AN ARTIFICIAL INTELLIGENCE-BASED SYSTEM FOR VISUAL RECOGNITION OF HAZARDOUS PARTICLES IN AN AIR SAMPLE (ID8)

1 Introduction

Automating tasks through technological advancements has been an ongoing process in many industries. This development can also significantly impact occupational safety and health (OSH) in a work environment. It enables the removal of workers from hazardous situations and can improve the quality of work. This can be accomplished by automating cognitively strenuous tasks using an artificial intelligence (AI)-based system or by 'delegating' repetitive tasks to accurate and tireless machines like intelligent robotic systems. Some tasks might not be fully automated, but workers can still receive support through, for example, collaborative robots (cobots) operating in a shared space with workers. An increasing number of companies employ AI or advanced robotics. Although still in their infancy in terms of deployment, AI-based systems for the automation of both cognitive and physical tasks, as well as intelligent cobots, show promise in a variety of sectors. However, more information is needed on how they are implemented and managed in the workplace to help ensure workers' safety and health in present as well as in future applications.

EU-OSHA has developed a number of case studies with the aim of investigating the practical implementation of AI-based systems for the automation of physical and cognitive tasks and of intelligent cobots in the workplace, their impact on workers, how OSH is managed in relation to such systems, and to gain a better understanding of the drivers, barriers and success factors for the safe and effective implementation of these systems.

To develop these case studies, several key informants at the EU and international levels, such as workers' representatives and industry associations representing the targeted sectors, were consulted. Initially, 16 cases were identified and preliminary information was collected through a questionnaire. Hereafter, 11 of them were further developed into case studies, including higher levels of information collected at the workplace level.

2 Methodology

The primary data source for the case studies was interviews held with different stakeholders within companies. For each case study, up to five interviews were conducted with workers of the company from different work areas. The participants included operators, data protection officers, health and safety engineers, managers work-councillors and technology officers.

The interviews had a duration of 1-1.5 hours each and were performed in the participants' native language, if possible, or alternatively in English. The interviews were conducted using an interview guide, while the results of the interviews were anonymised.

3 General company description

The ministerial research institute used for this case study is in Germany, was founded in the 1990s, and focuses on a wide variety of topics and research relating to OSH. This institute currently employs over 500 people. Its core tasks include providing political advice as well as information and guidelines for operational practice and practice-oriented research and development. This includes **research regarding occupational safety, working conditions, health hazards to workers resulting from exposure to work equipment and materials, and complex workplace influences or work processes on workers**. To achieve this, the institute also employs AI-based systems.

The institute's central task is to promote OSH and humane work design. It has the ability to monitor issues of significance in the long term, which in return enables it to identify emerging trends in the world of work and close gaps in existing research. The institute strives to identify opportunities and risks for workers early, develop approaches for innovative OSH measures, and ensure OSH concerns are factored in, as technological and organisational innovations are developed and introduced in the workplace. Their research contributes to the knowledge base in specialised, work-related disciplines and provides a scientific foundation for policymakers, official agencies and workplace OSH practitioners.

One specialist research department within this institute focuses on OSH regarding particulate hazardous substances such as nanomaterials. They research the effect of exposure and material morphology. In addition, they are involved in the development of pre-regulatory testing and preventive strategies to protect workers from particle exposure. To research the effect of particulate hazardous substances and innovative materials, they use state-of-the-art equipment for aerosol measurement, particle analysis and imaging. A recent addition is an AI-based system to support researchers in determining the count of specific fibre material in a sample.

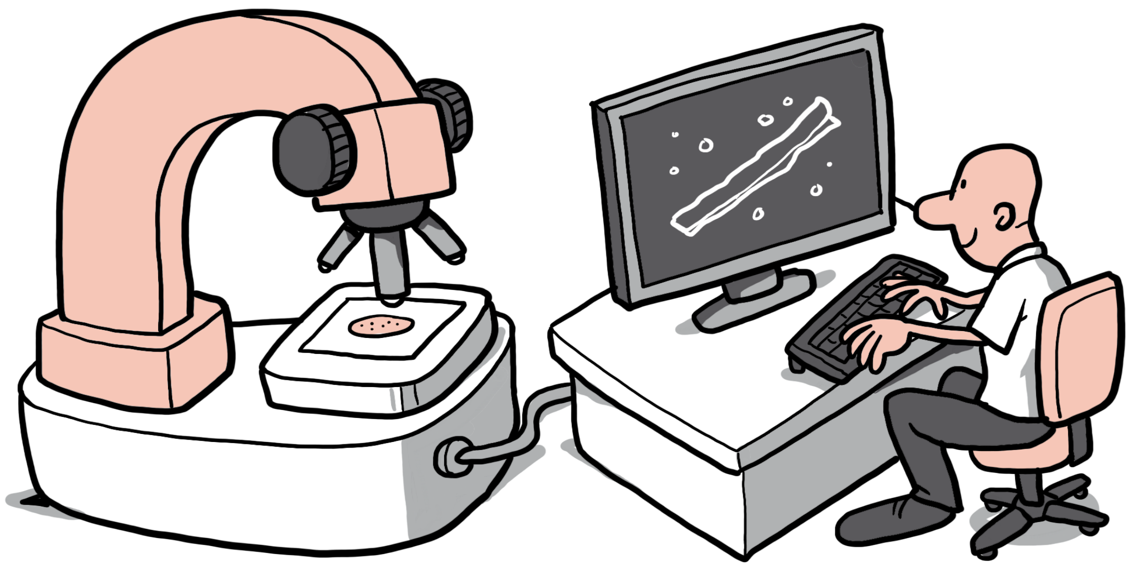
3.1 Description of the system

To research the density of specific hazardous particles in an air sample, advanced analysis techniques have to be used. Microscopic particles of materials like asbestos can have detrimental health effects if a person breathes them in. Hence, samples can be taken at workplaces to analyse the present particles and should a worker's exposure rate be too high, countermeasures like air filters need to be introduced. These particles can be as small as 20 nm to 3 µm and can be seen under specialised electron microscopes. Previous analysis tools had to operate at their maximum capacity to detect these fibres. Most common electron microscopes do not perform this task efficiently. Once they were detected, they had to be classified by hand, which is a time-consuming process.

The developed AI can instead analyse the electron microscope image, and then detect and classify fibres on the filter by size. The size of the detected fibre matters, especially when it comes to particulate hazardous substances. Only those that are **bio-persistent and fit specific size criteria (longer than 5 µm, with a circumference smaller than 3 µm, and a length to width ration of 3:1 higher than 3) are to be included in the analysis**. This can create more than 700 images for one sample. The AI-based system was developed by the researchers who use it themselves. Initially, it was developed to detect nanofibers, however, during training, it was discovered that the system is also highly efficient in classifying larger fibres. Hence, it was trained with new annotated data to specialise it for its current purpose. The underlying algorithm uses a random forest to learn. It was trained on hand-annotated data by the developers. Furthermore, they used transfer learning and reinforcement learning to improve their system. Automating the detection and analysis of particles of the electron microscope images with an AI-based system makes the process more efficient, decreases completion time and reduces subjective errors.

A cartoon-style representation of the system, performed tasks and interaction with workers, including some of the challenges and opportunities for OSH is presented in Figure 1.

Figure 1. An artificial intelligence-based system for visual recognition of hazardous particles



3.2 Taxonomy-based categorisation

To categorise different types of technology, a taxonomy specific for different important criteria of AI-based systems and advanced robotics was developed by EU-OSHA.[1] This taxonomy includes, among others, 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 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.

Figure 2: Taxonomy for AI-based systems and advanced robotics for the automation of tasks

For one thing, this technology is a time saver for researchers. It preselects images in which relevant fibres are present and helps classify the detected fibres.

Regarding a change in job content, the AI had little to no impact. Analysing these images is not the primary task the researchers have, but rather interpreting the results of the fibre count and drawing conclusions based on them. The system therefore **reduces time spent on a task that requires continuous concentration, on highly repetitive content**.

[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

The research institute developed the AI in house. No third-party developer was involved. When creating it, they took ample considerations to ensure that data security was taken seriously, also following the general data protection regulation (GDPR). However, no person-related data were collected at any given moment. While the system is, in theory, connected to a camera, the said camera cannot be used to capture someone’s likeness in an identifiable way. Therefore, concerns for privacy violations could be dismissed.

The primary group affected by the introduction of the system are the researchers who developed it. The system is not commercially distributed and has changed their job content and routine significantly. Previously, every member of the team was trained in identifying and marking fibres in the images and spent a significant amount of time performing this task. The task was so time consuming that, at times, it was the primary task of hired assistants (student workers). In some research projects, to ensure accuracy of their sample analysis, each image was analysed by two workers independently, doubling the time and resources needed to complete the task. While today all members of the team are still able to perform categorisation by hand, and do so sporadically, they now have more time to dedicate to their primary job content, which is the analysis and interpretation of their research data.

4 Implementation process

A key factor for the successful integration of technology into a new work environment is the implementation process. Several factors, such as the identification of objectives and goals prior to implementing the technology, design decisions and participation, worker involvement and training, as well as the inclusion of guidelines or legislation, can influence it. In addition, some of the most important steps are the assessment of whether the intended goals have been reached, documentation of what challenges were faced, and finally consideration of how these lessons influence future company plans regarding the implementation of either new systems or more of those already implemented.

4.1 Motivators and goals

Setting **goals** prior to implementing a technology can help quantify the success of the implementation and also inform what kind of technology is needed to reach them. The interviewees expressed a number of objectives and goals for the introduction of the AI-based system.

One primary goal was to **make the process of manual image analysis redundant or optional**. It is a time- and labour-intense work step, which simultaneously requires concentration on a dull task. Advanced robotics and AI-based systems are often described to be well suited to automate 3D tasks: dull, dirty and dangerous. The image analysis was described by the interviewees as extremely dull, especially if done for long periods of time. While the work was split among the team members, some projects still required several days of image analysis. The AI-based system should perform this task, and ideally perform it faster and more accurately than a human.

In broad terms, the AI was also developed to **make the workplace more ergonomic**. The task of analysing each individual image by hand was described as extremely tiring, repetitive and dull. Hence, automating it would improve workplace ergonomics.

Lastly, resource-related considerations played a role. Not only was it a **time-consuming task**, it was performed by highly educated and skilled workers. A rough estimation of the time saving is that the process of analysing an image previously took a worker around 10 minutes, while it now takes the AI-based system around 10 seconds. The researchers’ time can now be allocated more effectively, performing tasks that involve critical and analytical thinking. The AI-based system was one way to enable them to do that.

While the technology is still comparatively new, so far, the interviewees consider these goals to be met.

4.2 Implementation

Before a new technology can be introduced to a workplace, there are a variety of factors to consider and often several stakeholders to involve. The implementation process can differ from company to company. With AI-based systems and advanced robotics being so customisable in their application, the general implementation is going to be different for each case study. Nonetheless, there can be common implementation steps taken, with regard to who is involved in the process. The standards considered to implement a technology are equally important, both with regard to which are widely used and which are relevant to a specific case study. Furthermore, the individual difficulties and challenges are as vital to understanding the success of a case study as the ones more broadly shared among several case studies.

4.2.1 Implementation steps

The research team developed the AI-based system themselves. As is typical with newly created AI-based systems in their developmental stages, it was an iterative process. Development of the AI-based system started in 2015 as a non-AI-based approach, however later they incorporated a neural network, as it proved to be the more efficient solution. The neural network was trained on hand-annotated data from the researchers, however the learning strategy had to be adjusted several times to improve the results. In theory, the implementation of the system has not yet been finalised, as the researchers continually train the neural network to improve its accuracy. The implementation process happened in close collaboration with and involvement of the research team. While there was a head developer, others contributed to the system by creating the training data.

At some point during the development process, the developers saw benefits in upgrading their hardware system, for which a formal application to the financial department of the research institute needed to be submitted. This was granted, and they upgraded their hardware as needed.

The implementation process as a whole can be considered on a low threshold level, and comparatively self-contained within the research group, which held the approval authority to initiate the development of the AI, and the technological competences to translate their ideas into action.

4.2.2 Standards and regulations

The German data protection regulation was considered during the development of the AI-based system. They found that the technology does not collect nor analyse any sensitive or person-related data. Furthermore, the research institute has its own safety guidelines, which were considered during the development and implementation of the system.

4.2.3 Difficulties and challenges during the implementation

The difficulties and challenges encountered during the development process of the AI-based system were mainly on the technological side. An initial hurdle was **selecting training data that were high quality enough on which to train the AI**. This was partially due to human error, or the AI's initial decisions on how to handle corner cases, like a fibre touching the outer frame of an image or identifying fibres that overlap accurately. Furthermore, as the developers used transfer learning, they encountered instances in which the system lost certain skills from one instance to another. However, in combination with reinforcement learning, the AI reached a level that provides a sufficient analysis.

4.3 Worker involvement

Worker involvement during the implementation process can contribute to the success of a technology's implementation. Depending on the circumstances, this involvement can start at the design stage, or once training to use the technology starts. While there are external factors that can limit the extent to which workers can be involved, companies seeking to introduce AI-based systems should consider at what stage worker input can be included.

The system was developed by the researchers who ultimately ended up using it. The idea for the system also came from within the team. This would be the most fundamental and earliest type of worker involvement in the system development process one can find. They were able to create a system that uniquely fit their needs and preferences and were able to provide input from start to finish.

4.3.1 Training and worker qualifications

Worker training and education is a major element for the success of technology implementation,[2, 3] For workers to use the AI-based system, no additional training was needed. This is partially because the people who ended up using it were actively involved in its development. Secondly, it is now integrated as part of the initial analysis software and all researchers need to do to use it is click a few buttons on the familiar and intuitively designed interface. Should the system, or a system similar to it, be distributed or used by someone with no prior experience with the software, they would need training, but not specifically because of the AI-based system.

[2] Waldeck, N. E. (2000). *Advanced manufacturing technologies and workforce development*. Garland Press.

[3] Fraser, K., Harris, K., & Luong, L. (2007). Improving the implementation effectiveness of cellular manufacturing: A comprehensive framework for practitioners. *International Journal of Production Research, 45*(24), 5835-5856. https://doi.org/10.1080/00207540601159516

One of the concerns when it comes to the automation of tasks through an AI-based system is the process of deskilling. Automation like this is generally seen as a starting point for one of three skill developments: **deskilling, reskilling or upskilling**.

It is true that the amount of time a researcher spends on marking fibres manually has decreased significantly. However, interviewees did consider this a process of deskilling for two reasons. First, manual analysis is still sporadically performed and a vital source of new training data for the system. Output by the AI is also sometimes corrected manually, a process that relies on a worker currently having a higher skill level than the AI (especially regarding more complex or rare cases). Second, it is not considered a task that needs a highly specialised skill set and can be taught to a person in a relatively short period of time.

As mentioned before, the **AI has freed up a significant amount of time within the research group**. This newly available time can be used to attend trainings and focus on upskilling, however, upskilling is not mandatory to use the system, but rather an opportunity that arose because of it.

4.3.2 Feedback system and report handling

Given that the system was developed within the research group and is being used by them, the feedback system and report handling can be described as very direct. Should a researcher using the technology run into any problems or concerns with the AI-based system, they can directly voice their concerns to either the head developer or their team lead. Regarding OSH, so far there has only been positive feedback about the system, as it is perceived as a significant relief.

For all concerns or feedback, be it OSH-related or not, which a worker would or could not communicate directly to their team lead, the research institute offers a variety of support systems. Depending on the feedback or report, a worker can contact the **workers council, equal opportunities officer, representative for people with disabilities, the occupational safety and health committee, corporate health management, an independent confidential worker and managerial advisor, or the company doctor**. **There are also resources available for psychological support and special needs in case of parenthood.** Depending on the type of information and institution contacted, the report is handled openly or anonymously and processed with appropriate urgency.

4.3.3 Level of trust and control

An adequate level of human trust towards the interacting system promotes an appropriate system use,[4,5] while extreme forms of trust can lead to adverse effects. Excessive trust can lead to automation complacency,[6] whereas insufficient trust may lead to neglect of the technology.[4]

Any researcher who wants to use the AI-based system can do so. **They have the freedom of choice to use the AI in the programme or not.** In individual circumstances, analysing the images by hand is still done, however, most of the time, researchers decide to use the system. It is more efficient and mostly more precise than human analysis. In some cases, the researcher corrects the system's output manually, and thereby creates new training data for the next training cycle. The researchers also remain in control over the system's output. It only provides the annotated images and data on them. How to proceed and how to interpret the results is still up to the researchers.

Importantly, as this AI-based system is continuously being trained on new and improved data, one could think that a factor of unpredictability might arise for the people using it. This is not the case. The system does not learn during day-to-day use but instead during dedicated training episodes. Hence, the system will not change its behaviour unannounced.

In addition to trusting the system, a **worker's level of control** can have significant influence on a number of factors. As everyone in the research team contributed to the system in some way and was aware of its development from the start, they are all very familiar with the capabilities and limitations of the system. Hence, they have an adequate level of trust in the system to perform its tasks reliably and efficiently. At the same time, they are aware that the system can still improve, which is why they continuously work on improving the underlying algorithm.

[4] Parasuraman, R., & Riley, V. (1997). Humans and automation: Use, misuse, disuse, abuse. *Human Factors, 39*(2), 230-253. https://doi.org/10.1518/001872097778543886

[5] Hancock, P. A., Kessler, T. T., Kaplan, A. D., Brill, J. C., & Szalma, J. L. (2020). Evolving trust in robots: Specification through sequential and comparative meta-analyses. *Human Factors, 63*(7), 1196-1229. https://doi.org/10.1177/0018720820922080

[6] Parasuraman, R., & Manzey, D. H. (2010). Complacency and bias in human use of automation: An attentional integration. *Human Factors, 52*(3), 381-410. https://doi.org/10.1177/0018720810376055

4.3.4 Company culture and structure

When talking about advanced robotics and AI-based systems, one encounters the fear that their introduction will lead to social isolation or have other negative impacts on a company's culture and structure. Counterbalancing that is the opportunity to have machines perform repetitive, less social tasks and free workers up to focus on more socially complex or supervisory tasks.

The effect this specific AI-based system had on the social structure of the team is particularly interesting. Among those who were performing the image analysis by hand, there seems to have been a **feeling of community in the mutual dislike for the task**. Once the AI was introduced to perform the task, this mentality dissipated. Overall, the social interaction in the group now is described as less polarised and on a higher intellectual level. So, while there were no formal changes to the research team's structure, the social culture changed. The interviewees all much preferred 'losing' a specific task and having this feeling of shared dislike to keeping the task around. General conversation among co-workers is now described as being of higher quality and focused on more relevant topics.

4.4 Future developments

The AI-based system is still to be expanded in the future. The developers **aim to integrate material information about the analysed fibres** (types of atoms and what kinds of chemical bonds occur). The AI is to be trained to distinguish between different materials and their components. The output would then include the identification as, for example, 'synthetic fibre', or 'iron fibre', and so on. This can be especially useful in differentiating between different types of asbestos. Until now, this step is still performed manually by workers comparing the current image analysis with component tables.

However, while there is the intention to expand the system in its capabilities, the developers are also aware that this kind of expansion will come with unique challenges. The amount of data and processing power needed is likely to grow exponentially, which needs to be accounted for.

5 OSH Impact

The introduction of an AI-based system or a collaborative robot can have a wide impact on OSH. It can pose a number of challenges as well as opportunities unique to each case study. In addition, it is important to identify possible barriers and drivers to consider them in future projects. These new forms of task automation can even lead to changes in the overall OSH management of a company. Through the interview, a number of these factors for this specific case study have been identified and discussed.

5.1 Challenges

As AI-based systems allow highly individualised solutions for most end users, they might also present challenges specific to their use. In addition, more universal challenges can emerge, which the company then must address. The interviewees did not report any OSH challenges during both the implementation phase and in ongoing day-to-day work.

The system is described as being uniquely positioned to only create opportunities in terms of OSH. This does not mean that the system is not to be observed critically and that developments should not be recorded. However, the biggest challenges and considerations that the interviewees see with this system is its impact in the context of workplace OSH analysis.

The system is used to assess OSH-relevant factors at workplaces. This comes along with the challenge and need to create a system that is as free from bias as possible. **Any bias in the system could erode trust and obviate third-party companies to have their workplace samples analysed.** Should the AI-based system be too sensitive, it can result in high costs for a company without actually improving their workers' situation. If it is not sensitive enough, workers might be exposed to particles, like asbestos, risking health complications. **So, the challenge is to create a system that can maximise its usefulness for OSH by being reliable and unbiased.**

5.2 Opportunities

The introduction of the technology to the production site also held numerous OSH benefits and opportunities.

5.2.1 Cognitive demand and workload

The task of manually selecting every fibre on every image for an analysis is described as dull and tiring. It is a task with little to no cognitive stimulation or creativity. The electron microscope images also look highly similar to one another, in different shades of grey. At the same time, the results of the analysis can have significant impact on the workplaces from where the samples were taken (for example, if particle exposure is too high, expensive air filtration might need to be installed). And the task is a prerequisite to the follow-up steps of analysing and assessing the data. So, next to significantly reducing the workload of researchers, the new system also decreases mental fatigue.

5.2.2 Job satisfaction

Increased job satisfaction as a result of the automation of a dull task is not exclusive to AI-based systems, but rather to automation itself. Nevertheless, AI-based systems can contribute to higher job satisfaction should they be implemented in such a way that these dull tasks need no longer be performed by workers. This case study is a good example of this effect.

5.2.3 Workplace safety and health

The AI-based system can also be used by the researchers to gather information on the air quality of their own workspaces. They theoretically can take samples and run them through the system. Should the output indicate heightened levels of dangerous particles, they can use these results to initiate countermeasures, like an air filtration system. In theory, they could have performed this type of analysis manually already before the AI-based system was developed. However, now that the AI-based system has made the process significantly less time and resource consuming, it becomes feasible to actually do so.

5.2.4 Screen time reduction

On numerous occasions in this case study, it has been described how time consuming the manual analysis process was. The process can also only be done at a computer. For the duration of the task, a researcher has to look at their screen and concentrate. While it cannot be said that with the AI-based system in place this time has been entirely replaced with non-screen work, a task that can only be performed in front of a screen has been automated. The researchers' remaining activities can be partially performed without a screen (for example, reading research-related papers, developing project ideas with colleagues), which they may choose to do away from a screen.

Nevertheless, the interviewees noted that excessive screen time in combination with elongated periods of sitting are an OSH concern in their field of work. This concern predates the introduction of AI-based systems. The research facility as a whole offers several opportunities to decrease time spent sitting (for example, standing desks, mobility breaks). Whether an AI-based system will increase or decrease the hours researchers spend working at a screen will vary for each case study.

5.3 Barriers and drivers

Many companies go through the process of integrating advanced robotics or AI-based systems in their workspaces for the first time. The present case study encountered a variety of barriers and drivers throughout this process. Identifying these can help this company as well as others avoid barriers and promote drivers for their process automations.

5.3.1 Barriers

When developing a technology that previously did not exist, it is expected to encounter some form of barriers and obstacles to be overcome. In the beginning, selecting adequate training data was difficult as it was not of consistent quality. However, as the project progressed, this could be overcome.

Another barrier is the **lack of systems to compare their technology** with. Currently, there are no other laboratories that use this type of analysis, so the researchers cannot compare measurements with an independent result. Comparative measures would be one way to validate the process.

5.3.2 Drivers

The most significant driver for the success of the development and implementation of this AI-based system was a **dedicated workforce**. As the system was trained by the researchers themselves, they needed to ensure the highest quality of training data possible. This required dedicated and reliable workers to provide the highest possible quality of manual image analysis. To do so, some workers spent additional time on the manual image analysis, as they knew that the quality of their training data is the foundation for creating a reliable system.

Another driver was the financial support their institute provided them with to invest in better hardware.

Additionally, they collaborated with a university and students to research how variance in the training data can be used to make the algorithm more robust.

5.4 OSH management

New technology can lead to a change in work procedure. This also includes OSH, the expectations placed in the technology and subsequent OSH management.

5.4.1 Expectations for OSH

This case study presents an interesting application for AI in relation to OSH. Not only does it affect OSH for the researchers who primarily use it, it was also specifically developed to be used in OSH research. This kind of technology becoming more widespread and used to improve OSH on a larger scale is likely to become increasingly common. The system holds promise that detection of **particulate hazardous substances such as nanomaterials will become more efficient and reliable than ever before**. So, while the technology has OSH implications for the primary users, it has the potential to improve OSH on a larger scale, beyond the research team that developed it.

5.4.2 Emerging OSH risks and monitoring

The interviewees did not name any immediate OSH risks that they see associated with the introduction of the AI-based system. Prolonged sitting and screen time are characteristics of their job regardless of the AI-based system. There is no formal system in place within the research team to monitor OSH developments specific to the system, however, as all team members work in OSH research, they have an above-average understanding of emerging OSH risks. Should any concern be found, they can directly address the head developer or their team lead so countermeasures can be taken.

5.4.3 Communication strategies

The members of the research team communicate directly with one another. Any official information on changes regarding OSH would be communicated by their team lead. **The introduction of the AI-based system has not had an effect on the communication strategies of the research team.**

5.4.4 Organisational and social impact

The development and implementation of the AI-based system has not changed the larger organisational structure nor the official group structure. Where it has had an impact is the aforementioned social component in the office. It disbanded the community around the mutual dislike for the task; a development welcomed by the researchers.

5.4.5 Integration of OSH management

No additional OSH measures needed to be taken when it comes to this specific case study. Hence, the system seamlessly integrated into the existing OSH management of the researchers' workplace.

5.4.6 Need for action

The need the interviewees identified relate more to the general approach towards technology and media. Firstly, **they highlighted that current media coverage paints a difficult and often inaccurate picture of AI, its challenges and opportunities**. They are concerned that this type of coverage will make companies and other end users less likely to accept results from an AI. This is especially problematic should the AI be used to assess the need for OSH intervention, as the results impact workers' health and safety.

Secondly, the research group wished for more **exchange between experts in the field**, expanding beyond their institute and current cooperation with universities. Exchange could not only help validate the system but also be beneficial in the development of future AI.

Lastly, they highlight that for any AI-based system used in the context of OSH, both the developers and users need to have high-quality standards for future neural networks, because only then can they be used to benefit OSH.

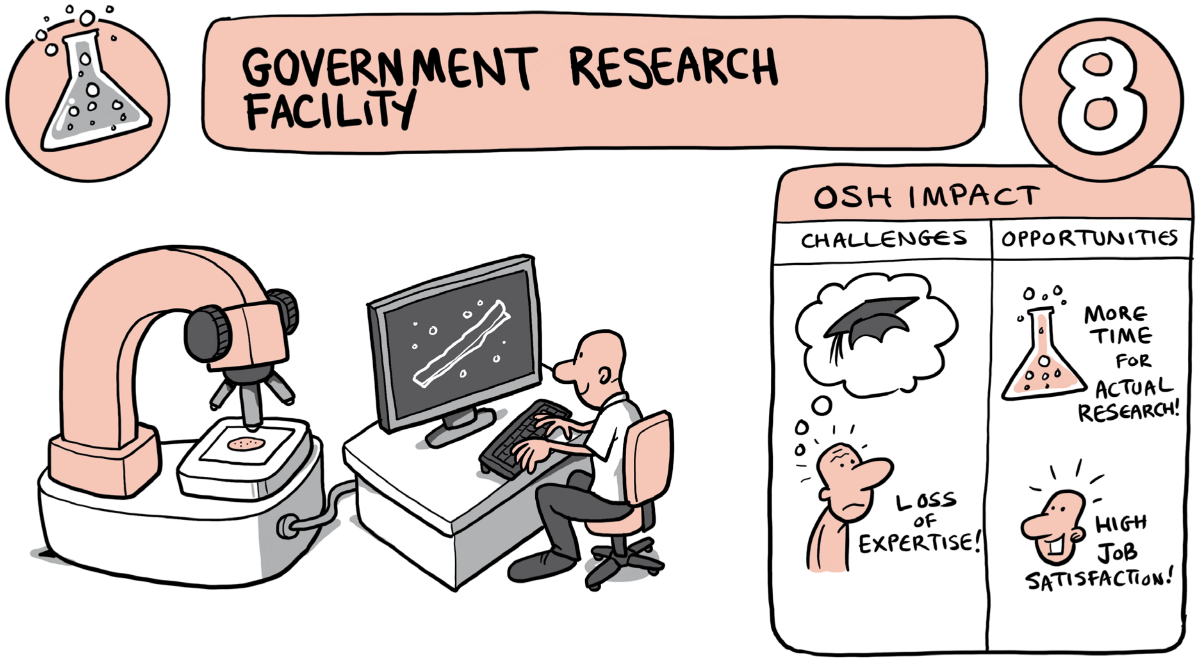
5.4.7 Cybersecurity

With technology becoming increasingly interconnected and data being a resource needed by some AI-based systems to improve their functionality, the topic of cybersecurity becomes prevalent in companies employing these technologies. The way that cybersecurity is handled at a company level is a key factor in securing the data when it comes to AI-based systems. Some systems require additional safety measurements, depending on their use.

Given that it is a government research institute, **extremely high security standards were already in place prior to the implementation of the AI-based system**. The introduction of the technology also has not sparked the impulse for additional layers of cybersecurity. The software with which the AI can be operated on is a program not connected to any other network. To gain access to the software, one would already need to have access to the researchers' protected computers; and even then, the software does not grant access to any network or data. The AI-based system is also deemed an unlikely target for a cyberattack and is seen as sufficiently protected by all measures that were in place prior to its integration.

A cartoon-style representation of the system, including some of the challenges and opportunities for OSH is presented in Figure 3.

Figure 3. AI-based system for visual recognition of hazardous particles, posing challenges and opportunities for OSH



6 Key takeaways

AI-based systems can have a direct impact on OSH. While the primary context of these case studies examines the impact of AI on OSH in relation to the tasks it automates, **this case study is uniquely positioned as it also uses AI for OSH research**. Using AI to improve OSH via that avenue is not an entirely new concept.[7] However, the larger implication is that as AI-based systems improve in their performance, they could be used to support OSH research and management on a larger scale. While these topics often focus on the risks associated with AI (for example, surveillance, bias and discrimination), AI-based systems for OSH that do not handle person-related data tend to be overlooked. The above-mentioned risk must not be overlooked; however, it should not come at the cost of dismissing AI-based systems operating without person-related data, AI-based systems for OSH research and subsequently the implications for OSH at a wide range of workplaces.

This AI-based system is extremely specialised. Its sole purpose is the analysis of one type of image. **By doing so, it effectively outperforms every individual researcher, both concerning the time needed to finish the task and, depending on the individual, the system outperforming in accuracy.** Given how much time was dedicated to image analysis before the AI-based system, one could expect fear of job loss to arise after the process became automated. This, however, was not the case. The researchers were highly supportive of automation because the task that was automated was so disliked. Instead of seeing this as a machine possibly

[7] Weerts, S., Naous, D., Bouchikhi, M. E., & Clavien, C. (2022). AI systems for occupational safety and health: From ethical concerns to limited legal solutions. In M. Janssen, C. Csáki, I. Lindgren, E. Loukis, U. Melin, G. Viale Pereira, M. P. Rodríguez Bolívar, & E. Tambouris (Eds), *Electronic Government. EGOV 2022* (pp. 499-514). Lecture Notes in Computer Science, Vol. 13391. Springer. https://doi.org/10.1007/978-3-031-15086-9_32

replacing them, it was seen as an opportunity to do more of the work they actually specialise in and enjoy. **The introduction of AI-based systems does not always instigate feelings of fear of job loss.**

Furthermore, this AI-based system also highlights that with sufficient technological knowledge present at a workplace, **workers might develop AI-based solutions to automate tasks themselves**. These highly individualised AI-based systems might not be usable for many outside a specific group, however, within the group they can have immense benefits. Nevertheless, as the interviewees have highlighted, to make an AI-based system truly reliable, comparison with other independent systems is needed. As more AI-based systems are being developed and used, the likelihood of this becoming easier increases.

The AI-based system presented in this case study is a good representation of how AI can benefit OSH, without being a disruption to the workplace. It automates a dull, time-consuming task, which it performs comparably to or better than humans, operating almost imperceptibly and undisruptively in the background. By doing so, workers can now dedicate their time to jobs that involve creative thinking and problem solving.

Authors: Eva Heinold, Federal Institute for Occupational Safety and Health (BAuA), Patricia Helen Rosen, Federal Institute for Occupational Safety and Health (BAuA), Sascha Wischniewski, Federal Institute for Occupational Safety and Health (BAuA).

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.