CASE STUDY

SMART AUTOMATION TO REDUCE PHYSICALLY DEMANDING WORK IN MANUFACTURING OF STEEL PRODUCTS (ID12)

Introduction

An increasing number of companies employ artificial intelligence (AI) or advanced robotics in their workplaces. As part of EU-OSHA's research on advanced robotic and AI-based systems for the automation of tasks and occupational safety and health (OSH), 11 case studies and 5 short case studies were developed that focus on workplaces that use these technologies.

The objective of a case study is to investigate the practical implementation of advanced robotic and AI-based systems for the automation of physical and cognitive tasks in the workplace. This includes researching their impact on workers and related OSH dimensions, specifically, how OSH is managed in relation to such systems. This will help companies, policymakers and researchers gain a better understanding of the drivers, barriers and success factors for safe and healthy implementation of these systems.

To identify such case studies, several key informants at the EU and international levels, including workers' representatives and industry associations, were consulted. The participating companies then filled out a questionnaire, providing information about their company, describing the technology they use and addressing OSH-relevant topics regarding task automation. These results were then categorised within a taxonomy published in EU-OSHA's report 'Advanced robotics, artificial intelligence and the automation of tasks: definitions, uses, policies and strategies and Occupational Safety and Health'. Finally, each case study presents key takeaways, based on the experience of each company.

General company description

This Swedish company manufactures and sells steel products, specifically mesh and grid screens and panels for the protection of machinery and property. Their products are found at both commercial and residential sites worldwide. With around 1,000 workers, the company is considered a large enterprise and has been active since the 1950s. They are represented in the European, Asian and American markets, with locations in more than 40 countries.

Their key product is offering protection measures for the workplace. Their three main business areas are in machine guarding, warehouse partitioning and property protection. In these areas, they translate their involvement into protecting not only property and processes but also people. **They aim to keep their product users safe and develop innovative safety solutions.** Furthermore, they continuously strive to improve quality and standards within the industry.

To achieve these goals, they have turned to various solutions for smart automation. According to them, they belong to the **early adopters of industrial robots** and automated production. **Their automated systems have to be marked CE based on the Machinery Directive.** The company is using harmonised standards to fulfil the requirements of the directive. The company also provides **training** to staff who will be using the industrial robots.

Description of the system

Over time, production in this company's facilities has progressively become automated to the point where production today is almost fully automated. The short case study presented here involves a large production line with **robots performing different tasks from welding to painting of the steel panels**. **Autonomous guided vehicles (AGVs)** are also involved in the processes. AGVs retrieve materials, deposit them into the machinery (production line), and then retrieve and package for them storage afterwards. There is, in some locations, an automated warehouse attached to the production site. Workers are involved only in a few steps of the production, with some discrete tasks in **tagging wares and at the stages where products are painted**. They may also have a more hands-on role for **smaller, custom orders** that are not produced in large numbers.

Overall, the new systems have automated monotonous repetitive tasks, leading to a larger task variety and more specialised work for the workers.

There are two main components to the system: firstly, **AGVs**, which move materials and products to and from the production line, and secondly, machinery within the automated production line. AGVs are equipped with lidar sensors (radar sensors to measure distances and velocity) that can identify whether workers, vehicles or other objects are in the way, at which point they brake and only resume driving when the road is clear.

The machinery for the automated production line is monitored and, when necessary, guided by touch screens operated by workers. It carries out all aspects of production from start to end. **Only about 10% of production is still performed manually, applying to small batch orders. For these tasks, it is important to have workers in the company who are skilled in manual assembly processes.** However, most workers have been upskilled into supervisory positions. This includes monitoring of the robotic systems as well as new maintenance tasks. The AGVs are capable of navigating the shop floor while human operators are on it as well. This way there is collision-free coexistence between the two parties.

As production automation has been a continuous process, no one specific challenge stood out to the company. **Workers in the production area had to be retrained to move into more specialised or supervisory tasks in the factory.** By now, the workers' main role is to provide key impulses to continue specific processes during production.

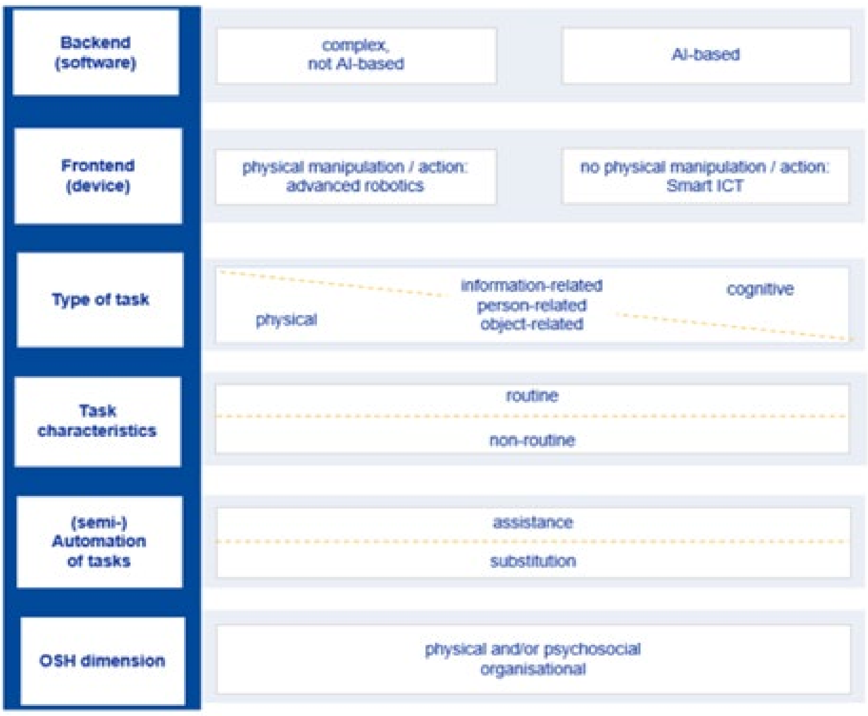
Taxonomy-based categorisation

To categorise different types of technology, a taxonomy specific for different important criteria of advanced robotics and AI-based systems was developed and published in the EU-OSHA report 'Advanced robotics, artificial intelligence and the automation of tasks: definitions, uses, policies and strategies and Occupational Safety and Health'.[1] This taxonomy includes the type of backend and frontend used and the type of task performed, as well as which category it falls under (information-related, person-related or object-related). It distinguishes between routine and non-routine task characteristics as well as the degree of automation in the forms of assistance or substitution. Finally, the taxonomy takes into account different OSH dimensions (physical, psychosocial and/or organisational) that are impacted by the technology.

The production line by now incorporates a mix of **cognitive and physical tasks** based on a **complex non-AI-based** backend software. It performs **physical** manipulation with the help of a non-physical **decision-making mechanism**. As described earlier, workers are involved only in a few steps of production, giving key impulses for the systems to continue working. This falls under the category of labour **substitution**, as the robots primarily perform the tasks, not the humans. Concerning the AGVs, they too perform a physical task based on object manipulation and operate on a non-AI-based software backend. The company describes OSH implications mainly regarding **physical** aspects of the automation; however, there are also **cognitive and organisational** factors, which are described in detail below.

[1] EU-OSHA – European Agency for Safety and Health at Work, *Advanced robotics, artificial intelligence and the automation of tasks: definitions, uses, policies and strategies and Occupational Safety and Health*, 2022. Available at: https://osha.europa.eu/en/publications/advanced-robotics-artificial-intelligence-and-automation-tasks-definitions-uses-policies-and-strategies-and-occupational-safety-and-health

Figure 1: Taxonomy for advanced robotics and AI-based systems for the automation of tasks



OSH implications

The system is set up in such a way that workers interact as little as possible with the machinery and the AGVs. This is, for instance, done through a **screen or door separating** workers from the automated production line and sensors in automated processes that identify the presence of workers. Safety mechanisms are triggered should a worker enter a dangerous zone.

In terms of OSH effects, the automation of the production and logistics has meant that workers carry out far **fewer physical tasks**. This means that there are fewer **strain injuries** from lifting heavy objects or carrying out repeated tasks and fewer work injuries relating to, for example, welding (where fumes over time can have a negative effect on the health of workers' lungs).

An identified OSH risk, despite all this, is that some workers appear to either **not be aware of the machine** or not treat it **as intended and expected**, meaning here that a worker feels the need to **second-guess** or **alter the course** of the machinery, rather than let it progress according to its planned programme. Unplanned alterations to a standardised process can lead to unplanned risks and financial losses.

To cut down on **unauthorised or unnecessary interactions** between workers and machinery, biometric doors and barriers have been installed, which automatically log when they are opened and record who enters the area. **Workers or maintenance personnel** should only enter an area where machines are active, if they have a clear and mandated purpose there. Further, there is a **risk assessment** process in place to identify and mitigate any risks that might arise from the use of the machines. One important aspect is **to take the perspective of the workers into account** so that they truly understand the safety issues. According to the **safety manager**, this is a **pre-condition for designing safety rules** and procedures that work (for instance, workers might try to 'outsmart' or manipulate the safety procedures if they are not convinced about their usefulness). This process is dynamic and is updated regularly with ongoing additions to the machinery. **The importance of a 'safety culture' was stressed multiple times, which also means there is zero tolerance from management towards risky behaviour.**

The company expects that as time goes on and workers become more **used to the machinery**, the increased familiarity will lead to fewer such incidences. Since the installation of automated machinery in 2009, significant adaptations have already been made. The company expects to expand its automation process in the future, which will have different implications, especially regarding human–robot collaborative processes.

Another important implication regarding the OSH impact might be the initial reaction of the workers to the machines, which might have a **negative impact on their wellbeing**. In the beginning of the automation process, there was **worry among workers that their jobs would be replaced by robots** but the company states that this did not happen. Workers were subsequently assigned elsewhere, and some had to **learn new skills** (regarding the control of the new machinery). These initial issues have been resolved, with the acknowledgment that the company still needs workers who are very familiar with the production process — even if they are not doing it manually anymore.

Key takeaways and transferability

The use and functionality of advanced robotics or AI-based systems can differ greatly from use case to use case. However, gathering information on similar use cases and transferring applicable insights about opportunities, risks and challenges, or other lessons, learned can help companies navigate the implementation process more efficiently and successfully, especially concerning OSH.

A major influencing factor on OSH is the **trust** that workers have in the system. It can affect how or even whether the system is used at all, if it is used correctly and safely, and whether it is properly maintained. Mistrust can lead to a number of OSH risks, which this short case study has been able to identify, in cases where workers are **not using** or do not **trust** the machinery. This leads to workers **second-guessing** or altering the work process rather than letting it progress according to its planned programme. These changes can lead to increased safety risks. Any benefits possible through the use of the system cannot be taken advantage of when it is not used at all, and misuse or alteration of functions can pose unforeseen physical risks. Identifying this lack of trust in workers is vital to enact countermeasures.

Another important takeaway is the observed **development over time** and the different OSH factors throughout. While at first a negative impact was observed (**fear of job loss**), countermeasures by the company in the form or re- and upskilling their workers, and reassigning them to new tasks, resolved this fear efficiently. The second time-related effect is that increased familiarity with the systems **reduces incident rates** of injuries or complications. This illustrates that OSH is a continuous process that should be monitored as such to become fully aware of both positive and negative developments.

Authors: Eva Heinold, Federal Institute for Occupational Safety and Health (BAuA), Patricia Helen Rosen, Federal Institute for Occupational Safety and Health (BAuA), Linus Siöland, Milieu Consulting SRL, Dr Sascha Wischniewski, Federal Institute for Occupational Safety and Health (BAuA).

Acknowledgement: The authors thank Prof. Dr Phoebe Moore, University of Essex, for her constructive comments and feedback.

Project management: Ioannis Anyfantis, Annick Starren (EU-OSHA).

This case study was commissioned by the European Agency for Safety and Health at Work (EU-OSHA). Its contents, including any opinions and/or conclusions expressed, are those of the authors alone and do not necessarily reflect the views of EU-OSHA.