On the use of ergonomic standards in Finnish manufacturing SMEs

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SUMMARY

Ergonomics standards contain essential knowledge for the design of human work and human-technology interactions. When effectively implemented, this knowledge can significantly benefit companies by enhancing technological development, business performance and employee well-being. In this study, Finnish manufacturing small and medium-sized enterprises (SMEs) (n=16) were interviewed to assess the utilisation of ergonomics standards when designing human-technology interfaces during their endeavours to digitalise their manufacturing processes. The interviews indicate a general lack of awareness, and minimal application of ergonomic standards among the companies. This is a worrying observation, as it suggests that companies' design solutions may not always be based on current ergonomics knowledge but rather on alternative perspectives. To increase their competitiveness, it is recommended that these companies adopt a strategic approach to the utilisation of ergonomics standards. Future studies in diverse industrial settings and involving a broader set of companies are needed to confirm our findings and draw stronger conclusions.

KEYWORDS

Human work, Manufacturing, Standard

Introduction

European Union's (EU) Industry 5.0 vision (European Commission, n.d.) portrays a human-centric perspective for the future of working life. The vision is often considered a continuation of the earlier industrial revolutions that have revolutionised industrial work and human work alongside it. The most recent expression of these revolutions has been the so-called fourth industrial revolution - or Industry 4.0 - that is associated to broad workplace digitalisation. The corporate sector is still in many ways struggling with this overall ambition for this digitalisation, and for instance manufacturing SME's capabilities for successful new technology adoption have been seen immature in many ways (Ghobakhloo et al., 2022). In that regard, this qualitative study focuses on Finnish manufacturing SMEs and their organisational capabilities for human-centric design and management when seeking for competitive edge through manufacturing process development and related digital technological transitions.

There is considerable consensus in the research literature on how the central role of humans as users of digitalised new technologies has been overlooked. The kinds of physical, cognitive and psychosocial discomforts and loads or accident hazards related to the use of new digital technologies are still uncharted in many ways. Human productivity is also not always optimised when it comes to such new kinds of human-technology interaction situations (e.g. Alves et al., 2022; Grosse et al., 2023; Reiman et al., 2021). In that respect, it is good to remember that humans have not changed much in terms of their physical or cognitive characteristics, even though the

intensity of work and technological demands have significantly increased during the last centuries (de Winter and Hancock, 2021).

Ergonomics standards contain up-to-date design knowledge to be used when designing human work. The standards provide a deeper understanding and interpretation of how to design human work and human-technology interactions effectively. Standards go beyond mere data by offering insights, principles, and guidelines that can be applied in practical contexts (Karwowski et al., 2021). The importance of using the knowledge contained in ergonomic standards seems to be raising increasing awareness with the EU decision makers. The recently launched EU regulation on machinery (2023/1230) points out the need for better ergonomics design activities and for instance, in a recently published Industry 5.0 road map for manufacturing (European Commission, 2024a) the use of ergonomics standards is highlighted in many ways. In another topical publication by the EU, designers' awareness of the existence of anthropometrics data—and also adequacies related to their presentation in current harmonised European standards—was critically discussed (European Commission, 2023). Paralleling with these EU level outcomes, there is evidence from the Finnish manufacturing companies—not depending on their company sizes, nor products manufactured—that the companies seem to lack certain organisational dynamic capabilities when it comes to design human work phases alongside the rapid technological development (Reiman et al., 2024a; 2024b).

Research approach

In an ongoing (2024-2027) Finnish research project, the aim is to increase understanding on Finnish manufacturing SMEs' organisational capabilities to meet present and upcoming challenges and opportunities that the digital technological development brings along from the human work design and management perspective. As one part of that project, companies are interviewed on their skills and knowledge to apply up-to-date ergonomics standards when they design their manufacturing processes and related new digital technology implementation (see Figure 1).

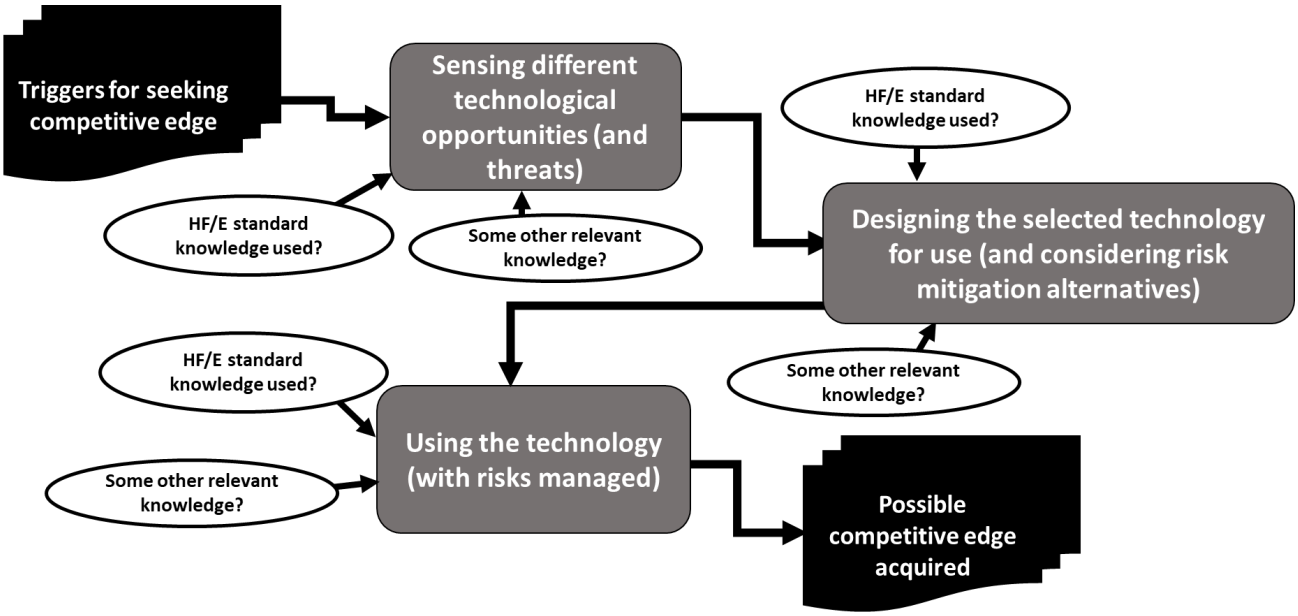

Figure 1: Research interests of this study

The interview guide with altogether 31 questions was created merging the existing knowledge on ergonomics in design (e.g., Karwowski et al., 2021; Reiman et al., 2021; 2024a), business development thinking (e.g., Teece, 2018) with insights arising from existing organisational level (maturity) standards on ergonomics (e.g., ISO 27500, 2017; ANSI HFE 400, 2021). To give an

overall view of the interview guide, Table 1 presents the main themes of it and gives some examples of the questions addressing these themes.

Table 1: Interview themes and examples of specific questions

Theme	**Examples of ergonomics related questions**
Digital strategies and management	- … - What kinds of development needs have been identified for enhancing employees' skills and competences to utilise new digital technologies? - …
Identification of digital technologies	- … - How are the technologies' potential impacts on employees' physical and cognitive performance and well-being identified and considered? - …
Implementation of digital technologies	- … - How is it ensured in design that the use of a particular digital technology solution is ergonomic for employees? - …
Utilisation of digital technologies	- … - How are standards related to occupational safety and ergonomics monitored and applied in design? - …
Utilisation of data acquired	- … - What principles and processes are there in place for the collection, recording and evaluation of data related to human work? - …
Well-being at work	- … - What kind of health and safety threats related to digital technologies have been identified? - ...

The interviews started in November 2024. Altogether 16 companies have been interviewed. The interview process is continuing in the first half of 2025. In the interviews, company decision-makers, like managing directors and production managers, production designers, and occupational safety and health professionals, participate as informants.

Outcomes and key takeaways

Finland performs well in many areas of digitalisation (e.g. European Commission, 2024b), making it reasonable to examine the organisational capabilities Finnish manufacturing SMEs have in new digital technology transitions and how human work is considered in the transitions. Whilst the sample of interviews is small when it comes to the number of companies (n=16), the interviews were still uniform in a sense, that they revealed how immature the companies were when it comes to the broad use of ergonomic standards when designing the use of new digital technologies, and implementing them into practical use. In a few companies, the informants considered how some ergonomics standards had been used for machinery safety design purposes and when designing their end products. However, as an overall impression of the interviews, it can be concluded that they were not fully aware of the broad spectrum of the knowledge ergonomics standards would provide, nor did they identify that they would be in active use inside the company.

This research encourages companies to explore ways to advance human-centric industrial practices through the better use of ergonomics knowledge available in standards. This study is still ongoing, and further material will be collected in this respect. These initial findings seem uniform, suggesting that the use of ergonomics standards could be improved in manufacturing SMEs. Further research is still needed to draw stronger conclusions. Through this ongoing research process, the ultimate aim is to provide actionable insights into improving ergonomic design practices, supporting the transition to human-centric manufacturing in line with Industry 5.0 goals. Ergonomics standards have an essential role in this, as they contain scientifically proven information and knowledge on human limitations and capabilities, relevant to be understood when designing human-technology- and human-system-interfaces.

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