ARTIFICIAL INTELLIGENCE FOR WORKER MANAGEMENT: MAPPING DEFINITIONS, USES AND IMPLICATIONS

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 or ensuring workers' health and safety (Koontz and O'Donnell, 1955; Richman, 2015). From humble beginnings in the late 18th century, when worker management was autocratic in nature and productivity was ensured through fear, it evolved into a science that aims to improve efficiency of workers without jeopardising their health, safety or well-being. One of the biggest shifts in worker management happened in the 1970s 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 artificial intelligence (AI) tools in the workplace. To explore this and how this shift might affect workers, this policy brief defines AI-based worker management (AIWM), provides an overview on how AIWM is used, as well as describes the risks and opportunities for workers' safety and health that the use of such systems can create. The policy brief is based on an extensive literature review, in-depth interviews with 22 experts in the field, consultation with national Focal Points[1] and an analysis of the European Survey of Enterprises on New and Emerging Risks (ESENER-3) data.

What is AIWM?

The concept of AI is heavily used (and misused) by many scholars, businesses and journalists. However, there is no singular and widely accepted definition of AI (De Mauro, et al., 2015; OECD, 2019; Wang, 2019). Hence, in this policy brief one of the most up-to-date definitions that comes from the EC proposal on AI regulation (European Commission, 2021, p. 39) is used: '**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)[2].

In broad strokes, for AI to work, it requires three elements (OECD, 2019, pp. 22-24): (i) data, (ii) algorithm(s) and (iii) hardware:

- **Data** refers to information on which an AI system could act on, which is often collected from the environment. The data relevant for this project can be collected both by machines (such as through machine sensors) or a human (such as through employee interviews) and it can be in a structured form (such as tabular/table) or unstructured form (such as textual data).
- An **algorithm** or AI operation logic, refers to an explicitly defined set of instructions describing how a computer could perform an action, task, procedure or solve a problem using the collected data (Dourish, 2016). Regarding AI systems, they often create the appropriate algorithms through self-learning. In other words, AI uses complex mathematics to derive appropriate algorithms that can give meaning to data or use it to make decisions, predictions and recommendations.
- **Hardware** refers to a machine that can collect data, analyse this data and act on it through some form of actuators that perform an action based on the data.

Going beyond generic AI applications, due to its large potential, AI started to be used for managing workers around a decade ago. AI tools that are used to manage workers can be called **AI-based worker management (AIWM)**, which refers to a **worker management system that gathers data, often in**

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

[2] For more, see Annex I of the proposal on AI regulation.

real time, from the workspace, workers, the work they do and the (digital) tools they use for their work, which is then fed into an AI-based system that makes automated or semi-automated decisions or provides information for decision-makers (such as HR managers, employers, sometimes workers), on worker management related questions (European Commission, 2021; European Parliamentary Research Service, 2020; High-Level Expert Group on Artificial Intelligence, 2019; Moore, 2019). These decisions and recommendations might include but are in no way limited to establishing work shifts and/or allocating 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 (Moore, 2019; PwC, 2017), improve the organisation of work and task distribution, HR management (Lane and Saint-Martin, 2021), as well as workers' health and safety and overall well-being (Badri et al., 2018). AIWM is an umbrella term that includes 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 (EU-OSHA, 2017; Bérastégui, 2021, Mateescu and Nguyen, 2019; Kellogg et al., 2020).

AIWM systems follow a sequence of events to arrive at a prediction, recommendation or decision. Based on OECD (2019), Russell and Norvig (2020), Tamers et al. (2020) and the project/research team's considerations:

- Data is collected on workers, their workplace and/or the work they do using worker monitoring or worker surveillance[3].
- Data is processed so that an AI or algorithm-based system could use it. Processing might include, but is not limited to, extracting key points from textual information, structuring the collected data in a tabular form and calculating some statistics that will be used by the AI model.
- The processed data is fed into an AI or algorithm-based system that provides output in the form of a prediction, recommendation or decision on worker management questions.
- This output is then sent to actors – humans or machines – that act upon it changing or modifying the work (such as how tasks are performed), the workplace/workspace (such as recommending the introduction of sensors to monitor workers or systems that can direct workers on their tasks) and/or workforce/workers (such as how workers are disciplined or rewarded).

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, well-being, 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 workers – or **rewarding** – rewarding high-performing workers.

[3] Worker monitoring is the practice of capturing information on workers during working hours (Eurofound, 2020; EU-OSHA, 2017), for example, tracking the location of workers, their well-being, and their current task, making sure no workers are violating company policies, identifying health issues or safety risks and so on. Worker surveillance is more intrusive worker tracking extending beyond work, including such activities as tracking social media posts and websites visited (Edwards et al., 2019; McNall and Stanton, 2011, cited in Eurofound, 2020b).

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 among workers (Publicis Groupe, 2018). It also includes approaches aimed at preventing conflict, bullying, favouritism at the workplace through, for example, emotional distress identification tools, which in turn might increase worker engagement and hence, productivity (Belton, 2019).

Why implement AIWM systems?

Organisations choose their own ways of managing workers ranging from autocratic command and control approaches (De Stefano, 2020; Kellogg et al., 2020) to more consensus, engagement and trust building methods (Albrecht et al., 2021; Truss et al., 2013). These choices are shaped by institutional factors, such as the role of trade unions, the tradition of collective bargaining, labour market norms, cultural aspects and by internal factors such as the size, business sector, work organisation model, available resources, management approach and similar. However, irrespective of the conditions, in the majority of cases, integrating particular worker management approaches or tools is motivated by a need to reach specific business objectives.

Business objectives can take many forms. However, in the majority of cases, they are related to bringing economic and operational value to organisations (Kellogg et al., 2020; Mateescu and Nguyen, 2019; PEGA, 2020). Organisations achieve these objectives through modifications in how they do business and how they manage workers, which could include implementing algorithmic or AI-based systems, including AIWM. Expanding on this, a recent global survey by PEGA (2020) of over 3,000 senior managers and frontline IT employees, revealed that the main reasons behind the deployment of AI technologies in the workplaces are to achieve higher quality work (65%), create more reliable work (50%), increase employee satisfaction (49%), save costs (46%) and generate revenue (43%) (PEGA, 2020). Similarly, a survey of 1,463 Norwegian employers (Bråten, 2017) revealed that the most common reasons why monitoring systems were deployed in workplaces were to comply with regulations and ensure the better organisation of work, as well as to improve the safety of employees or for reasons related to customers. Some academics also stipulate that AIWM tools can help employees be more efficient and effective by, for instance, improving their engagement (Hughes et al., 2019). Kellogg et al. (2020) also mention that algorithmic technologies are often implemented to improve decision-making by increasing their accuracy.

Based on this, the approaches through which organisations seek to reach business objectives by implementing AIWM systems can be grouped into three broad categories relevant for the research at hand. First of all, 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).

Finally, **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 and Kongar, 2020).

Who uses AIWM?

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 (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. In a more extreme example, according to the MMC Venture report (2019, p. 99) only around 1,580 of 2,830 (around 56%) self-declared 'AI-based' start-ups from 13 EU countries[4] really use AI. 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

[4] Austria, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, and the United Kingdom.

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.

First, 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. Second, according to ESENER-3, organisations with some sort of worker representation also more often use technologies that might be considered as proxies for AIWM than those that do not have any worker representation. However, this can be explained given that bigger organisations often employ more workers. Finally, and according to ESENER-3, private and public organisations use the aforementioned technology 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 public sectors, while around 9% of private organisations use 'systems to monitor worker performance', compared to around 6% in the public sector.

What are the risks of using AIWM systems?

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, bias 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 and 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).

It also bears mentioning that according to Article 6(2) of the European Commission Proposal for a Regulation on a European approach for Artificial Intelligence[5], the use of AI for making decisions on promotion and termination of work-related contractual relationships, for task allocation and for monitoring and evaluating performance and behaviour of persons in such relationships is identified as high-risk. Such use of AI is considered high-risk because it can have an adverse effect on people's safety as well as violate their fundamental rights. In addition, the EU tries to curb these possible negative consequences through regulations, such as the GDPR which, for example, according to Article 22, forbids 'decisions based solely on automated processing, including profiling'[6]. Nevertheless, interviewed experts highlight that there are still some gaps in existing regulations and there are concerns that the usage of such systems might lead to a large array of negative consequences for workers.

How to trustfully and ethically implement AIWM systems?

The aforementioned issues indicate that many factors need to be considered to ensure that AIWM is not misused or does not lead to a plethora of risks and negative consequences. Nevertheless, it is possible to successfully implement useful AIWM systems that might contribute to better OSH if they are implemented in a transparent and ethical way, ensuring worker and worker representatives participation and consultation in all steps, including at the design stage, incorporating the OSH perspectives in the technologies, minimising worker data collection, ensuring workers' safety and health, privacy and, in turn, dignity.

According to interviewed experts, this can be achieved in many ways including, but not limited to:

- **Giving workers the tools to negotiate** how their data is collected, analysed, stored and off-boarded/sold (for more see Colclough, 2020);
- Ensuring **worker representation in the co-governance** of AI-based systems (for more see Colclough, 2020);
- Building a clear line of **responsibility of what should happen** if an AI-system operation results in human harm;
- Ensuring that AI-system **developers are transparent in how they operate**;
- Ensuring that such systems are **developed, used and evaluated following a human-centric approach**.

Additionally, and more formally, a trustworthy and ethical implementation of AI-based systems, which subsequently includes AIWM, according to the High-Level Expert Group on Artificial Intelligence (2019) can be ensured if it follows the following four principles:

- **Respect for human autonomy** – AI systems should follow a human-centric design that fosters humans' cognitive, social and cultural skills and it should not manipulate, deceive or take away their autonomy.
- **Prevention of harm** – AI systems should not bring or exacerbate any physical or psychosocial harm to humans. This also entails trying to prevent harm to nature.

[5] See: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1623335154975&uri=CELEX%3A52021PC0206
[6] See: https://gdpr-info.eu/art-22-gdpr/

- **Fairness** – AI systems should provide equal opportunities to humans and not discriminate, nor take away their freedom of choice. This principle is closely related to the AI decision-making discriminatory bias discussed above.
- **Explicability** – AI systems should be as transparent as possible and provide as much information as possible on the logic behind their results to ensure that decision-makers can duly evaluate it.

To some extent, this is already ensured by existing regulations such as the GDPR which covers data protection and automated decision-making. Nevertheless, some gaps still exist (for gaps in the EU and national regulations see EU-OSHA (2022a)).

Conclusions

The use of AIWM systems is increasing as they allow organisations to improve productivity and efficiency, leading to higher profits. However, introduction of such systems in an organisation can also lead to an array of OSH-related risks. Nevertheless, if AIWM systems are built and implemented in a trustworthy and transparent way based on workers' participation, consultation, trust and on the principle of minimisation of the collection of workers' data, such worker management systems may also provide opportunities to improve OSH in the workplace. The key to trustworthy AIWM is using a human-centred and human-in-command approach, guaranteeing equal access to information for employers, managers, workers and their representatives, as well as the consultation and participation of workers and their representatives in the decisions made regarding the design, development, implementation and use of the AI-based management systems. This also includes respecting human autonomy, preventing harm, ensuring fairness and being explicable. To a large extent, this can be achieved by considering workers and their health, safety and well-being starting with the design stage of AI-based management systems. This, in turn, will ensure that 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 or employers. To some extent, GDPR and other relevant regulations already ensure this, but there are still some gaps as some personal data (for example workers' emotional well-being) can be deducted from workers body language, facial expressions or tone of voice gathered using AIWM systems. 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 of what kind of data the systems collect, how this data is used, what outputs the system produces and similar. Furthermore, to support the implementation of trustworthy AI, it is important to have a strong awareness of - and build knowledge about - AI-based tools in workplaces, how they work in general terms and the effects they might have on workers. These policies should foster a strong knowledge exchange and social dialogue among AIWM tool creator organisations, workers and other relevant stakeholders, with human health, safety and well-being 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 human-centred AIWM.

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