

# Challenges and requirements in the development of a safety culture for industry 4.0

## Introduction and Research Questions

Digitalization rapidly changes the diverse modern industries. Several advantages of this fourth industrial revolution (short: industry 4.0) include fast time to market, increasing innovation cycles, agile manufacturing, diminishing cross-company boundaries, autonomous data exchange between systems and machines and digital engineering strategies (Brettel et al. 2014). Alongside to this technological innovation, new risks emerge which often affect the workers in these industries. In this context, approaches towards industry 4.0 do not consider communicative measures that empower workers to participate in decision-making processes.

This paper presents a study focusing on challenges and requirements towards a safety culture for industry 4.0. The study focuses on two research questions:

- RQ1: Which challenges do experts perceive that emerge due to the trend towards an industry 4.0? Which of these challenges are domain-interlinking, which are domain-specific?
- RQ2: Which requirements do experts perceive that need to be considered in the development of a safety culture tailored towards an industry 4.0? Which of these requirements relate to communication and participation?

## Method

In the study, two exemplary industry domains are examined: the production industry and the construction industry (especially planning departments). An interview guide was developed and 12 expert interviews from both industry domains were conducted (50%: manufacturing SMEs, 41.67%: construction industry, 8.33%: research institutes in the field of energy and environmental engineering). The interview guideline includes questions on the perception of risks in the development towards an industry 4.0 and perceived requirements for establishing a safety culture for industry 4.0. All interviews were audio recorded, transcribed and anonymized. The transcripts were converted into MAXQDA format. Data were coded and analyzed with qualitative content analysis procedures.

## Results

RQ1: The results indicate cross-domain challenges in the development towards an industry 4.0 due to the increasing interconnectedness of systems as well as of systems and machines. The specific manifestation of these aspects is industry-specific.

With regard to the interconnectedness of systems, representatives of both domains emphasize the relevance of data security. In the construction industry, this challenge relates to the need for collaborative work between project partners on a 3D model with the concurrent need to protect the intellectual property of each partner. In manufacturing SMEs, the challenge is to share information in secure ways with suppliers and customers and exclude third parties at the same time.

With regard to the interconnectedness of systems and machines, both industry domains are concerned with the question which safety concepts are required for the introduction of novel intelligent machines. In the construction industry, this question is focused on the control of machines and components against unauthorized access: There is an increasing trend towards the establishment of smart building technologies that lack concepts for the identification and prevention of associated security risks. On the other hand, producing SMEs focus on challenges of interaction between humans and intelligent machines or robots. In this context, the respondents emphasize the partial incompatibility of legal requirements with technical possibilities.

RQ2: The interviewees state various requirements that address the challenges stated above. With regard to the interconnectedness of systems, necessary prerequisites include guidelines for data management and corresponding standards for secure file formats. With regard to the interconnectedness of systems and machines, innovative approaches to support humans in interacting with machines are required (e.g., with the help of augmented reality). Communication measures are described as being a key factor in shaping and introducing a safety culture 4.0: The interviewees consider necessary several formal as well as informal means to train workers, distribute information with respect to safety issues and involve workers in decision-making processes (e.g., round tables, team briefings, approaches such as lifelong learning or open innovation).

## Conclusion

The results indicate the need for a deeper understanding of the professional situations which are affected by the trend towards an industry 4.0. Communication professionals involved in transformation processes towards an industry 4.0 need to consider task-, role-, and context-related approaches to a safety culture 4.0.

## Literature

Brettel, M./ Friederichsen, N./ Keller, M./ Rosenberg, M. (2014): How Virtualization, Decentralization and Network Building Change the Manufacturing Landscape: An Industry 4.0 Perspective. In: International Scholarly and Scientific Research & Innovation 8 (1) 2014, 37-44

This research and development project is funded by the German Federal Ministry of Education and Research (BMBF) within the “Innovations for Tomorrow’s Production, Services, and Work” Program and by the European Social Fund (ESF) (funding number 02L15A002) and implemented by the Project Management Agency Karlsruhe (PTKA). The author is responsible for the content of this publication.

