DRONES INSPECTING WORKSITES OF GAS INFRASTRUCTURE OPERATOR (ID16)

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 short case study, describes a Norwegian gas infrastructure company that is operator for integrated systems that transports gas from the Norwegian continental region to other European countries and the United Kingdom. Their objective is **safe and reliable gas transport**. They are state-owned and were founded in the early 2000s. They currently employ over 350 workers. They heavily focus on value-driven business conduct towards their customers, partners and workers. Their core values lie in **ethical, sustainable and socially responsible business conduct** as well as a strong internal focus on the **personal development of their workers**.

The expertise of their workers is described as a fundamental requirement for the safety and reliability of their operation. They see the personal and professional development of their workforce as an important goal and aim to support talent within their company. They also created a specialised unit focusing on safety, security and sustainability towards the environment but also towards their workers' workspaces. Duties of this unit include risk assessments and management, emergency preparations, monitoring of OSH laws and governing documents, and regarding all points: continuous improvement.

As they are state-owned, the Norwegian government sets their operation framework. They operate pursuant to the **Norwegian Petroleum Activities Act** and in close collaboration and agreement with the gas transport system owners. This also includes maintenance of current and future developments of gas infrastructure. It is within the nature of their operation that they need to supervise large worksites, in which operations take place on several levels of height. These worksites are, if over ground, outside and exposed to weather conditions. Furthermore, as the needed infrastructure for gas transportation is large, operators need to work at different heights throughout the worksite.

Overseeing such a large area for obstacles or other safety hazards can be a physically demanding manual task. To improve working conditions and worksite safety simultaneously, they introduced AI-supported drones.

Description of the system

Being a gas infrastructure operator results in the company having multiple worksites. Each worksite spans over a large area that needs supervision and maintenance. Keeping these areas free of obstacles, be they natural hazards, material detrition or human-made obstacles, is a vital part of keeping the area safe to work in. Furthermore, the worksites need to be inspected for damages or other types of anomalies on a regular basis. However, as the worksite is large, and some areas involve safety hazards (for example, inspecting a high construction), the company started to equip **drones** with modern camera technology as well as an **AI-algorithm**. These drone-based visual inspection systems can safely be employed onsite by an operator and fly to inspect an area either for obstacles or for specific hazards. The algorithm analyses the visual input of the camera specifically for fallen or forgotten objects or work parts. It was **trained** on a large **indexed image database** to differentiate between, for example, tools forgotten by workers, which have to be collected and returned, and other hazards, which do not need imminent human intervention, like tree leaves. When the algorithm categorises an object as an obstacle that needs to be removed, the **operator is informed**, and a worker is deployed to that specific worksite to carry out the necessary follow-up tasks. These tasks can be the removal of the obstacle or lead to a more thorough worksite inspection.

So far, there have been no obstacles during the introduction of the system. Its effectiveness is highly dependent on the quality of the AI-based image analysis. Hence, **extensive training** prior to using the drones was necessary.

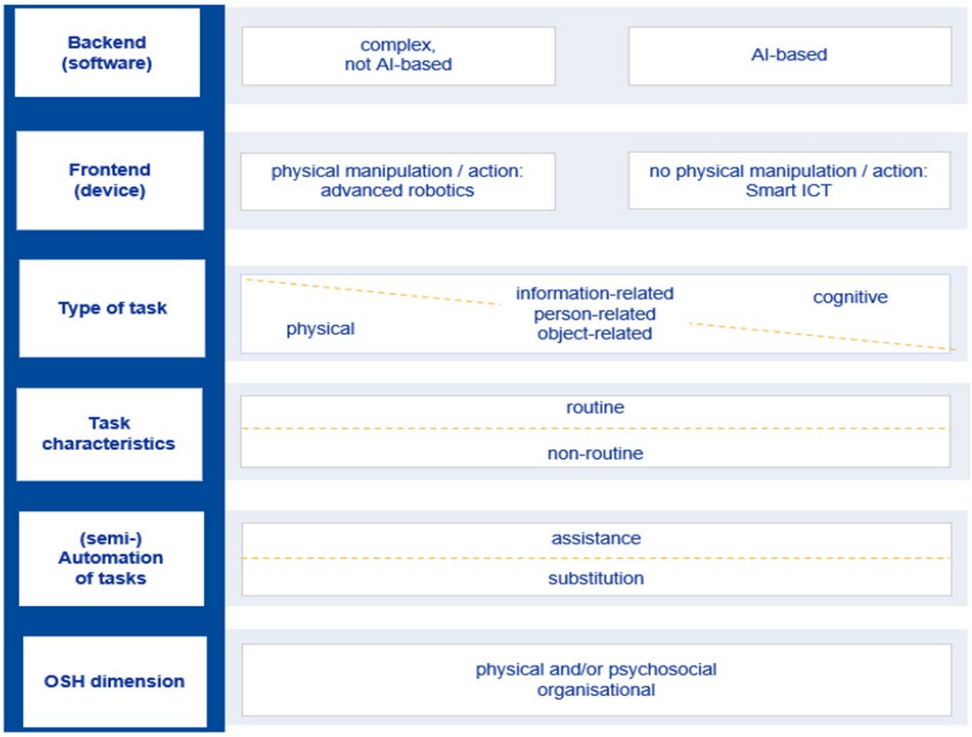
Taxonomy-based categorisation

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 drone-based visual inspection system performs a primarily **cognitive task** based on **AI-based backend software**. It therefore performs a **cognitive, information-related** task. While it identifies physical objects and its results can lead to these objects being physically removed, its primary task, the image analysis, is information-based. With this, the visual inspection system is **substituting** human labour to a significant degree. While a worker can theoretically still judge each case individually to change the actions taken based on the AI results, with increasing precision of the algorithm, the likelihood of this occurring is reduced. The **remaining parts of the task** are the necessary interventions that need to be performed based on the analysis. These interventions can be retrieving or removing a fallen object, performing minor repair work or initialising the process for major repairs. For these tasks, unskilled or specialised workers are then sent out accordingly. OSH implications described by the company focus on **physical benefit** 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 AI implemented in the drones mainly affects **physical OSH**, while it automates a **primarily cognitive task**. Collecting or removing tools, parts or other obstacles from a worksite can involve safety hazards. Visual inspections in **high** areas can mean a worker has to physically be elevated to the inspection level. By using the drone, they do not have to expose themselves to the risk of falling and, overall, can reduce their time spent in high places. Additionally, workers' **physical workload and strain** is reduced thanks to the system. The time workers spend walking to and from inspection sites is cut down significantly. In addition, given that most of the worksite is outside, without cover, workers are less exposed to weather **conditions**, be it heat or rain.

Prior to the adoption of the drone system, workers had to walk on the worksite for inspection, or go towards specific areas, if/when someone spotted an obstacle. There, they would identify the object and perform the needed intervention (for example, forgotten tools were collected and returned to storage). The automation through drones results in workers performing this task less, and in a different manner. They no longer need to inspect sites that do not need intervention. Instead, **they have more time to perform their primary tasks with fewer interruptions, or even pick up other tasks as well**. This can be seen as an improvement in the psychosocial OSH dimension.

Drones provide another, initially unintuitive, benefit regarding worksite supervision and maintenance. In more traditional worksites, surveillance solutions would require cameras being installed at the worksite. However, given the area the cameras would need to cover to be effective, this would be a significant financial investment. At the same time, it would be unavoidable for workers to be on the camera feed. **Drones with cameras can be used for much more targeted visual inspection**, avoiding unnecessary recordings of workers. This way, the drones allow **greater data privacy** for workers.

The system **supports** workers in charge of worksite supervision and maintenance. While the drones **do not replace thorough and detailed inspections** of machinery and parts, they reduce the time spent on general retrieval in the field. Manual inspections are still performed, however. By having a drone fly to a specific zone to inspect it, the operators save time and can focus on more vital maintenance tasks. However, operating the drone is a new skill that workers have had to acquire. And should the operator disagree with the AI's assessment of the obstacle, they can still employ someone to physically inspect the area.

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.

This short case study demonstrates how an AI-based system can automate a primarily **cognitive task**, yet in its application primarily have **physical OSH effects**. Having to physically walk to an area of the worksite, only to identify if a spotted object needs to be removed, is a cognitively unchallenging task. It falls under the **3Ds (dull, dirty and dangerous)** of tasks, which are well suited for automation. In addition, there is no noticeable risk of deskilling, when it comes to this kind of task. Hence, the company identified a highly suitable task to automate that resulted in their specialised workers performing more of the task they trained for.

Combining the visual analysis with a drone results in initially unintuitive benefits. By utilising camera-equipped drones as a method for collecting the visual data, the company not only achieves greater flexibility for worksite inspections, it also **maintains greater data privacy for their workers**. A drone can be sent into a specific area and collect localised visual data. To achieve the same area coverage on continuous security cameras would be a large financial investment, at the possible cost of worker privacy.

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