FACILITATING ACCEPTANCE OF AI-BASED SYSTEMS IN THE WORKPLACE AND MINIMISING ORGANISATIONAL IMPACT

Developing an effective strategy for implementing a new technology can benefit both workers and companies. There are several factors already known that influence the success of technology implementation that also seem to apply to advanced robotics as well as AI-based systems. Absolute numbers on the current state of successful innovation in companies are difficult to find, but in the early 2000s, an estimation was upheld 'that up to 70 percent of new programs – from re-engineering, installing new technology to changing culture fail'.[1] Based on our findings from in-depth interviews with companies that have successfully implemented innovative systems like advanced robotics and AI-based systems, the process is by no means guaranteed to succeed.

Organisational adjustments can help facilitate this process and possibly increase the rate of success. This is of interest for occupational safety and health (OSH) questions, for a number of reasons. Firstly, one of the underlying goals repeatedly named when it comes to the implementation of advanced robotics and AI-based systems is improving workplace ergonomics, be it the reduction of physical stressors, like forced posture, heavy lifting, cognitive strain from monotony or cognitive overload. When the introduction of a new technology that aims to improve workplace ergonomics fails, workers may stay in a suboptimal work environment longer than necessary. Secondly, the benefits of successful change management can also influence OSH post-implementation. When workers trust and accept the systems, and do not only work with them because it is mandatory, there is less risk of misuse or neglectful behaviour towards the system. This could result in more avoidable injuries or stress.

There are numerous approaches and theories about change management[2,3,4] and different companies follow different approaches, for various reasons. Hence, addressing each change management approach as applied to technological changes on a granular level would reduce the applicability of our own insights. We gained significant new insights from the empirical work we carried out, interviewing several companies about their experiences with the implementation process of advanced robotics and AI-based systems.

An established approach to resilience in the context of OSH is resilience engineering, which mainly originated from research on the functioning of complex socio-technical systems. Here, safety is not 'freedom from risk' but rather 'the ability to succeed under varying conditions'.[5] Approaches to resilience concerning safety and health tend to focus on the psychological and behavioural aspects of resilience, the organisational and individual resilience itself.[6] A more global approach promises more widespread applicability. When it comes to the implementation of advanced robotics and AI-based systems and *resilience*, resilience engineering was brought up during the interview process. The European Commission states: 'Resilience is the ability of an individual, a household, a community, a country or a region to withstand, to adapt, and to quickly recover from stresses and shocks'.[7]

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[1] Washington, M., & Hacker, M. (2005). Why change fails: Knowledge counts. *Leadership & Organization Development Journal*, *26*(5), 400-411. https://doi.org/10.1108/01437730510607880

[2] Hussain, S. T., Lei, S., Akram, T., Haider, M. J., Hussain, S. H., & Ali, M. (2018). Kurt Lewin's change model: A critical review of the role of leadership and employee involvement in organizational change. *Journal of Innovation & Knowledge*, *3*(3), 123-127. https://doi.org/10.1016/j.jik.2016.07.002

[3] Kotter, J. P. (2012). *Leading change*. Harvard Business Press.

[4] Voit, T. (2017). Gamification als Change-Management-Methode im Prozessmanagement. In S. Strahringer & C. Leyh (Eds), *Gamification und Serious Games Edition HMD*. Springer Viewer. https://doi.org/10.1007/978-3-658-16742-4_4

[5] Pęciłło, M. (2016). The concept of resilience in OSH management: A review of approaches. *International Journal of Occupational Safety and Ergonomics*, *22*(2), 291-300. https://doi.org/10.1080/10803548.2015.1126142

[6] Kamphuis, W., & Delahaij, R. (2013). The relevance of resources for resilience at different organizational levels within the military deployment cycle. In I. Herrera, J. M. Schraagen, J. van der Vorm, & D. Woods (Eds), *Proceedings 5th REA Symposium. Managing Trade-offs* (pp. 137-142). Resilience Engineering Association. https://www.resilience-engineering-association.org/wp-content/uploads/2016/09/Frontpage-REA5SYM-proceedings-030916.pdf

[7] European Commission. (2012). *Communication from the Commission to the European Parliament and the Council The EU approach to resilience: learning from food security crises*. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52012DC0586
Hamel, G., & Välikangas, L. (2003). The quest for resilience. Harvard Business Review. https://hbr.org/2003/09/the-quest-for-resilience

There are four cornerstones that outline the fundamental concepts of resilience engineering

Figure 1: The four concepts of resilience engineering[8]

- knowing what to do
  - responding to actual/regular disruptions and disturbances
- knowing what to look for
  - monitoring the critical
- knowing what to expect
  - anticipating the potential
- knowing what has happened
  - learning from experience

Based on a resilience engineering approach, studying the factors that contribute to a process failure is as important as studying the success factors. It can be easier and more effective to increase safety by improving the things that go right, rather than reducing those that go wrong.[9] The four cornerstones of resilience engineering are reflected in the experience of most use cases, even if not named explicitly. Based on these cornerstones, some common organisational measures can be outlined to navigate not only the implementation process of advanced robotics or AI-based systems in a new work environment but also facilitate an increased focus on OSH.

Organisational changes

The impact of an advanced robotic system or AI-based application on a company differs from use case to use case. Depending on the scope of tasks automated by the system, as well as the number of systems introduced, organisational changes can range from minimal to fundamental. Within the given use cases, several interviewees reported that the introduction of a cobot has not significantly changed organisational or social structures of the workplace. However, interviewees also acknowledge that this often happens because the system is either the only one or one of few. Should, however, all iterations of the tasks that the system performed become automated, companies foresee that this **will lead to major organisational changes**. This is relevant, primarily in the case of the introduction of cobots, as this will likely result in the transition from primarily physical workplaces/jobs to primarily cognitive jobs. This change needs to be planned for, to make it as successful as possible and the transition as stress-free as possible for all parties involved.

Some common organisational adjustments are the creation of new **departments** that focus on the **installation or maintenance of the system**. If the creation of an entirely new department is not yet justified by the impact the systems have on the company, smaller division or expert groups with a subset of these skills are formed. Generally speaking, companies also increase their **IT staff** when implementing advanced robotics or AI-based systems.

Guidance provided by the company

‘Knowing what to do’ can be challenging even when the change or disturbance to the socio-technological environment is planned and anticipated. Introducing a new technology can lead, in particular, to significant changes in **working routine** and **job content**. Job content tends to shift from primarily physical to more cognitive tasks. For example, a worker who previously assembled workpieces might now monitor several robots that assemble the parts instead. In some cases, the introduction of advanced robotics or AI-based systems to a workplace can increase the need for **additional support for workers** to help them adapt to this change. Most interviewed companies report that they provide some form of social support for their workers, be it as official **human resources personnel** to help them address work or non-work-related issues, a provision of help from supervisors, and/or information-based support including company-based recommendations for wellbeing. Especially regarding robotic systems, there has been a noticeable **increase in fear of job loss**. Addressing this through **additional, targeted support and guidance** for workers has been prioritised by many interviewed companies. These measures include additional **training** to upskill or reskill workers, seminars on how the system works to illustrate that the robot is not intended to lead to job loss, but rather move workers into better workspaces, and, in some cases, the provided guidance includes **one-on-one conversations** to address specific fears.

[8] Hollnagel, E., Woods, D. D., & Leveson, N. (Eds) (2006). *Resilience engineering: Concepts and precepts*. CRC Press. (pp. 21-34).
[9] Hollnagel, E., Pariès, J., & Wreathall, J. (Eds) (2013). *Resilience engineering in practice: A guidebook*. CRC Press. (pp. 29-39).

Restructuring

Anticipating the **potential** describes the resilience concept 'know what to expect'. While the change some cobots or AI-based systems bring has not yet resulted in larger, systematic changes for the companies studied, interviewees do anticipate these changes to come once more systems are implemented. However, this does not mean that **no singular system can facilitate meaningful restructuring for the sake of OSH**. In singular use cases, a robotic system enabled the job structure of an entire production floor to be changed, from a stationary eight-hour shift to a two-hour-based rotation system. This **balanced job demands** throughout the day and **increased wellbeing**, next to the physical benefits the system brought. This was a change to the factory's structure that was not necessary to implement the robotic system. However, companies anticipated the positive impact this change would have on their workforce, beyond the original intent of the cobot.

Social impact

While the impact technology can have on workers and their surroundings is often primarily assessed with regard to the tasks they automate, they can also impact the social structure of a company. Frequently, **concerns of social isolation** are raised. However, based on the use case experiences, these concerns could not be confirmed. Predominantly, cobots are introduced in workstations, where previously a worker was performing tasks without another worker's assistance. In these cases, the cobot did not increase or decrease the number of social interactions in the workplace. However, there are two phenomena related to the social impact of these systems. Firstly, the changes in task structure and job routine have, in some cases, resulted in workers having more control over their time, which they spend assisting their colleagues, **increasing the amount of social interaction** overall. In some cases, cobots led to a restructure of work cycles, which not only made the job demands more balanced but also encouraged social interaction as workers were not bound to one post for an entire shift.

The second phenomenon is the 'inclusion' of advanced robotics or AI-based systems into the social structure of a workplace. There are incidences where the acceptance towards the systems has become so high that workers have assigned the individual systems names and address them as such. While there are robotic systems that come with pre-assigned names, workers taking the initiative to name them individually is interpreted by the use cases as **an indicator of high acceptance and trust and low negative attitude or fear** towards them. Trust is especially seen as an antecedent for safe and effective human–robot collaboration.[10] Systems that are accepted to such a degree are less likely to be misused or neglected, resulting in **workers receiving the full extent of possible OSH benefits** from the system.

Emerging OSH risks and continuous monitoring

With any new technology there is the potential for new OSH risks to emerge. While there are some that can be apparent during the implementation process, others might only arise over time. The resilience engineering principles of 'knowing what to expect' and 'knowing what to look out for' can be rather difficult to adhere to with advanced robotics or AI-based systems, due to a lack of experience within many industries with these systems and their continuous innovation. Some of the successful strategies to monitor for new and emerging OSH risks are have been identified though this research.

Workplace inspections that are carried out by **work safety specialists** and possibly a technology specialist on a regular basis can identify possible new threats, based on time-dependent factors like wear. Another way to anticipate developing OSH risks in advanced robotics and AI-based systems is the active involvement of workers. Several companies create specialised **worker feedback systems** through which workers are able to flag any changes or concerns based on their first-hand experience with the system. These steps are taken in addition to several built-in features of many systems. Especially in use cases with advanced robotics, the systems often **perform initial checks on themselves** before starting operation. These checks typically include a status check of all internal components, as well as the check if all external safety measures are in place. If possible, some companies have also introduced a specialised system to report system-related **near misses and accidents** as a way to increase their knowledge on what to look out for and thereby monitor.

For AI-based applications, a tool used by some companies is specialised **audits** with the sole focus on workplace safety, and possible ethical concerns about the decision process of the AI-based system.

While all companies agree that some form of OSH risk monitoring with autonomous systems is important, they also highlight that **these monitoring measures need to be in line with the right to privacy of their workers**.

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[10] Hancock, P. A., Billings, D. R., Schaefer, K. E., Chen, J. Y., De Visser, E. J., & Parasuraman, R. (2011). A meta-analysis of factors affecting trust in human-robot interaction. *Human Factors, 53*(5), 517-527. https://doi.org/10.1177/0018720811417254

Recommendations

Monitoring the critical

Monitoring critical components and their changes in a technology, or 'knowing what to look out for', is a vital part of any OSH-related process. When it comes to advanced robotics or AI-based systems, companies have expanded their portfolio of techniques to anticipate OSH risks. Using the **built-in monitoring functions** already allows companies a great deal of insight into a system's state. However, most significant for our findings is the **first-hand experiences workers have** had and reported. This is particularly relevant for advanced robotics that now, unlike their predecessors, allow direct interaction between human and machine. This makes the experience from this interaction a valuable insight for OSH changes that need to be addressed.

Seeing the potential

Many change-related processes are sparked from an identified potential for improvement. In the case of advanced robotics and AI-based systems, this impulse often contains goals for OSH. Reduction of physical workload, more ergonomic workplaces or more cognitively engaging tasks for workers are part of these areas identified for improvement. However, there can be greater OSH benefits if the system is assessed beyond its immediate task and in the larger context of the workplace. There might be the potential for organisational changes that go beyond the initial goal. Companies should **invest time during their planning process to assess their technology and its surroundings for broader changes to work routines and structures with OSH in mind**.

Responding to disruptions

While the original phrasing of this principle is incidence-related, in a socio-technological system, disruptions do not necessarily need to be classified as negative. Advanced robotics and AI-based systems can impact the social structures within a company. However, these changes do not need to be negative, and initial use cases indicate the potential for positive change. The way in which advanced robotics or an AI-based system is integrated into the workspace **should not reduce the quality or quantity of social interaction for the operator** and, if possible, should increase it. In addition, phenomena like the active integration of technology in social structures should not be discouraged.

Learning from experience

'Knowing what has happened' and the associated 'learning from experience', while equally important, like the other three cornerstones, are currently the least applied of the four. Companies continuously stressed that the **lack of experience with the systems has posed one of the biggest challenges** to their implementation attempts. It is apparent that **this gap will close over time** but, until then, those who want to implement advanced robotics or AI-based systems often need to try to identify other European-based use cases they can consult. Those are rare at the moment; however, companies can use their own experiences and draw wisdom from them.

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

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