors, work characteristics, and performance of teams and individuals affect the success of production and the safety of processes. However, we do not currently know whether the HF approach has been implemented in the safety management practices of chemical industry workplaces.

Theoretical background

We use Systemic Human Factors (HF) and Systems Intelligence (SI) to evaluate the current state and areas in need of development through HF implementation in the chemical industry. In previous studies, the HF Tool has efficiently improved safety thinking and procedures by considering human contribution in a holistic, participative, positive, and solution-based manner. However, the use of the HF Tool has not yet been researched in the chemical industry nor combined with other lines of research. SI describes human experience and interaction within a system. It also describes succeeding in systems, and SI-metrics have been found to work well as indicators of learning organization and well-being at work.

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The current phase in safety research calls for adaptive measures to improve safety in complex, dynamic circumstances by deliberating the role of human variability in a mindful manner. Safety management and HF approaches have evolved from being individual-, risk- and error-prone to being more systemic, proactive, and success-based. The focus is on improving the enablers of resilient performance from anticipation to recovery, analysis, and on learning from everyday operations. However, we have a wealth of knowledge on HF, but availability of means to tackle HF issues in the reality of all workplace levels is far from ideal. Earlier studies have shown that in other safety-critical fields, HF has been successfully implemented by utilizing a holistic, solution-based, and participative HF approach with practical models. In practice, this means several years of stepwise development processes, during which the actors themselves become the subjects of change and learn measures to implement HF in safety practices. HF activities take place before accidents or incidents happen and require understanding and competence to facilitate resilient performance from

¹ Finnish Institute of Occupational Health, Helsinki, Finland, anna-maria.teperi@ttl.fi, p. +358 43 8257454

² Aalto-university, Espoo, Finland

the bottom up, not through top-down actions and compliance targets. Thus, we need more conceptual and practical power to understand how the people themselves see the system from the inside, and how they feel about their work and safety. We aim for this by combining the SI framework and the HF approach (SIHF), highlighting the subjective experience and reflecting on the skills essential for improving safety in organizations.

Methodology

Four companies are participating in the study, representing four different chemical industry sectors: oil and gas, paint manufacturing, tall oil refining, and plastics and rubber. We conduct interviews (n=36), 12 workshops, and analyze 89 documents to assess the current state of SIHF in the studied companies. In 2022 we have already developed and conducted a survey with ten items (n=210). SIHF models and practical tools for preventive safety management will be developed on the basis of the collected data.

Results

The preliminary results of the survey and interviews show that the HF concept is still narrowly understood, which indicates a clear need to expand the concept and competence related to it. The HF Tool for chemical industry purposes will be renewed using SI, and an SIHF model will be produced to help supervisors and managers lead safety culture. The results will be finalized in 2023–2024.

Limitations

This variety of chemical industry companies provides a good basis for our research. However, it is important to carefully consider how the results are disseminated to ensure that they are widely available and applicable in the multifaceted field of chemical industry.

Relevance to Congress Theme

This study utilizes knowledge of work and organizational psychology and creates new safety culture theory and practice for industry and academia.

Relevant UN SDGs

Our SDGs are safety, health, and well-being. We believe that our study findings will facilitate workplaces' future climate actions.