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

Executive summary

European Agency for Safety and Health at Work

Safety and health at work is everyone's concern. It's good for you. It's good for business.

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1 Introduction

This document summarises types and definitions of Artificial Intelligence (AI) -based systems and advanced robotics for the automation of tasks. For this purpose, a comprehensive taxonomy was developed to provide a framework for the analysis of OSH implications throughout further research work by EU-OSHA. Furthermore, this report presents current and potential uses of AI-based systems and advanced robotics for the automation of tasks, their sectoral distribution as well as a description of the primarily impacted tasks. Finally, this report gives an overview of policies and strategies on a national and international level regarding the automation of tasks by AI-based systems and advanced robotics.

2 Methodology

For this work, systematic reviews of scientific literature in three specific topics relevant to this research work and a review of grey literature were performed. Further, a consultation of EU-OSHA's national focal points was performed as well as in-depth interviews with dedicated experts. The systematic review of scientific literature was mainly used to identify technologies, current trends as well as uses of systems for the automation of tasks. The reviews were based on the categorisation of tasks into **physical** and **cognitive tasks**. The main areas that were covered in the reviews were artificial intelligence (AI), human-robot interaction (HRI) and automation of tasks (AOT). A combined number of 3,975 results were screened, of which 183 contained relevant information for this project. A number of in-depth interviews were conducted to complement these findings. A consultation of EU-OSHA´s network of focal points (FOPs)[1] was conducted, which provided information on regulation, policies, strategies, initiatives and programmes in relation to AI-based systems and advanced robotics for the automation of tasks and OSH. The questionnaire was distributed to the national focal points of the 27 member states as well as to the four EFTA countries. Thirteen countries answered the questionnaire. Remaining gaps were completed, when possible, with grey literature.

2.1 A focus on the nature of tasks

A focus on tasks rather than jobs is a valid approach as (automation) technologies assist or substitute individual functions in specific tasks. Task content can be defined as *what* is being produced or transformed in the work process (Bisello et al., 2019). Methods and tools are defined as *how* tasks are completed. The idea of content and tool will be included in our taxonomy. We will use the categories **object-related**, **information-related** and **person-related**, being purely based on the object of work according to the focus programme 'Occupational Safety & Health in the Digital World of Work' established by the German Federal Institute of Occupational Safety and Health (Tegtmeier et al., 2019). To accomplish different tasks, cognitive functions, like information processing, and physical actions, like object manipulation, are necessary. As a result, we see in our taxonomy the more abstract level of **cognitive** or **physical tasks**, which then can be object-related, information-related and person-related to a variable extent as well as their combinations.

2.2 Definitions of AI-based systems

The assistance or substitution of functions in order to complete different tasks requires AI-based systems that entail various technological characteristics. When it comes to the definition of AI or AI-based systems, there is no single definition that is commonly accepted among different scholars, practitioners or policy-makers. We incorporate definitions by two major stakeholders, those presented by the Organisation for Economic Co-operation and Development (OECD) as well the EU Commission. Both definitions can be found in the full report.

Concepts of AI-based systems have in common that systems perceive their environments in some way, analyse the information and act in response. In relation to the assistance and/or substitution of cognitive and physical tasks and their different level of occurrence in object-related, information-related and person-related tasks, a major differentiating aspect among AI-based systems lies within their ability to perform physical manipulations or actions in their environment. Additionally, we broaden the taxonomy for some technologies that are under the scope when addressing the issue of automation of tasks which

[1] https://osha.europa.eu/en/about-eu-osha/national-focal-points

are not strictly AI-based. These technologies often show very advanced abilities, but from a purely technical perspective they have no real AI embedded. This is, for example, quite often the case for collaborative robotic systems. Hence, we have labelled the possible categories of the backend level in our framework as **AI-based** and **complex, not AI-based**.

2.3 Major AI-based technologies

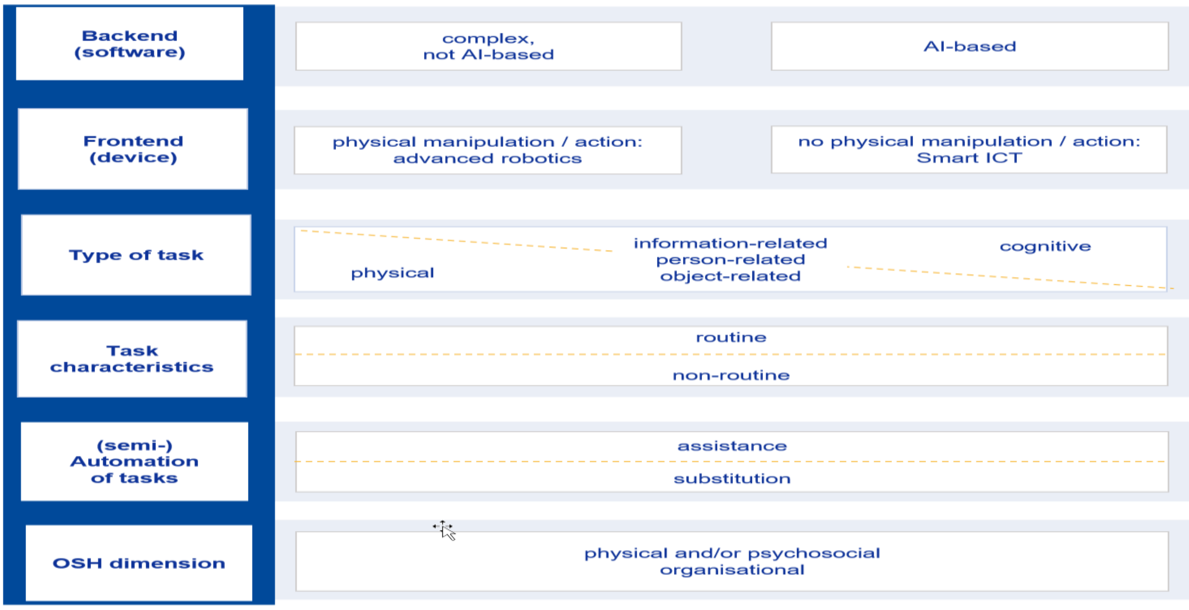
When it comes to investigating the effects of the automation of tasks and its effects on OSH, a closer look at specific technological developments is useful. One main area is the field of robotics. Newer types of systems are often referred to as cobots, yet they only include the interaction form of cooperation and collaboration (Onnasch et al., 2016). In the **interaction form** of **co-existence**, the actions of the human and robot are close, but time-wise unrelated. The interaction form of **cooperation** shows humans and robots working closely together, their actions are time dependable but not simultaneous. The third interaction form, **collaboration**, can be seen as the closest interaction form. As we include any kind of interaction form between human and robotic systems, we will refer to these systems as **intelligent or advanced robots.**

To support or substitute cognitive tasks where no physical handling of objects or persons is required, modern (or innovative) information and communications technologies (ICT) are mainly deployed. The entities can range from **desktop computers** and **mobile devices (smartphones, tablets)** to **wearables** like **smartwatches** or **smart glasses**. Depending on the algorithms' complexity or the degree of artificial intelligence, both systems are able to support different degrees and levels of functions as well as actions necessary to complete the task in question. It is the combination of the specific backend (software) with the individual technological frontend (device) that creates new challenges and opportunities for OSH.

2.4 Taxonomy for AI-based systems and the automation of tasks

It is not only technologies themselves that affect OSH on potentially different levels. It is the use of AI-based systems for the automation of tasks that create new or changes in existing working systems. To provide meaningful advice for prevention, policy and practice regarding AI-based ICT systems and intelligent robots in the workplace, the three dimensions of **physical**, **psychosocial** and **organisational safety and health** are included in the taxonomy. Non AI-based robotic systems are included, as many advanced robotics, which can be found already, operate without AI. The specific OSH related challenges and opportunities associated with these systems will be investigated in the following project activities.

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



Source: Author

3 Mapping of current and potential uses

The exploration of technology diffusion reveals a high variety of available systems and applications that are not always assigned to perform a specific task. Therefore, a purely technology-based approach when addressing associated risks and benefits for OSH is not sufficient.

3.1 Automation of cognitive tasks

3.1.1 Types of technologies

AI-based systems for the automation of cognitive tasks

For the automation of cognitive tasks with AI-based systems, the systematic review of high quality scientific literature reveals that most studies focus on the exploration of different types of **automated software**. Automated software tools refer to various applications in different domains like online examination (Butler-Henderson & Crawford, 2020) and learning applications (e.g., Davis, 2018), feedback systems for learners (Deeva et al., 2021), software testing tools (Garousi & Mantyla, 2016), automated retrieval and indexing of scientific information (e.g., Golub et al., 2016), clinical information systems (Govindan et al., 2010) or business processing modelling tools (Zafar et al., 2018). Nearly every AI-based system for the automation of cognitive tasks can be defined as some form of automated software, but there are systems which can be distinguished further.

In the field of medicine in particular, a lot of high quality research is dedicated to **automated medical devices** such as closed-loop systems, which, for example, are used for vital parameter monitoring or systems related to automated diagnosis generation. Another remarkable group of technologies that can be found are **decision support systems (DSS)**. Not quite as many as for DSS, but still a noticeable number of studies address some type of **natural language processing (NLP)** system. Other systems that are described, but to a significant lesser degree, are **conversational agents, also called chatbots**, and **data mining**.

Robotic systems for the automation of cognitive tasks

Apart from the large number of software applications, another remarkable technology category used for the automation of cognitive tasks, addressed in scientific literature as well as by the experts, are **educational** and **social robots**. **Socially assistive robots**, for example, are used in elderly care to increase positive emotions or therapy engagement (Bemelmans et al., 2012). Especially within social robots, the issue of **anthropomorphism** in **humanoid systems** is considered. Some of the aforementioned robotic systems can also be described as **service robots**. Humanoid systems are frequently found in service applications, as they are especially designed for direct interaction purposes.

AI techniques and future uses

Within scientific literature related to AI-based systems, there are some specific (statistical) AI-procedures that can be identified as noteworthy clusters. The most common techniques addressed in high quality scientific literature are **neural networks**, while among them convolutional neural networks appear most frequently (Dallora et al., 2019; Wäldchen & Mäder, 2018; Xiao et al., 2018). Other AI techniques, which bear mentioning in relation to the automation of cognitive tasks, are support vector machines, decision trees, genetic or clustering algorithms, deep learning or self-supervised learning.

As stated by the interviewed experts, new systems for the automation of cognitive tasks are being adopted very quickly and are very focused on **data processing and analysis**. Based on the experts' opinion, the **Internet of Things (IoT)**, the interconnection of devices and systems, is considered the most disruptive technology. For **future uses**, the experts see the next milestone in **logging information / data from a long-term deployment** of a system to generate broader datasets. Extracting patterns from larger datasets to anticipate changing conditions is foreseen as a real-world application.

3.1.2 Sectoral distribution

When analysing the appearance of AI-based systems for the automation of cognitive tasks regarding their sectoral distribution, the most outstanding category according to the NACE Rev. 2.0 (Nomenclature of Economic Activities) code is the sector of **human health and social work activities**. The majority of analysed studies address systems from the human health and social sector and, in particular, the field of medicine is frequently mentioned by the experts as well as the FOPs. An extensive body of scientific literature is dedicated to the **education** sector. The experts point out the relevance of this sector, however, the answers from the FOP consultation do not explicitly mention this sector. In the experts' opinion as well as indicated by the FOPs, the **financial and insurance activities** sector plays an important role. They explicitly state that automation activities in banking are noticeable and expected to increase. Mainly addressed in scientific literature, to a noteworthy degree, is the sector of **professional, scientific and technical activities**. This is to some extent supported by the experts, and the pervasiveness of AI-based systems in this sector is in line with the above-described findings regarding the broad distribution of automated software systems. To a lesser degree than the others, the **information and communication** sector is covered by scientific literature. It is, however, mentioned by the FOP consultation.

3.1.3 Impacted tasks and jobs

A variety of cognitive tasks that AI-based systems fulfil is found in scientific literature. There are two types of tasks prominently represented in the body of scientific literature. The first task frequently supported by AI-based systems is **giving a medical diagnosis** and is strongly information-related. This finding mirrors the above-mentioned results regarding the high prevalence of DSS systems in the human health and social work activities sector. Cognitive tasks such as giving a diagnosis can be partially done by AI-based systems; however, the experts state that it will be complementary to the doctor's work.

The second frequently reported task is some form of **learning support** in teaching activities. This person-related task is often supported by automated software or natural language processing (NLP) systems. A number of single tasks related to **language and textual processing** are addressed in scientific literature. Among them, **information coding**, **indexing** or **classification** are mentioned frequently. Recently, the number of AI-based systems capable of language production like textual content creation, speech production like reading, or even real-time language production like translation has increased.

The experts stress a phenomenon, which is also prominently addressed in scientific literature, under the term 'polarisation of employment structure': within jobs, tasks which require a mid-skilled profile are impacted by automation, leaving jobs to change in a way that automation will create an increasing number of higher-skilled jobs and low-skilled jobs likewise (Goos & Manning, 2007; Goose et al., 2009).

3.2 Automation of physical tasks

3.2.1 Types of technologies

For the automation of physical tasks, **industrial robots** appear most frequently. Based on sales figures of robot suppliers, the International Federation of Robotics (IFR) states that in 2019, 4.8 % of installed industrial robot units were **cobots**. A second noticeable group that is addressed in scientific literature is medical robots. As mentioned in the section for the automation of cognitive tasks, there are robotic systems that are used for medical care, for example, by supporting therapy commitment or therapeutic training. **Medical robots** for the automation of physical tasks refer to systems like robotic rollators (Werner et al., 2016; Werner et al., 2018) in the care of the elderly or impaired as well as robot-assisted therapy for balance function rehabilitation after stroke (Zheng et al., 2019). Still in the earlier development stage are medical robots designed for carrying and lifting patients, sometimes referred to as **nursing robots**. Other, already more frequently found medical robots navigate autonomously through hospitals performing transportation tasks. Surgical robots support the surgeon during operational tasks with light, reducing jitter or magnifying structures. The integration of **mobile robots** or **autonomous vehicles (AV)** in any environment raises a number of issues. Quite commonly these systems can be found for autonomous cleaning tasks in different environments like department stores, shop floors or hospitals. Especially in **logistics** and **warehousing** robots are increasingly autonomous. Already very well developed autonomous robotic applications can be found in the agricultural industry (EU-OSHA, 2020).

The experts predict that in areas such as **autonomous driving** there will likely be semi-automation of the task in the next ten years, rather than full automation. Companies have started developing delivery robots that move in the streets to cover **last-mile deliveries**. In the long term, the experts even see the potential for changes regarding public transport. In the area of manufacturing, the increasing integration of AI-based software tools into robotic hardware does not only lead to new generations of robotic systems, but also to **new business models**. The model **robot-as-a-service (RaaS)**, for example, foresees leasing a robot instead of purchasing it. Maintenance, upgrades and services are performed remotely by the supplier.

3.2.2 Sectoral distribution

The analysis of automated physical tasks among sectors reveals a high number of automated or supported tasks in the sector of **human health and social work activities.** Here, the majority of tasks can be found in **hospital activities**. Secondly, the **manufacturing** sector is strongly affected. This cannot only be found in scientific literature, but is emphasized by the experts as well as the FOP consultation. The experts agreed that the manufacturing sector is predominant regarding the deployment of advanced robotics and that outside this sector, deployment is lower. Within the manufacturing sector, the **automotive Industry** is named as the main one. However, the **human health and social work activities** sector is represented slightly more in scientific literature, which might be due to a publication bias though. The **transportation and storage** sector is also addressed quite frequently in scientific literature and also mentioned by the experts. Less frequently observed in scientific literature, but emphasized by the experts, are the sectors of **construction** and **agriculture, forestry and fishing**. Especially regarding construction, Japan is leading in deployment. According to the experts, deployment in the construction sector is more difficult because a construction site is less structured. The **agriculture, forestry and fishing** sector is quite developed regarding autonomous systems, and innovation of these technologies in the sector is rapidly increasing.

3.2.3 Impacted tasks and jobs

As the nature of physical tasks implies, most physical tasks impacted by the automation of AI-based systems are object-related. In the medical field, apart from **lifting**, a number of systems provide other **movement support**, like walking. Other physical tasks that are highly affected by robotic systems are **cleaning** or **transporting**. As described by most experts, tasks more likely to be automated are **repetitive** and **routine tasks**. These tasks can be programmed and coded, and a system can be built that learns from this data using AI techniques. Therefore, easy physical tasks are more likely to be replaced. The experts see a potential of job destruction, especially among **low-skilled jobs** with high levels of repetitiveness and routine characteristics.

In the opinion of some experts, the use of collaborative robots even has the potential to create more jobs. Teaming humans with robots can increase productivity, thus benefitting the organisation, which in turn is able to invest more and create new jobs. Likely, we will be observing a change towards a situation where one human orchestrates multiple robotic systems.

3.3 Task impact – Evaluation and OSH implications

Regarding the pervasiveness of systems and their use, a slight publication bias is observable in scientific literature. Medicine and education science are both disciplines with eager publication ambitions and are therefore slightly overrepresented in scientific literature.

According to the experts, new technologies can have a positive impact on OSH for workers according to most stakeholders, especially regarding the so-called 3D jobs (**dirty, dull and dangerous**). More specifically related to physical tasks (object- and person-related) supported by advanced robotics, the interviewed experts mainly address issues regarding the physical OSH dimension. For instance, the reduction of **physical risks** is often mentioned by the experts. AI-based systems can also help to get rid of **unfavourable and repetitive cognitive routine tasks**, leading to work becoming more interesting for workers. More in relation to OSH management, the experts see the risk that when AI-based systems **change the nature of a workers' task**, the newly arising health and safety risks (of the changed task) may not have been adequately assessed.

The expert interviews as well as the results from the FOP consultation support a view commonly found in scientific literature. Tasks or jobs with more codifiable tasks will be more rapidly displaced. Further, the experts describe a process of upskilling and deskilling in the future. There might be a risk of deskilling when AI-based systems are used for performing some tasks. The experts argue that **deskilling** rather appears at work force level, but not at a personal level.

In relation to impacts on workers' psychological wellbeing, the experts mentioned the risk that an AI-based system might be highly automated or even autonomous to a degree, where it dictates a certain course of actions to the worker. In this case, there is the risk that workers will negatively experience a **loss of control** over their own work. Dynamic learning and adaptive systems further hold the risk of output not being completely **predictable** since the machine changes its behaviour depending on the processing of information. Unpredictability of systems can **reduce trust** and **impair user acceptance**.

4 Overview of policies and strategies

4.1 European level

Most stakeholders present some form of requirements or demand principles for AI-based systems. The principle that finds the highest agreement is **system transparency**, which is addressed in nearly every initiative. In addition to that, explainability is highlighted. **Technical robustness** as well as the **respect of human rights**, **diversity** and **non-discrimination** for AI-based systems are frequently included. **Data privacy** and **data governance** are also pointed out.

4.1.1 Regulation

Within Europe there are currently two main Directives that apply to technology and workplaces and therefore also build the legislative basis for AI-based systems and advanced robotics for the automation of tasks. One is the **Machinery Directive 2006/42/EC**. It applies to products that are to be placed on the EU market for the first time. The evaluation of the directive in 2018 revealed a general fit of the directive for digital revision.

The second important directive to be named is the **OSH Framework Directive 89/391/EEC**. It lists the general principles of prevention (e.g., avoiding risks, risk evaluation) and states employers' and workers' obligations. While not specifically written for AI systems and advanced robotics, given its broad coverage it can be applied to the risks that AI-based systems can pose, too.

In 2021, however, as artificial intelligence is an area of strategic importance, the European Commission launched an additional legislative horizontal regulatory proposal: a proposal for the **Artificial Intelligence Act**. It includes a **classification of AI systems as high-risk** and a chapter on **requirements for high-risk AI systems**.

4.1.2 Strategies, programmes, initiatives and campaigns

In 2020, the **Organisation for Economic Co-operation and Development (OECD)** launched the platform 'AI Observatory' providing a database of AI policies from around the world. The platform provides information on AI policy areas, explores over 600 AI policy initiatives from over 60 countries and presents latest trends and data on AI developments. Further, the OECD presents five complementary value-based principles for trustworthy AI on the platform (OECD.AI, 2021). The human-centred AI principles were adopted by G20, as stated in the G20 ministerial statement on trade and digital economy.

In 2020, the **European Trade Union Confederation (ETUC)** published their 'Resolution on the European strategies on artificial intelligence and data,' a resolution paper targeted towards artificial intelligence on a European level (ETUC, 2020). According to their key messages as presented in the publication, ETUC demands that European AI and data strategies should 'provide a legal and empowering European framework based on human rights, and therefore including labour and trade union rights and ethical rules.' Furthermore, the resolution proposes that 'the principle of "human remains in control" should apply to workers and managers.'

The **European Trade Union Institute (ETUI)** published a foresight brief on 'A law on robotics and artificial intelligence in the EU?' targeting both AI and robotic regulation on European level. It examines the regulatory aspects of existing and future technologies, drawing attention to several key issues, such as the visibility, accountability and liability of all stakeholders (ETUI, 2017). In a second position paper, named 'Labour in the age of AI: Why regulation is needed to protect workers,' ETUI suggest that the EU needs to put in place an adequate ethical and legal framework for working with AI.

In 2020, the **European Social Partners Framework Agreement on Digitalisation** was launched by the European cross-sectoral social partners BusinessEurope, SMEunited, European Centre of Employers and Enterprises providing Public Services (CEEP) and ETUC (and the liaison committee EUROCADERS/CEC). This agreement is a shared commitment of the contributing partners 'to optimise the benefits and deal with the challenges of digitalisation in the world of work' (ETUC, 2020).

While ETUC and ETUI address specific requirements towards potential future legislation and regulation, this point of view is contrasted by **BusinessEurope**'s strategy paper on 'Robotics and automation – BusinessEurope strategy paper.' (BusinessEurope, 2018). They focus on advanced robotics in Europe and claim a critical assessment of existing regulation to determine whether all frameworks in place are suitable to enable responsible robotics use and development.

As an industrial representative, the **International Federation of Robotics (IFR)** has launched a report on 'World Robotics R&D Programs' on worldwide advanced robotics (IFR, 2020). The aim of this report is to give an overview of governmental focus and investments in the main global robotics markets. In this publication, worldwide initiatives and programs regarding advanced robotics have been collected and summarised. Their extensive analysis comprises three global regions (Asia, Europe and America) and according countries. The report presents the robotics **R&D programmes of each country and region in detail** including background, funding budget or issuing authority.

On the governmental side, the **European Council** – Council of the European Union, included some AI-based systems related content in their new strategic agenda for EU 2019-2024 (European Council, 2019). This includes working on all aspects of the digital revolution and artificial intelligence: infrastructure, connectivity, services, data, regulation and investment. They also published the 'Coordinated plan on the development and use of artificial intelligence made in Europe.' In 2020, the **European Commission** published a white paper on 'Artificial Intelligence – a European approach to excellence and trust.'

4.1.3 Gaps and needs

In general terms, the responses collected through the FOPs do not highlight any particular needs or gaps in relation to regulation on a European level in terms of worker protection. Especially the OSH framework directive is labelled positively. All new hazards and risks are properly covered in the Machinery Directive 2006/42/EC in relation with workplace equipment. What is seen as a greater issue, is the lack of proper implementation and enforcement of the Machinery Directive. Legislation can only be effective when applied properly.

4.1.4 National level

Within the FOP consultation, only a few countries report specific initiatives in the field of national legally binding regulation regarding **AI-based systems such as advanced robotics or smart ICT** and **OSH.**

Austria reports specific discussion regarding advanced robotics that could result in a national legally binding (international) standard. **The Netherlands** reports that in terms of smart robotics there are many (mandatory) discussion platforms deriving from the Machine Directive for inspectors, for industry partners, for standardization bureaus, etc. **Finland** reports that data handling in relation to smart ICT is being included in preparation for many legislative updates, but on a more general level.

4.1.5 Strategies, programmes, initiatives and campaigns

Within the European states, different sectoral programmes, social partner's guidelines or recommendations given by major stakeholders or the state can be found. An overview of selected national strategies, programmes and/or initiatives put forward by actors is presented in detail in the report.

4.1.6 Gaps and needs

Regarding gaps and need on a national level, the answers from the FOP consultation indicate that many countries seem to be missing national activities on different levels. The gap between existing regulation and an adequate application is also supported by some answers of the FOPs, stating that clear guidelines for different industries are poorly developed and that most research is technology-fixed and does not consider OSH.

5 Summary and Conclusion

Regarding the automation of **cognitive tasks**, the analysis of scientific literature as well as the in-depth expert interviews reveal that elaborate software systems in the field of decision support systems and pattern recognition, especially in **speech and language based tasks**, dominate the field. AI-based systems for the automation of cognitive tasks are most frequently found in the sector of **human health and social work activities**, especially in the field of **medicine**. There are strong digitalisation movements in this sector, however, a slight overrepresentation due to a publication bias in scientific medical literature should not be neglected. With relation to special tasks, it becomes clear that especially **information-based tasks** show high potential for the use of AI-based systems. Very frequently the task of **providing a medical diagnosis** is supported. Additionally, a variety of **communication tasks** are supported or substituted by AI-based systems. The use of natural language processing and conversational agents are frequently found. Furthermore, the use of **robotic systems for the automation of cognitive** tasks, information- and person-related is striking. These systems can be found supporting **learning**, **services tasks** and **therapeutic actions** like supporting therapy commitment. Regarding the automation of **physical tasks**, a variety of robotic applications can be found. Especially within the **manufacturing** sector, there has been a long history with the applications of robotic systems for a number of object-related tasks like **lifting**, **assembling**, **welding** or **painting**. However, scientific literature as well as the experts' consultation reveals a broad application of robotic systems also in the sector of **human health and social work activities**. Within this sector, but not exclusively, the tasks of **lifting**, or more general **movement support** in any way, **transportation** or **cleaning** are mostly supported or substituted by advanced robotics or exoskeletons. Regardless of the specific sector, the results indicate that **routine tasks** are the most affected by AI-based systems and advanced robotics.

On a European level, most strategies, campaigns or initiatives mainly address broad requirements that AI in general should meet and present principles that potential AI frameworks or regulation should be based on. Yet, they differ slightly in their objectives. **Data privacy**, **fairness**, **accountability** and **transparency** are the most striking aspects addressed by the different stakeholders. These values and principles are to some extent also related to OSH, however, in a broader sense rather than on a specific level.

On a national level, nearly every country reports some form of not legally binding activity related to AI-based systems and advanced robotics. Within the EU countries, a vast number of sectoral programmes, social partner's guidelines or recommendations given by major stakeholders or the state can be found. Nevertheless, most countries also report to be missing activities. This can be seen as a striking result, as it strongly indicates in the direction of what is often referred to as a 'knowing-doing gap.' On a more global level, there are large numbers of campaigns, actions, strategies and visions.

The expert interviews revealed a number of opportunities and challenges for OSH associated with the use of AI-based systems and advanced robotics for the automation of tasks. The **reduction of physical risks** is often mentioned by the experts. Especially using robotic systems for physically strenuous tasks can be beneficial and has the potential for long-term improvements. Physical ergonomics can be improved by **reducing awkward and unhealthy postures** in different environments. An improved handling of heavy workloads and increasing efficiency might also **reduce perceived stress**. AI-based systems can also help to get rid of **unfavourable and repetitive cognitive routine tasks**, leading to work becoming more interesting for workers. Smart ICT might have the potential to **reduce stress** by improving workforce planning within and across teams and by improving the workflow.

However, high degrees of autonomous system behaviour also raise a number of risks. In relation to impacts on workers' psychological wellbeing, the experts mentioned the risk that an AI-based system might be autonomous to a degree where it **dictates a certain course of actions** to the worker. In this case, there is the risk that workers will negatively **experience a loss of control** over their own work. **Unpredictability** of systems can also **reduce trust and impair user acceptance**. More in relation to OSH management, the experts see the risk that when AI-based systems **change the nature of a workers' task**, the newly arising health and safety risks (of the changed task) may not have been adequately assessed. Experts agree that awareness among workers and line managers is crucial, as well as in-depth training of workers on how to handle AI-based systems.

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