Artificial intelligence for worker management: an overview

Executive Summary

European Agency
for Safety and Health
at Work

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Introduction

The introduction of digital technologies in the workplace, including those powered by artificial intelligence (AI), brings along innovative developments but also challenges and risks for workers' safety, health and wellbeing. Building on its foresight work, in 2020 the European Agency for Safety and Health at Work (EU-OSHA) initiated a four-year research programme on digitalisation and occupational safety and health (OSH) with the aim of supporting evidence-based policymaking by providing deeper insights into the consequences of digitalisation on workers' health, safety and wellbeing and how these are addressed at the research, policy and practice levels, as well as by describing examples of successful practices. This report presents findings from EU-OSHA's project on new forms of worker management through AI-based systems (AI-based worker management, AIWM) and OSH. The aim of the project was to identify gaps, needs and priorities for OSH and make recommendations for policy, research and practices in order to support decision-making discussed at a high-level workshop that concluded the project. A separate report (EU-OSHA, 2022a) presents an overview of the implications for OSH of the use of AI-based worker management systems. The research was based on an extensive literature review, in-depth interviews with 22 experts in the field, consultation with EU-OSHA National Focal Points[1] and statistical data analysis, including the analysis of data from EU-OSHA's European Survey of Enterprises on New and Emerging Risks (ESENER-3).

Defining AIWM

According to Richman (2015) and Koontz and O'Donnell (1955), worker management refers to a process of overseeing and governing employees to better achieve organisational goals, such as increasing productivity and efficiency, decreasing employee turnover, and ensuring workers' health and safety. It is a process of worker organisation that might include worker monitoring, surveillance, control, reward and punishment systems. The roots of modern systematic worker management, where workers started to be managed following guidelines or plans instead of *ad hoc*, could be traced to the late 18th century with the Industrial Revolution and the labour movement from agriculture to manufacturing (Deadrick, 2014). From its beginnings worker management evolved into a science that aims to improve the efficiency of workers without jeopardising their health, safety or wellbeing. One of the biggest shifts in worker management happened with the introduction of personal computers in the workplace that allowed companies to control, govern, supervise and monitor their employees to a greater extent. Some speculate that a similar disruptive shift is happening now with the growing use of AI tools in the workplace.

Nowadays, even though the concept of AI is heavily used (and misused) by many scholars, businesspeople, journalists, and companies there is no singular and widely accepted definition of AI (De Mauro, 2015; OECD, 2019; Wang, 2019). Some define it in broad terms as a tool that tries to mimic human intelligence (Fjelland, 2020). Others go down a more technical route such as the European Commission's High-Level Expert Group on Artificial Intelligence (2019a). Hence in this project we use one of the most up-to-date definitions that comes from the European Commission proposal on AI regulation (European Commission, 2021), which 'aims to be as technology neutral and future proof as possible' (European Commission, 2021, p. 12). According to the proposal (European Commission, 2021, p. 39):

> '…artificial intelligence system" (AI system) means software that is developed with one or more of the techniques and approaches listed in Annex I [of the proposal] and can, for a given set of human-defined objectives, generate outputs such as content, predictions, recommendations, or decisions influencing the environments they interact with'.

Relevant technologies and approaches include, but are not limited to, machine learning, logic- and knowledge-based approaches, and some statistical approaches (European Commission, 2021). For more, see Annex I of the proposal on AI regulation (European Commission, 2021).

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[1] Official EU-OSHA representatives in the EU-27 (2020) as well as European Free Trade Association (EFTA) countries. In the majority of cases, national authorities for safety and health at work serve as representatives. For more information, see: https://osha.europa.eu/en/about-eu-osha/national-focal-points/focal-points-index

Around a decade ago, AI started to be used for managing workers.

Based on research by the European Commission (2021), the European Parliamentary Research Services (2020a), the High-Level Expert Group on Artificial Intelligence (2019a), and EU-OSHA (2019), artificial intelligence (AI)-based worker management (AIWM) is an umbrella term that refers to a worker management system that gathers data, often in real time, on the workspace, workers, the work they do, and the (digital) tools they use for their work, which is then fed into an AI-based model that makes automated or semi-automated decisions or provides information for decision-makers on worker management-related questions. It is one of the recent developments in the workplace that presents opportunities but also risks and challenges for workers' safety and health.

These decisions and recommendations might include but are in no way limited to establishing work shifts and/or the allocation of tasks, evaluating the performance of workers, monitoring the activities of workers and giving recommendations on how to prevent health risks. With AIWM systems, organisations typically aim to automate some of their activities and to improve worker performance and engagement (EU-OSHA, 2019; PwC, 2017), the organisation of work and task distribution, HR management (Lane and Saint-Martin, 2021), and workers' health and safety and overall wellbeing (Badri et al., 2018). AIWM is an umbrella term that include also algorithmic management, which is equally characterised by the use of algorithms to allocate, monitor and evaluate work tasks and/or to monitor and evaluate workers' behaviour and performance through digital technologies and the (semi-) automatic implementation of decisions (Bérastégui, 2021; EU-OSHA, 2017; Kellogg et al., 2020; Mateescu & Nguyen, 2019).

Worker management, in general, includes worker control and worker support mechanisms. It is important to note that control and support are not mutually exclusive as many organisations often employ both to manage workers. On the one hand, based on Kellogg et al. (2020), algorithmic management (and by extension AIWM) – similarly to any worker management system not based on the use of AI - consists of three worker control mechanisms – direction, evaluation and discipline – that can be split into 6 sub-mechanisms, the so-called '*6Rs*' model, which can be automated or semi-automated:

- Direction – 'specifying what needs to be performed, in what order and time period, and with different degrees of accuracy' (Kellogg et al., 2020, p. 372). Worker direction is implemented through recommendations – suggesting to workers courses of action in different situations – and restrictions – only sharing specific information with workers or restricting some behaviour.
- Evaluation – 'entails the review of workers to correct mistakes, assess performance, and identify those who are not performing adequately' (Kellogg et al., 2020, p. 369). Evaluation includes worker recording – monitoring/surveying workers' performance, wellbeing, safety – and rating – evaluating workers' performance, as well as predicting their future performance.
- Discipline – 'entails the punishment and reward of workers so as to elicit cooperation and enforce compliance with the employer's direction of the labour process' (Kellogg et al., 2020, p. 369). This includes replacement – replacing underperforming employees – or rewarding – rewarding high-performing workers.

On the other hand, worker management, and in turn AIWM, also includes a variety of support mechanisms (Browne, 2017). For example, this might include supporting workers to perform their task more efficiently through improved communication and cooperation between workers (Publicis Groupe, 2018). It also includes approaches aimed at preventing conflict, bullying and favouritism in the workplace through, for example, emotional distress identification tools, which in turn might increase worker engagement and, hence, productivity (Belton, 2019).

Uptake of AI-based worker management

AIWM entails a myriad of tools, techniques and practices making an analysis of its uptake difficult, especially as there is no single database that measures it. Besides this, some organisations might not completely understand what kind of AI tools they are using or if the tools they are using are AI-based at all, especially if they are buying/renting them from third parties (Tambe et al., 2019). Other organisations might also be unwilling to discuss the use of AIWM systems openly (Chamorro-Premuzic, 2020).

Because of this, the uptake of AIWM, predominantly, can only be inferred from the implementation of different AI-based or AI-adjacent technologies that organisations might use for worker management.

One thing that can be said for certain is that the use of AI technologies in organisations is increasing (Juniper, 2021; Oracle, 2019), although the available research does not agree on how many organisations are currently using AI. For example, according to McKinsey (2020, p. 2), in 2019 around 58% out of 2,395 surveyed companies around the globe have adopted AI in at least one area inside their company, including worker management. Similarly, according to a study carried out by Oracle (2019, p. 3), around 50% out of the 8,370 HR leaders, managers, and employees across 10 countries, interviewed about their attitudes toward and behaviours regarding AI reported that they were using AI in some form in their work in 2019.

However, according to Juniper networks (2021, p. 3), although 95% of the surveyed 700 individuals with direct involvement in their organisation's AI and machine learning plans or deployment across different levels and industries state that they would benefit from integrating AI in their day-to-day work, only 22% of organisations actually use AI systems. Similarly, several interviewed academic experts in AI also highlighted that even though some statistics might imply a relatively large uptake, in reality, a majority of organisations are using simple algorithms and mistaking them for AI. A similar opinion was voiced by an interviewed business representative who stated that AI is not used that frequently by organisations and early adopters will not be organisations from some sectors or of a specific type, but those that are the most innovative.

In terms of the uptake of such systems across different economic sectors, according to interviews, AIWM systems are used more heavily by organisations from sectors that are manual in nature and have a relatively large number of routine tasks that are performed in a relatively controlled environment. More specifically, interviewed experts highlight logistics, manufacturing sectors, transportation and the healthcare sector as those that should implement such systems first. Similarly, according to academic literature, AIWM systems are more frequently used on blue-collar workers who have a lot of routine tasks and hence can be easily monitored, evaluated and managed (Dzieza, 2020). However, the literature also stipulated that usage of such tools is also prevalent with lower-skilled white-collar workers, such as call-centre workers, whose work is also relatively routine (Mateescu and Nguyen, 2019). These findings are also supported by ESENER-3 data, according to which workplaces in sectors that are manual in nature, such as agriculture, mining and quarrying and manufacturing, tend to use technologies enabling AIWM more frequently. Around 23% of businesses in the manufacturing sector use machines, systems or computers to monitor workers' performance, while only around 14% of organisations from the information and communication sector and 11% from the financial and insurance activities sector do the same.

According to ESENER-3 and academic literature, larger companies tend to use technologies enabling AIWM systems before smaller companies (see Eurofound, 2020b; Mateescu and Nguyen, 2019; Wujciak, 2019). For example, around 6% of EU organisations that have 5-9 employees use systems to monitor worker performance, compared to 19% of organisations with 250+ employees. Also, as displayed by ESENER-3 data, organisations with some sort of worker representation more often use technologies that enable AIWM than those that do not have any worker representation. This can be explained given that bigger organisations that employ more workers are more likely to have a workers' representative. Finally, private and public organisations use the aforementioned technologies enabling AIWM to a similar extent. For example, around 12% of privately owned organisations in EU-27 (2020) use machines, systems or computers to determine the content or pace of work compared to 8% in the public sector, while around 9% of private organisations use systems to monitor worker performance, compared to around 6% in the public sector.

Goals of implementing AIWM systems

Organisations implement changes, including introducing AIWM systems, to achieve business objectives (Kellogg et al., 2020; Mateescu & Nguyen, 2019; PEGA, 2020). AIWM is implemented in three broad ways. First, AIWM might be used to increase efficiency and/or productivity of workers. For example, costs can be managed by automating scheduling and task allocation (Kronos, 2018). Such automation benefits companies by saving costs, but it might also benefit workers by allowing them to change their shifts without a need to directly contact human managers and/or to find willing colleagues to take their place (Brione, 2020; O'Connor, 2016). Organisations may also seek to increase productivity and efficiency through gamification (Eurofound, 2020a; Heaven, 2020). Gamification refers to bringing ideas

and concepts from games, such as rewards for milestones, into the work environment to improve efficiency and productivity (Savignac, 2019). It can promote collaboration and interaction among teams, reduce stress and improve overall employee satisfaction in the workplace (Makanawala et al., 2013). AIWM might help with gamification by proposing personalised rewards for each worker that would bring them the most values. Furthermore, AIWM systems can be used to increase efficiency and productivity by providing direction and guidance to workers (Eurofound, 2020b; European Parliamentary Research Service, 2020; Kellogg, et al., 2020; Wujciak, 2019). It involves both providing recommendations, often in real time, as to what a worker should do and restricting them from unwelcome actions (Kellogg, et al., 2020).

AIWM systems might also be used to improve the decision-making process in the organisation. For example, organisations might employ people or workforce analytics that uses digital tools and data to measure, report and understand employee performance (Collins et al., 2019, p. 98). They deal with questions related to the appraisal of workers, recruitment, promotion and career development, to identify when people are likely to leave their jobs and to select future leaders, to look for patterns across workers' data, which can help to spot trends in attendance, staff morale and health issues at the organisational level (Moore, 2019). Decision-making can also be improved through AI-powered prediction models. Forecasting models that predict different factors related to workers, such as those used for people analytics, are often used to predict who in the staff is most likely to leave soon and hence should receive more attention from managers (Punnoose and Ajit, 2016). Going further, some organisations, such as IBM, are also using their supercomputer Watson to get recommendations on actions that can be taken to prevent a worker from leaving (Fisher, 2019).

Organisations might decide to use AIWM to improve workers' health, safety and/or well-being. Integration of such systems is often driven by a need to comply with regulations (Zwetsloot, 2014), but also, they might be implemented by management to improve workers' productivity and efficiency as healthy and happy workers often perform better (Browne, 2017). The majority of AIWM systems that may contribute to ensuring a healthy workforce can collect data about workers and the work environment to identify risks to workers' health, safety and well-being and to help mitigate them (Belton, 2019; Till, 2016). For example, some organisations employ monitoring devices that measure the biometric information of workers to ensure that they are not fatigued (Gianatti, 2020), which might negatively affect their performance on the job and increase the probability of accidents (EU-OSHA, 2019). In addition to the monitoring-centred systems, there are also several more proactive well-being-centred systems, such as those that help workers to improve their emotional well-being, which is connected to improved worker productivity (Oracle and Workplace Intelligence, 2020). An example of such AI-powered tools is mental health chatbots – software robots that can be used by workers to communicate about their mental health. Mental health chatbots operate by analysing the communication patterns of workers and estimating the probability of different psychosocial issues, such as mental distress (Cameron et al., 2017; Oracle and Workplace Intelligence, 2020; Zel & Kongar, 2020).

Risks of the application of AI-based worker management

AIWM facilitating AI-based decision-making, if not trustfully and ethically implemented as discussed in the next section, often creates the risk of dehumanising workers and reducing them to behaving like machines (Heaven, 2020; Moore, 2018; Wujciak, 2019). More specifically, workers' decision-making capacity can be covertly subverted through nudging practices that are based on their personal data and can be manipulative and ethically questionable (Gal et al., 2020). Moreover, workers risk being objectified and treated like commodities when monitoring turns labour into sets of data points, stripping workers of liberties to choose, have a personality or emotions (Colclough, 2020). This is especially problematic with monitoring practices that invade workers' privacy, which negatively affects their creative thinking and limits independence of thought (Oliver, 2002). This dehumanisation can be referred to as the *'datafication'* of the workplace, where workers are not treated as living beings, but as collections of objective digital data that they have produced while going about their work (Mai, 2016). Such a perception of workers threatens their right to exercise freedom as reasonable and self-determining agents who can make decisions in accordance with their own levels of understanding, values and belief systems.

Organisations, as well as developers of AIWM systems, also often lack transparency in terms of disclosing whether they use AIWM tools and how it all works. Often, employees are also not aware that they are being monitored or that an algorithm and not a person is evaluating their performance automatically (AlgorithmWatch, 2019), even though this is explicitly prohibited by the EU General Data Protection regulation (GDPR). This might lead to issues related to data protection and privacy. More specifically, algorithm-based worker management practices can be highly invasive and intrusive (De Stefano, 2020), blurring work-life balance as workers are 'always watched' even during their 'off' time (Eurofound, 2020a) and thus violating people's privacy rights which might have repercussions on human dignity (Access Now, 2018). In addition, the sense of being observed can cause workers to act unnaturally, such as forcing them to always smile or supress their true feelings, personality or preferences to 'please' the algorithm.

Extensive use of AIWM systems might also increase the pace of work and performance pressure (Felstead et al., 2019). One way AI can do this is through real-time recommendations and directions for workers on how they should do their job, which might also put pressure on workers to work faster leading to more work-related stress, negative impacts on their physical health and accidents (Moore, 2018). For example, some Amazon employees have reported fainting from dizziness caused by the intense pace of work set by an algorithm (Wujciak, 2019). AI-based performance monitoring tools might also incentivise delivery workers, taxi drivers and other individuals working with vehicles to drive faster than is safe as then they will be rated more favourably, but, in turn, may also lead to more traffic accidents (Moore, 2018).

AIWM and algorithmic management systems might also exacerbate rather than curb biases that exist in organisations, as this is the case if an AI-based systems is trained based on, for example, biased recruitment data (Fernández-Martínez and Fernández, 2020). In other words, although a large proportion of individuals perceive AI-based decision-making to be more objective than human-based decision-making, as it is based on sophisticated approaches and large volumes of data (Amoore & Piotukh, 2015; Ziewitz, 2015), in reality, such approaches, which often learn and evolve from data, might amplify the biases and beliefs of the humans who have created them or the data on which they are trained (EU-OSHA, 2019; Deobald et al., 2019; World Economic Forum, 2018).

Regulatory contexts

To mitigate the negative effects AIWM might bring to OSH it is crucial to have a strong regulatory base that controls it.

At the EU level, some regulations already exist that contribute towards addressing the possible negative effects of AIWM. First, the EU Occupational health and safety acquis[2] though not directly referring to AIWM or algorithmic management, implicitly apply to the OSH risks posed by AIWM. For example, Directive 2002/14/EC – informing and consulting employees[3] – stipulates that in larger organisations[4] workers should be consulted or informed on decisions that might lead to significant changes in the company. Hence, as the introduction of AI-based tools might lead to such large changes, it is necessary that employers communicate these changes to workers or, ideally, discuss them. Second, the GDPR[5] directly addresses the key issues of personal data protection and automated decision-making, which is directly applicable to AIWM. For example, Article 22 of the GDPR grants data subjects the right to not be subject to decisions based 'solely' on the automated processing of personal data if the decision has significant legal consequences or a 'similarly significant' effect on the data subject, which might imply OSH-related issues. Such provision is expected to empower employees by giving them the right to demand human intervention on behalf of the data controller who could revoke or reconsider the decision made automatically by an AI system. Finally, the EU Charter of Fundamental Rights, the European Non-discrimination Law, the European Convention on Human Rights and the General Framework for Equal Treatment in Employment and Occupation, ensure that human rights are kept to the highest standards in the EU and prohibit any direct or indirect discrimination based on religion, disability, age, sexual

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[2] See: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A31989L0391
[3] See: https://osha.europa.eu/en/legislation/directives/directive-2002-14-ec-establishing-a-general-framework-for-informing-and-consulting-employees-in-the-european-community
[4] The Directive applies to organisations with 50 employees across several EU countries or 20 employees in one Member State.
[5] See: https://eur-lex.europa.eu/eli/reg/2016/679/oj

orientation and other grounds. In addition, in April 2021 the European Commission drafted a Proposal for a Regulation on a European Approach for AI[6] that, if approved, would be the first EU-wide regulation specifically targeting AI, which also covers certain AIWM applications and risks. The regulation proposal aims to ensure the safe deployment of AI systems, prohibiting some of them while casting others as being high-risk and requiring more safeguards for the design, development and use of such systems. High-risk systems, relevant to AIWM, include AI systems used for recruitment, for making decisions on promotions and terminations of workers, for task allocation, and for monitoring and evaluating the performance and behaviour of persons in such relationships. However, though such regulation is quite comprehensive, many academics highlighted that it still has a lot of gaps. This includes, but is not limited to, the regulation not being subject to social dialogue, and generally lacking the voice of workers and their representatives, as well as having absence of clear provisions attributing liability (provider vs user), and subsequent redress against the liable party is another shortcoming of the proposal (De Stefano, 2021; Ponce del Castillo, 2021).

At the Member State level, some AI-related provisions also exist, but they are, in many cases, broad in scope and do not focus specifically on AIWM and its effect on OSH. For example, at least 20 out of 27 EU Member States, as well as Norway and Switzerland, have adopted AI strategies, but the majority of them are rather general and rarely include provisions explicitly related to AI systems that interact with, or might directly affect, workers. However, exceptions exist. For example, the German Federal Government's Artificial Intelligence Strategy (2018)[7] includes a provision to establish an AI observatory to draw up joint guidelines and frameworks, together with data protection authorities and business associations, specifically for the use of AI in the world of work. The strategy also points to several legislative changes to empower workers, such as ensuring co-determination and the right for work councils to be involved in the processes of introducing and using AI at the workplace. Similarly, the French national AI strategy[8] points to two key actions relevant to AIWM and OSH. First, it encourages the inclusion of workers as the *subjects* of digital transformation into *ex ante* discussions regarding AI usage in workplaces. Second, the strategy urges for the launch of legislative reform to adjust the overall framework for governing working conditions in the digital age with a specific focus on increasing human-machine complementarity. Furthermore, the Czech national AI strategy[9], besides other provisions, lays down measures to address the impact of AI on the labour market and the social security system.

Beyond AI strategies, some EU countries also have other initiatives that are relevant to AIWM and its effects on OSH. For example, a concept paper on how to deploy and use AI in business in Germany[10], developed by the German Trade Union Confederation, outlines a six-step process for the deployment of trustworthy AI in workplaces, each containing a set of crucial questions to be asked before the process. Operational indications on the installation and use of support tools, including AI-based ones, in call centres in Italy drafted by the National Labour Inspectorate covers how various tools and software that can be used to manage workers, including AIWM, can be used in call centres. In Spain, the so-called Riders' Law aims to establish the employment status of food delivery riders and algorithm transparency (Aranguiz, 2021), which might be also relevant for other occupations. The law makes it mandatory for digital platform companies to be transparent about how the algorithms and AI they use affect working conditions as well as profiling, hiring and lay-off decisions (Pérez del Prado, 2021).

Remaining gaps and ways forward

Though the aforementioned regulatory initiatives provide a good basis to curb the negative effects of AIWM, gaps still exist, and, hence, based on the findings of the research presented in the previous sections, a number of recommendations that can be used to mitigate risks to workers' safety, health and wellbeing that are associated with the design and use of AIWM systems were formulated.

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[6] See: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1623335154975&uri=CELEX%3A52021PC0206
[7] See: https://ai-watch.ec.europa.eu/countries/germany/germany-ai-strategy-report_en
[8] See: https://ai-watch.ec.europa.eu/countries/france/france-ai-strategy-report_en
[9] See: https://www.mpo.cz/assets/en/guidepost/for-the-media/press-releases/2019/5/NAIS_eng_web.pdf
[10] See: https://www.dgb.de/downloadcenter/++co++b794879a-9f2e-11ea-a8e8-52540088cada

Recommendation 1:
Making the design, development and use of AIWM systems human-centred, so that they are used to support workers and leave humans in control. This would also guarantee that the compassion, empathy and care for workers brought by humans is not replaced by computer decision-making that solely tries to increase profits for a business.

Recommendation 2:
Ensuring workers' participation, consultation and social dialogue. Workers should be included in the design, development and testing phases, and ex ante and ex post assessments, as well as usage of AI-based systems. The inclusion of workers at all stages of AI development and usage will contribute to making such systems trustworthy, human-centred and remaining under human control. This can also be achieved by enforcing the co-governance of AIWM systems, giving a say to workers on how AIWM is developed, acquired, introduced and used. This is key to preventing the possible risks of AIWM to OSH.

Recommendation 3:
Fostering a holistic approach in evaluating AIWM systems encompasses including different stakeholders in the evaluation process, as well as ensuring that such systems are not evaluated in a vacuum; it also covers the effects AIWM might have on workers and society as a whole. The evaluation process should also be a dynamic process rather than a one-off exercise as AI-based systems are able to evolve through self-learning, which might lead to some systems that were safe in the past becoming dangerous for workers.

Recommendation 4:
Improving the design, development and use of AI-based systems by making the functioning and purpose of AIWM transparent, explainable and understandable. This might be ensured by introducing more binding requirements for AIWM providers and developers to ensure that **workers' health, safety and wellbeing are already considered from the design stage**. This should also go hand-in-hand with a strong enforcement policy ensuring that organisations comply with regulations.

Recommendation 5:
Establishing a clear line of responsibility indicating who is responsible for ensuring that an AIWM system does not cause harm to workers, break the law or malfunction. This includes establishing oversight mechanisms, remedies on how the negative effect of AIWM can be mitigated, and a course of action on what to do if managers fail to govern the AIWM system. Ensuring the line of responsibility could also go beyond simply stating that an employer in general is responsible for AIWM systems by instead requiring organisations to specifically name responsible managers.

Recommendation 6:
Improving workers' privacy and data protection by increasing transparency about data collection and usage and introducing better reporting mechanisms on misuses of AIWM tools. More specifically, workers should have the right to edit or block algorithmic inferences, and to contest automated decisions, and they should also be ensured full freedom to refuse to give consent to collect their data by additional provisions prohibiting lay-offs or any other negative actions against workers in these cases. This can be expanded upon by ensuring workers the right to an explanation for decisions made by algorithms. This includes what private data the algorithm used, how these data were collected and how it made its decision.

Recommendation 7:
Ensuring the right to disconnect for workers. In addition to its primary goal of guaranteeing workers the right to disconnect from work during non-working hours, it could also serve as a means to ensure workers' privacy and personal data protection, in particular when it relates to a disproportionate amount of monitoring and surveillance not strictly necessary for a legitimate purpose.

Recommendation 8:

There is a need for knowledge exchange, dissemination and awareness building on AIWM and how it might affect OSH. This might include creating a dialogue involving relevant stakeholders, such as representatives of workers, employers, OSH authorities, experts and AIWM tool developers. The dialogue should be open, allow all sides to express their opinions, and focus not only on what should be controlled, banned and mitigated, but also on how to ethically use AI-based tools.

Recommendation 9:

Worker privacy and data protection can also be improved by enhancing labour inspectorates' capacities and cooperation with national data protection authorities. This includes improving their knowledge about AIWM and how it might affect OSH, as well as providing tools to labour inspectors for closer cooperation with data protection officers on questions relating to how AIWM and similar AI-based systems affect OSH.

Recommendation 10:

More education efforts that enhance workers' and employers' AI literacy by promoting qualification and skills development for AIWM applications. This would empower them to better understand AIWM systems and thereby be able to exert their right of consultation and participation in the design and implementation of such systems. Education and awareness-raising efforts should focus on ensuring that current and future AIWM systems put humans and their health, safety and wellbeing at the centre.

Recommendation 11:

Ensuring transparency between developers of AIWM systems and deploying organisations. This includes, but is not limited to, sharing with organisations how such a tool operates, how it makes decisions, what kind of risks and negative effects it can create, its benefits and drawbacks, and so on. However, if full transparency is not possible, any agreement should include the caveat that if a system causes harm and the deploying company has no right to demand that the system be changed, the system would be shut down at once by such system developers.

Conclusions

The usage of AIWM systems is steadily growing across companies and economic sectors in the European Union, which can be explained by the fact that they allow organisations to improve productivity and efficiency. However, the introduction of such systems in an organisation can also lead to a large array of ethical and privacy issues, as well as to OSH-related risks. Nevertheless, if AIWM systems are built and implemented in a trustworthy and transparent way based on workers' information, participation, consultation and trust, and on the principle of minimisation of workers' data collection and usage, AIWM systems may also provide opportunities to improve OSH in the workplace. Trustworthy AIWM can be built by using a human-centred and human-in-command approach, guaranteeing equal access to information of employers, managers, workers and their representatives, and the consultation and participation of workers and their representatives in the decisions taken with regard to the design, development, implementation and use of the AI-based management systems and in the decisions taken are key. This also includes respecting human autonomy, preventing harm, ensuring fairness, and establishing the AIWM systems' explicability. To a large extent, this can be achieved by considering workers and their health, safety and wellbeing from the very initial design phase of AIWM systems and related subsequent programming. This, in turn, will allow to ensure that when used, AI does not replace traditional human management practices but supports them.

Human-centric AI can also be further fostered by ensuring worker privacy and that the collected data is not abused by AIWM system developers of employers. To some extent, GDPR and other relevant regulations already ensure this, but there are still some gaps as personal data, such as workers' emotional wellbeing, can be derived using AIWM systems from public data, such as workers' body language, facial expressions and tone of voice. Worker privacy might be further fostered by ensuring that they have a right to an explanation of how AIWM systems that are used on them work. This includes

an explanation on a number of aspects including what kind of data the systems collect, how this data is used, and what outputs the system produces. Furthermore, to support the implementation of trustworthy AI it is important to have strong awareness and knowledge building regarding the AI-based tools in workplaces, how they work in general terms and the effects they might have on workers. Therefore, policies should foster a strong knowledge exchange and social dialogue between AIWM tool creators, organisations, workers and other relevant stakeholders, with the humans' health, safety and wellbeing put at the centre of the discussion. They also should foster adequate education and training of all stakeholders connected to the creation, implementation and use of AIWM, putting always humans at the centre.

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The European Agency for Safety and Health at Work (EU-OSHA) contributes to making Europe a safer, healthier and more productive place to work. The Agency researches, develops, and distributes reliable, balanced, and impartial safety and health information and organises pan-European awareness raising campaigns. Set up by the European Union in 1994 and based in Bilbao, Spain, the Agency brings together representatives from the European Commission, Member State governments, employers' and workers' organisations, as well as leading experts in each of the EU Member States and beyond.

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