From data to decision: A case study on ergonomics in manufacturing automation

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SUMMARY

Manufacturing process development is often technology and business oriented. The development of human work in this context is often neglected to a certain extent. With the use of ergonomics tools and methods, it is possible to identify targets for development and justify development investments also from the human work improvement perspective. For that purpose, physical ergonomics data were collected through video observations. In addition, occupational health and safety (OHS) and productivity indicator data were collected. In a series of group interviews, participants representing management and designers discussed the strengths and weaknesses of these data when it comes to decision-making on manufacturing development and related investments. As an outcome, the company decided to invest in production automation in the welding unit to avoid ergonomic problems and to increase productivity.

KEYWORDS

Manufacturing, Physical ergonomics, Video observation

Introduction

Manufacturing companies constantly consider means to develop their production performance and efficiency. Often, in manufacturing, human-technology and human-system interfaces are not optimised, resulting in different hazards for health and safety and lowering employee productivity. In this context, the use of ergonomics expertise would be highly beneficial. In reality, however, ergonomics is too often leaning towards siloed needs arising from occupational health and safety, whilst too little attention is paid to human productivity. While manufacturing development is inherently business-driven, companies with a broader vision for their future are increasingly considering how to gain a competitive edge through various factors, including the development of human work. In the current literature on manufacturing development, these—often paradigmatic—sociotechnical transitions are often discussed under the concepts of Industry 4.0 and Industry 5.0 (e.g., Grosse et al., 2023; Reiman et al., 2021).

As a scientific discipline, ergonomics aims to understand, design and develop work from a socio-technical work systems perspective. Arising from the complexities related to systems thinking in general, the concept of a system can be approached from different perspectives in ergonomics. A traditional way to discuss systems in ergonomics is to divide them into microergonomics and macroergonomics (also mesoergonomics on some occasions). When simplified, microergonomics focuses on individual-level work systems, whereas macroergonomics focuses on broader system complexities and their design and management (e.g., Kleiner, 2008). Usually, success in macroergonomics development requires microergonomics analyses focusing on the workstation level (Hendrick, 2003). Such microergonomics workstation level knowledge to be processed in

further macroergonomics development processes can be collected with various means depending on the need (e.g., Lowe et al., 2019).

Case study approach and main findings

In this practical case study, we focused on one welding unit in a major-sized manufacturing company in Finland. The company has many subsidiaries in Central Europe. We discuss how physical ergonomics data, collected through ergonomics video observations, alongside actual OHS and productivity data from 2018 to 2023, eventually persuaded the company decision-makers to make significant changes in the welding unit to avoid the growth of ergonomics problems and to increase the unit's productivity. We present the video observation method, tailored for the company's purposes, and discuss its strengths and weaknesses. For this purpose, we conducted group interviews (n=4) for management and white-collar workers (15 persons). Finally, we discuss the process of how the company decision-makers eventually decided to invest in automatisation firstly to avoid ergonomics problems continuing and secondly to increase productivity. To concretise the development work done in the welding unit, we present in Figure 1 (on the left) one practical illustration of how the grinding task was earlier performed and (on the right) the design solution to automatise grinding work.

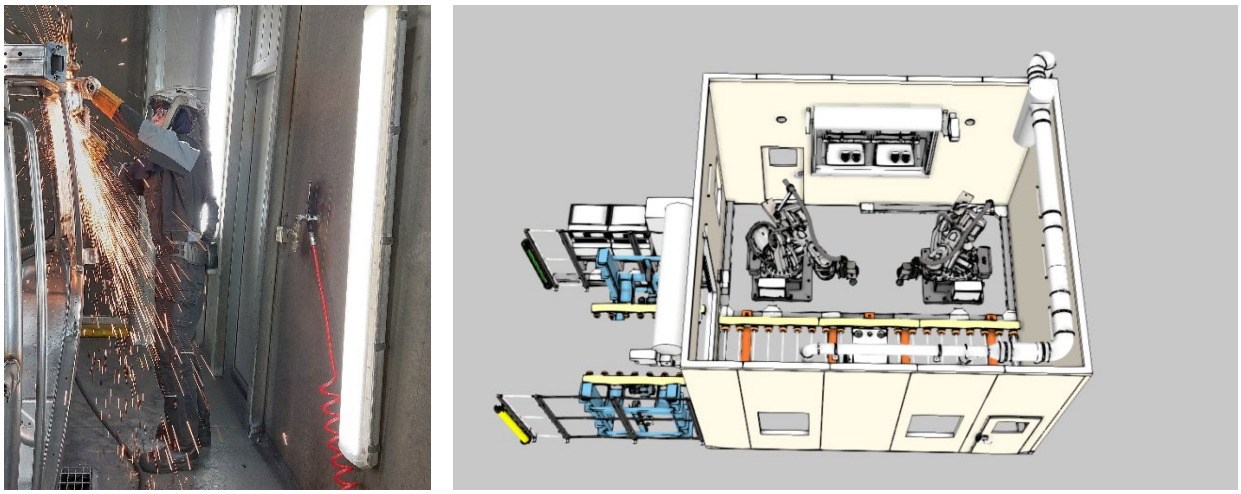

Figure 1: Grinding task with ergonomically hazardous working positions (left) and a design solution for a new automatised solution (right)

Discussion and key takeaways

Manufacturing companies need data on humans and technology to support their business development. This study shows how ergonomics data collected through video observations supplemented with actual OHS and productivity data can lead to investment decisions considerably higher than those being often in the ergonomics literature considered as “low-hanging fruits”. Through our interview approach, this study collected management and white-collar workers' insights into the usability of the ergonomics data collected and processed through the video observation process.

As the main author of this article works as the OHS manager in the case company, this study delivers a practical message from working life. A key takeaway is that ergonomics data is also of interest to the stakeholders if it can be tied to actual data on OHS and productivity. Thus, the data collected on ergonomics can be a good additional incentive for decision-makers to invest in manufacturing automation and technology.

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