IMPLEMENTING ADVANCED ROBOTICS AND AI-BASED SYSTEMS FOR TASK AUTOMATION: DRIVERS, BARRIERS AND RECOMMENDATIONS

Many companies go through the process of integrating an advanced robotic or AI-based system into their workplaces for the first time. Cobots, as a form of advanced robotic systems, can, for example, be used to hold a workpiece while a worker inspects it for errors, and AI-based systems might be used to support doctors in the diagnosis process. 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. In many of those companies from different industries in Europe and the United States, these systems are installed with the intention of improving occupational safety and health (OSH) as one of the primary goals. Companies that have already implemented these kinds of systems report a variety of drivers and barriers throughout their introduction process. Identifying arising issues or accelerators for the integration of advanced robotics and AI-based systems for the automation of tasks can help them and others to promote drivers and avoid barriers in future task automation.

Based on the experiences of companies that have already successfully introduced cobots and AI-based systems into their workplace, taking early initial steps can facilitate success in the long run.

Both drivers and barriers in the implementation of advanced robotics and/or AI-based systems can arise at different times and at a differing intensity throughout the process. One also needs to be mindful of surrounding factors and possible influences that have facilitated these phenomena. Drivers and barriers can be found internally, like the lived company culture regarding change, or externally, like a specific country's legislative requirements surrounding the implementation of these systems. It is normal that there are limits on how much any given company can facilitate certain drivers and avoid barriers. Knowledge of where to expect them is always beneficial during the planning and implementation process. Some drivers and barriers are the positive or negative expression of the same underlying factor. To give an example, worker motivation can be considered both a driver and a barrier. Highly motivated workers might facilitate change. In these cases, it is not redundant to consider, in both categories, the underlying reasons and possible measures that influence attitudes, as this can vary.

Accumulating drivers and barriers from different countries as well as different sectors can also allow one to identify underlying, transferable drivers and barriers from which a wide range of other companies can benefit. This policy brief summarises relevant drivers and barriers reported by different companies that were selected as case studies in EU-OSHA's relevant research.

Drivers

A great variety of aspects can be seen as drivers for the implementation of advanced robotics and AI-based systems. A suitable robotic system being newly available on the market can be considered a crucial driver for promoting automation in a company. However, unless a company is actively developing its own robotic solutions, this kind of factor is difficult to influence a company looking towards automating tasks with a cobot or AI-based system. Being able to stay competitive in their respective market is a driver for many companies to innovate and look towards advanced robotics and AI-based systems. While it is important to identify drivers that lie outside the direct influence of a company, being aware of those **within a company** can be more effective to facilitate a successful implementation of the new system.

Worker motivation

Among all interviewed companies, the most commonly named driver attributed for the successful integration of advanced robotics and AI-based systems was **'highly motivated workers'**, which is used as an umbrella

term to cover a variety of characteristics and expressions of motivation. Workers were described as **open for change** and generally expressed a **high affinity for technology**. These workers were able to anticipate and accurately understand the benefits of the technology quickly and engaged with it actively once it was installed. In some cases, these highly motivated workers even requested additional training to expand their responsibilities towards the technology. This facilitated training and general upskilling.

Exchange of expertise

While advanced robotics and AI-based systems are becoming more common, for many companies they are still a novel technology. Hence, the overall level of experience is considered rather low when compared to more established machines. A driver that was repeatedly listed by companies is **'collaborations and exchange with other companies'** that either already used a similar system or were also currently in the process of implementing it. Exchanging their experiences on and expertise in implementing the technology was perceived to be highly beneficial to the implementation process. This exchange was not only limited to other companies. Collaborations with, and from, universities were also seen as beneficial. Especially with newly developed systems, involving external researchers can benefit both parties.

First-hand experience

While the exchange of expertise is beneficial in the process and also before implementing advanced robotics and AI-based systems, actual first-hand experience with the process and the system itself has been accredited to be a major driver of long-term success. The more experience everyone in the process had, from management to technology engineers to OSH staff to the workers, the more successfully a project was handled. This was particularly noticeable on the workers' side. Gathering first-hand experience with a cobot or AI-based system has been reported to reduce fears (for example, of physical safety) and to increase a positive attitude towards the technology. There are illustrative examples of how these technologies become integrated not only in the production process but also in the social structure of a company. Some were given individual names and were playfully humanised by being referred to as 'colleagues'. This positive development is based on repeated interaction with a system, which cannot be artificially sped up.

Early worker involvement

While the introduction of first-hand experience with a new technology in the workplace can be done to help workers and inform individual opinions and trust is helpful, this cannot be artificially rushed. One opportunity to do so at a good pace and in good time is to ensure early worker involvement, which is a relevant driver for a variety of reasons. Firstly, the earlier workers are involved in the process of implementation, the earlier they can familiarise themselves with the technology. Secondly, early involvement allows workers to provide feedback on the system that can be considered before final implementation, and also allows them to voice any non-technology related concerns, like fear of job loss. This way, companies can react to their workers' needs earlier and possibly faster. Early involvement also affects other areas. It can be somewhat challenging to pinpoint exactly when early worker involvement should begin, or actually begins. In some companies, workers can actively request the implementation of new technology at their workplace. In this case they are theoretically involved from the start of the implementation. In other companies, workers can play an active role in the design of a future robotic system, especially when the company does not rely on a third-party supplier but develops their own systems. For other companies, decisions might be made on a global scale, with already designed systems, where workers have limited opportunities to participate in the implementation process. Overall, companies reported that involving workers early on in the decision-making process had a positive effect on implementation.

Some companies [provide] access to test devices, information and training on […] digitalisation, AI-based systems and advanced robotics to workers, regardless of their job position.

Barriers

Similar to drivers, there were a number of reoccurring barriers that different companies encountered when introducing AI-based systems or advanced robotics into their workplace.

Regulation

A repeatedly named barrier to integrating advanced robotics and AI-based systems was the current **state of regulation**, both national and EU-wide. Regulation was perceived as to not sufficiently reflect the potential positive capabilities and potential of current technologies, and thereby seen to have a severely limiting effect upon application. This also applies to many standards that have been described as being based on old research. Limiting an AI-based system to standards that were developed for systems with fewer capabilities, especially regarding OSH, means that robotics and AI-based systems might not be introduced in an impactful or meaningful way. While safety must not be compromised, collaborative robotic systems, in particular, have become increasingly safer to work with, through increased abilities to sense their surroundings and react accordingly. However, the interviewed companies bring forward their perception that new technological abilities are currently not represented in the standards that they must comply with. Some companies describe this as an unexpected extent of safety requirements and documentation. Introducing an unfenced, collaborative robotic system to a workplace is described, in some cases, to be accompanied by a higher demand for documentation and more complex safety regulations and concepts to consider and implement. The paperwork needed to document everything appropriately can significantly slow down the process.

One important standard, ISO/TS 15066 'Robots and robotic devices — Collaborative robots', is sometimes criticised by the interviewed companies for making the introduction of advanced robotics and AI-based systems more challenging. It has to be noted, however, that ISO/TS 15066 at the time of this policy brief's publication is undergoing revision, with the intent to integrate it into the EN ISO 10218-1 'Robots and robotic devices — Safety requirements for industrial robots'. The Machinery Directive 2006/42/EC and Work equipment Directive 2009/104/EC are also at times criticised for not always sufficiently matching the current state and capabilities of modern technologies. One of the interviewees summed this up as: 'newer technology demands newer standards'. At this point it should be mentioned that on 21 April 2021, the Commission put forward a proposal for a new Regulation on machinery products, which will repeal the Machinery Directive.

Worker resistance

While highly motivated workers were a driving force, the opposite type, or what we are calling **'change averse' workers**, were a barrier for integration. This group expressed multiple reasons to reject the technology, spanning from **fear of job loss and cognitive overload** to the rapid changes and raised cognitive expectations at their workplace. The **fear of being replaced** by the system as well as a **low understanding** of the relevant technology were identified as contributors to workers' aversion. Facing resistance from the workforce can be a major hindrance when introducing a new technology to a workplace, hence, it is vital to **identify the reasons** as early as possible and address them accordingly. There were selective reports where workers did not fulfil their maintenance or supervisory duty towards the technology if they felt that their aversion was not sufficiently addressed.

Lack of European focus

While collaboration with other companies was perceived as a driver for the implementation process, companies noticed the **lack of European case studies** as a barrier and hindrance. Currently, the most prevalent and easily available case studies and use cases are based in Asia. This results in a number of problems for companies based in Europe that want to learn from their experience. Asian countries, generally speaking, operate under different work and OSH regulations, as well as possibly other technological requirements. This difference in legislation severely limits applicability to the European market. While it is possible to gain insight from case studies outside the EU, this process can be time consuming and there always need to be additional resources allocated to gauge the applicability under current EU requirements.

Recommendations

Identifying drivers that reoccur across different sectors and technologies enables companies with the future intent to use cobots or AI-based systems to enhance them early on.

When looking at the presented drivers and barriers, one can notice that the drivers mostly come from inside the companies and their workforces. Barriers are mostly found in external factors, like legislative frameworks and in some internal such as worker resistance. Not all barriers and drivers apply to all case studies, nor do those presented here constitute an exhaustive list. However, as all of them have reoccurred through multiple sectors and companies, they can be seen as relevant for general consideration, when trying to implement advanced robotics or AI-based systems in a workplace. Based on companies' experiences with these barriers and drivers, one can formulate recommendations, considering how they handled them when they encountered them.

Act early

An essential recommendation regarding both drivers and barriers when it comes to the implementation of advanced robotics and AI-based systems, for the automation of either cognitive or physical tasks, is related to the **time component**. Underlying many more specific drivers and barriers is either the lack or abundance of time available for the implementation. This reoccurs regarding worker-related components like experience and trust, as well as the process-lengthening effect of having to match the emerging technology to the existing legal landscape and familiarise oneself with the according risk assessment methods. It is understandable that time, in profit-oriented production, is not an unlimited resource and has to be allocated as efficiently as possible. However, based on the experiences of companies that have already successfully introduced cobots and AI-based systems into their workplace, **taking early initial steps can facilitate success in the long run**.

More and better cross-company communication

The lack of available and applicable case studies and use cases and the beneficial effect of exchange between companies and universities relate to the same underlying concept of **shared information**. If possible, companies should try to reach out to other parties, for example, other companies that use similar systems to the ones they plan to implement, to inquire about their experiences. Similarly, companies that have already successfully implemented an advanced robotic or AI-based system should **consider sharing their experiences**. More active research into the drivers and barriers could be conducted.

The lack of company-level experience is a factor that will decrease over time. With more companies using AI-based systems and advanced robotics, other companies will have more opportunities to reach out and collaborate with them. Additionally, there should be an active effort to create more, easily accessible, European cases studies for companies to consult.

Worker inclusion

One of the most dominant and concurrent driver and barrier is worker motivation. There are some aspects to this that companies can try to influence to increase motivation in staff when it comes to the implementation of advanced robotics and/or an AI-based system. While factors like an inherent affinity for technology cannot be influenced from the outside, making sure that workers are aware of the benefits a technology will have for them can be. **Educating** workers not only on how to use a machine but also about **how using it will benefit them**, for example, avoiding strain injuries or providing them with more freedom over working time, is very important. This information should be included in training material the workers receive.

Furthermore, some companies have found it beneficial to identify workers with special interest in the technology and provide them with specialised training and responsibilities, if they wish. These workers, who were called **'key users' and 'technology ambassadors'** in one company, can fulfil a vital social role to further raise awareness of the system's benefits, as well as function as a low-threshold point of contact for their colleagues, for questions and concerns. A second way to influence a worker's motivation or attitude towards the implementation is by **addressing concerns** about the system. These concerns can span from the fear of job loss to concerns regarding the physical safety of the system. They should be taken seriously and addressed in sufficient form. In some cases, dealing with worker reservations surrounding the introduction of a new

technology on an individual level might suffice. For others, a department or company-wide measure might be more efficient, especially if a larger group of workers share a concern.

Early worker involvement can be facilitated by a number of methods from a company. Some companies do so by providing **access to test devices, information and training on processes related to digitalisation, AI-based systems and advanced robotics to workers, regardless of their job position**. This type of early worker engagement has led to an increase in acceptance for new systems, and an overall positive attitude towards the subject of task automation. This does not necessarily mean workers must be given executive say in the type of system that is being chosen for task automation, but it can lead to reduced overall inhibitions towards modern technology.

Regulatory awareness and dialogue

While it falls under the responsibility of legislators to address laws or standards, simply being acutely aware of the current regulatory landscape can help in the implementation process as it reduces the risk of investing time in a project that is currently not feasible. Furthermore, companies can raise awareness of the need for change by voicing their problems.

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