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Working conditions and sustainable work

Implications of algorithmic management for work, employment and social dialogue: Literature review

Automation, digitisation and platforms: Implications for work and employment

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Introduction

Background to the working paper

At a time when Artificial Intelligence (AI) has been dominating headlines, its potential impact on the world of work and society at large has become a major topic of policy debate. The exact effects of this new, broad technology - often described as a general-purpose technology for its wide applicability and transformative potential - on labour markets, labour relations, economic and societal developments remain uncertain. Yet, while much of the debate centres on AI's potential to transform entire sectors, occupations and labour markets, its influence is already being felt more directly in the workplace through algorithmic management (AM) practices, where data-driven systems and AI-powered tools are increasingly used to monitor, evaluate, schedule or direct workers' tasks. These changes are opening new possibilities for organising work, profoundly reshaping not only the tasks of workers and managers but also the broader dynamics of labour relations.

The use of algorithms in organisational decision-making is not entirely new. At its core, an algorithm is a set of instructions to be followed to solve a problem, and as Max Weber observed, modern bureaucracies have long relied on step-by-step, distributed, and nominally objective procedures for selection and sorting (Fourcade and Healy, 2016). Similarly, the split-up, routinisation, and automation of work processes reflect principles that Taylorism articulated nearly a century ago. What is new, however, is the scale and scope at which algorithms can now be applied. Advances in computing power and the exponential growth of digital data collection have transformed AM into a qualitatively different phenomenon (Wood, 2021; Kellogg et al., 2020). The COVID-19 pandemic further accelerated this shift, as the rapid expansion of remote and hybrid work increased demand for software capable of monitoring, coordinating, and evaluating workers' activities at a distance.

Against this backdrop, this literature review focuses on the current developments and new realities confronting workers and employers in the context of AM practices, which are spreading and intensifying across workplaces. In the context of this review, a broad understanding of AM is adopted, encompassing not only self-learning AI-based systems but also simpler rule-based applications, which nonetheless have significant implications for working conditions and labour relations.

In parallel to this literature review, which focuses on AM, another review was carried out to examine the broad effects of AI on work, employment, and social dialogue. Taken together, the two reviews aim to clarify what is known and what remains uncertain about the implications of AI and AM in these areas. The insights will inform a revised version of Eurofound's conceptual framework for the digital age, guiding its research agenda for the upcoming 2025-2028 programming cycle.

Algorithmic management as a policy issue

Algorithmic systems, whether AI-driven or rule-based, are extensively present in platform work - especially for on-location services, such as ride-hailing and food delivery. On these platforms, workers' activities are managed and coordinated in real time with limited or no human oversight. This model is associated with many challenges, including opacity, employment insecurity, and the erosion of labour protections. In response to these challenges, the European Union adopted the

Platform Work Directive ((EU) 2024/2831) at the end of 2024, with the aim of improving working conditions of platform workers and enhancing the accountability of digital labour platforms.

The AI Act is also relevant for the regulation of AM, although it does not explicitly refer to it as such. It classifies AI systems used in recruitment and work management as high-risk and subjects them to specific obligations, thereby signalling the policy importance of AM and the growing scrutiny of technology-enhanced management practices. The implementation of the AI Act is staggered over the coming years, with the AI Office within the European Commission preparing detailed guidelines that will determine the concrete effects of the Act on AM systems in the workplace.

The European Commission has reaffirmed the policy importance of AM in its current mandate. In her mission letter, Executive Vice-President Roxana Mînzatu was tasked with developing an initiative on AM and considering possible legislation on the use of AI in the workplace, in consultation with the social partners[1]. This initiative should align with the European Pillar of Social Rights[2], and in particular principles 3 ('equal opportunities'), 8 ('social dialogue'), and 10 ('a healthy, safe, and well-adapted work environment and data protection'), to establish a framework that promotes fairness, transparency, and worker involvement in workplace digitalisation. At the time of writing, the European Parliament is working on a new legislative initiative report on 'Digitalisation, artificial intelligence and algorithmic management in the workplace - shaping the future of work'[3].

This flurry of policy initiatives on AM highlights that it is not only a technological or business matter but also one with significant social, legal, and rights implications, thereby placing it firmly on the agenda of European social partners. Back in 2020, peak European social partner organisations had already signed a framework agreement on digitalisation, through which they established common ground on AI use in workplaces including when used for work management. Although the agreement does not explicitly refer to algorithmic management, it effectively addresses the issue by framing the deployment of AI in task allocation and decision-making under the human-in-control principle, while setting safeguards against intrusive AI-driven surveillance to protect human dignity and privacy.

Concepts, definitions and operationalisation

From work platforms to the workplace

As a relatively new and evolving concept, AM lacks a universally accepted definition, and no settled consensus has yet emerged among scholars or policymakers. The term was initially introduced by Lee and colleagues (2015) to explain how ride-hailing platforms oversee their workers without relying on conventional employer-employee structures. They defined it as a system where software algorithms take on managerial roles, including the allocation, coordination, and assessment of human labour. This definition has been instrumental in unpacking how algorithms are deployed to manage the workforce, extract value, and shape working conditions. It also challenged early

[1] European Commission, Mission Letter to Roxana Minzatu, Executive Vice-President for Social Rights and Skills and Quality Jobs and Preparedness, https://commission.europa.eu/document/download/4cf63610-ed00-498a-a7c1-a2af5fd23173_en?filename=mission-letter-minzatu.pdf

[2] European Commission. (2017). European Pillar of Social Rights. Proclaimed by the European Parliament, the Council and the European Commission on 17 November 2017, Gothenburg, Sweden https://commission.europa.eu/system/files/2017-11/social-summit-european-pillar-social-rights-booklet_en.pdf

[3] European Parliament, 2025/2080(INL), Digitalisation, artificial intelligence and algorithmic management in the workplace – shaping the future of work, https://oeil.secure.europarl.europa.eu/oeil/en/procedure-file?reference=2025/2080(INL)

narratives promoted by platform companies, which framed themselves as neutral tech providers connecting independent 'entrepreneurs' rather than as employers exerting managerial control over their platform workers (Wood, 2024).

From a regulatory perspective, the above-mentioned Platform Work Directive (PWD) distinguishes two types of AM: automated monitoring systems and automated decision-making systems - applicable specifically to individuals performing work through digital work platforms.

> *h) 'automated monitoring systems' means systems which are used for or which support monitoring, supervising or evaluating, by electronic means, the work performance of persons performing platform work or the activities carried out within the work environment, including by collecting personal data;*
>
> *(i) 'automated decision-making systems' means systems which are used to take or support, by electronic means, decisions that significantly affect persons performing platform work, including the working conditions of platform workers, in particular decisions affecting their recruitment, their access to and the organisation of work assignments, their earnings, including the pricing of individual assignments, their safety and health, their working time, their access to training, their promotion or its equivalent, and their contractual status including the restriction, suspension or termination of their account.*

(Article 2, PWD)

By encompassing both systems that make decisions directly and those that support human decision-making, the Directive extends legal protection to situations where technology is used as an auxiliary tool. This approach helps prevent circumvention of the rules through nominal human involvement or superficial validation.

Evidence shows that AM practices - entailing the automation of some management tasks through computer programmes - have spread beyond platform work into traditional sectors (see chapter 2), a development often described as 'the platformisation of work' (González Vázquez et al., 2025). This diffusion has been enabled by advances in computing power and the declining cost of digital technologies, which make the large-scale collection, processing, and use of workforce data increasingly feasible in traditional employment settings.

Although AM in conventional work settings manifests in a less pure form than in platform work and within a different context of labour relations (Möhlmann et al., 2019), its deployment in workplaces poses heightened challenges for privacy and labour rights (De Stefano, 2020). Unlike in platform work, where workers typically anticipate close algorithmic oversight as part of the business model, employees in conventional settings may face intrusive data collection, continuous monitoring, and opaque decision-making processes that erode established expectations of workplace privacy, due process, and collective protections.

Platform workers can also game algorithmic systems - by spoofing GPS, strategically rejecting orders, or informally redistributing shifts - forms of resistance enabled by digital opacity and the exploitable blind spots of automated management; in conventional workplaces, by contrast, established protocols and more direct oversight leave little room for such covert strategies, making acts of resistance more visible and thus more easily sanctioned.

Furthermore, while AM in platform work typically involves real-time, fully automated control over task assignment, monitoring, and coordination via data-driven algorithms with minimal human interference, AM in traditional sectors often serves to support managerial functions, conditioned by pre-existing organisational structures and subject to greater human oversight (Baiocco et al., 2022).

AM within vectors of change

Eurofound's conceptual framework on the digital age postulates that the digital revolution will bring about profound changes to work and employment along three vectors of change (Eurofound, 2018):

- **Automation of work** is *'the replacement of labour input by machine input for some types of tasks within production and distribution processes'* (p.16)
- **Digitisation of processes** is *'the use of sensors and rendering devices to translate parts of the physical production process into digital information […], and vice versa'* (p.18)
- **Coordination by platforms** is the use of *'digital networks that coordinate transactions in an algorithmic way'* (p.19)

Within this framework, **AM engages with all three vectors of change**, though in distinct ways, and primarily **affecting governance functions**, that is the set of processes and mechanisms through which work is directed, monitored and controlled. Its link to the **automation of tasks** lies in the automation of managerial functions, either fully or partially. For instance, algorithmic systems can screen job applications or assign and schedule shifts, thereby substituting tasks traditionally performed by HR staff or line managers. At the same time, AM may play an **augmentative role** by providing decision-support tools such as real-time dashboards for monitoring workforce performance, predictive analytics to forecast staffing needs, or scheduling software that suggests optimal task allocations while leaving the final decision to managers.

Algorithms can be used to both replace (fully automate) or assist (partly automate) a managerial task (Wood, 2021; Mateescu and Nguyen 2019; Gilbert et al., 2021; UNI Global Union, 2020). For more complex, fully automated AM systems, it is also more likely that the AM tools are AI-driven, due to the complexity of making decisions without a human in the loop. This becomes relevant when discussing issues around transparency, worker influence and the potential adverse effects of the bias in AM systems.

AM relies fundamentally on **digitisation of processes**, by which information is converted into digital data. In logistics, for example, paper-based schedules are replaced by digital workforce management systems that capture working hours, task completion rates, and delivery times, thereby enabling algorithmic allocation and monitoring of tasks. The spread of sensors and smart devices in workplaces, such as smartphones, smartwatches, and GPS tracking tools, further expands the scope of worker-related data that can be digitised. The digitisation of entire workflows generates productivity data that feeds into AM practices, which in turn reshape not only individual tasks but also the division of labour and the wider organisational structure. Through this process, AM practices influence both production and governance functions, embedding data-driven control into the organisation of work.

Under the vector of **coordination by platform**, AM reshapes governance functions by determining how work is assigned, supervised, and assessed, thereby redefining managerial authority, employment relationships, and mechanisms of control within organisations. Its purest expression

can be found in platform work, where algorithms rather than human supervisors structure the entire labour process in real time.

Constituent elements of AM

AM is best understood as a socio-technical process with two dimensions: a technical dimension, which includes the data collection, surveillance, algorithmic processing; and a social and organisational dimension, which includes the ways technologies are embedded in decision-making practices.

AI and rules-based AM

An important distinction to make, especially when discussing AI in the workplace, is that not all AM relies on AI. Some systems use rule-based algorithms or pre-programmed logic (e.g., 'if-then' statements) that operate on static criteria without learning or adapting over time (Wood, 2021; Baiocco et al., 2022). These systems are often deterministic and relatively more transparent, making their decision pathways easier to audit and regulate.

In contrast, AI-driven AM uses machine learning or natural language processing to identify patterns and make probabilistic predictions or decisions based on large volumes of data (Mateescu and Nguyen, 2019; Kellogg et al., 2020). These tools can adapt to changes in worker behaviour or performance (Jarrahi et al., 2021).

While the AI Act does not explicitly define AM, it identifies AI systems used in recruitment and work management as high-risk and therefore subject to specific regulatory requirements. The Act distinguishes between two categories of such systems. The first includes AI systems intended for use in recruitment or selection processes, such as those that place targeted job advertisements, analyse and filter job applications, or evaluate candidates. The second category includes AI systems designed to make decisions that affect the terms of work-related relationships, including decisions on promotion or termination, task allocation based on individual behaviour or characteristics, and systems used to monitor or evaluate performance and conduct in the workplace.

According to Article 3.1 of the AI Act, an AI system is defined as a machine-based system designed to operate with varying levels of autonomy and capable of adaptiveness after deployment. It infers how to generate outputs, such as predictions, content, recommendations, or decisions, based on the input it receives, with the potential to influence physical or virtual environments.

AI systems are therefore distinguished from simpler software or traditional programming approaches by their autonomy, inferential capacity, and adaptability, as outlined in Recital 12[4]. These characteristics set them apart from other forms of AM. In essence, while the use of AI in the workplace constitutes a subset of AM, not all algorithm-driven systems meet the threshold to be considered AI under the AI Act.

[4] The first defining characteristic of AI systems is their ability to operate with autonomy, meaning they possess a degree of independence from human involvement and can function without direct human intervention. The second is their capacity to infer or generate outputs, as well as to configure or adjust algorithms based on the data they process. It follows that these systems do not simply follow pre-programmed rules; instead, they can identify patterns and make decisions using machine learning techniques that involve reasoning capabilities. The third distinguishing feature is adaptability - AI systems can evolve after deployment, continuously learning and improving through ongoing use.

Operationalising AM through applications and functions

Several scholars have attempted to establish a typology to categorise tasks and AM functions in different ways (Holubová, 2022; UNI Global Union, 2020; Briône, 2020; Duggan et al., 2020; Parent-Rocheleau and Parker, 2022; Kellogg et al., 2020, Nurski and Hoffmann, 2022). In a seminal paper Kellogg et al. (2020) expanded the concept of AM by identifying three core functions it performs: direction, evaluation, and discipline. They explained these through the 'Six Rs': recommending/restricting (for direction), recording/rating (for evaluation), and replacing/rewarding (for discipline). This framework has become a widely cited tool for analysing how AM operates. A European Commission's study (2025) makes use of a typology based on Kellogg et al. (2020) to classify AM functions into: evaluation where they are collecting and processing performance data of workers, direction where they are guiding workers to perform tasks, and discipline for influencing worker behaviour through rewards/punishments, plus an extra category related to recruitment which is treated as a separate function due to its hybrid nature. Within these four categories, they distinguish the following eight management functions for which AM can be used: recruitment, work/task scheduling and distribution, nudging and directing, worker monitoring and surveillance, worker evaluation, talent management and training, rewarding workers, and worker termination and dismissal.

Similar to Kellogg et al. (2020), Parent-Rocheleau and Parker (2022) identify six management functions that algorithms can perform: monitoring, goal setting, performance management, scheduling, compensation, and job termination. Complementing the typologies from Kellogg et al. (2020) and Parent-Rocheleau and Parker (2022), Nurski and Hoffmann (2022) propose a five-function framework of AM - goal specification, task specification, planning specification, incentivising behaviour, and staffing - emphasising how algorithmic tools not only determine what work is done and when, but also who does it and how they are rewarded or disciplined. This adds nuance to discussions of risk exposure, since different functions, especially those related to staffing and incentive design, can introduce additional vulnerabilities such as bias in selection, inequity in rewards, or constraining workers' autonomy.

Beyond these typologies, Meijerink et al. (2021) emphasise the importance of distinguishing between AM as applied to human resource management (HRM) functions, such as recruitment, selection, appraisal, and workforce planning, and its broader use in operational and governance contexts. They stress the difference between augmentation, where algorithms provide data-driven insights to HR professionals, and automation, where decisions are fully delegated to algorithms. Building on this foundation, Meijerink et al. (2023) propose a 'duality' lens of AM, separating HR-related applications (e.g., recruitment and appraisal) from operational and governance-oriented practices (e.g., task allocation, workflow coordination, and performance monitoring). These contributions suggest that AM should be understood as spanning two domains: one focused on people management through HR systems, and another concerned with the broader coordination, management and control of work processes.

Another distinction is made between algorithmic systems used to guide or fully substitute managerial decisions based on the inputs, processes, and outputs of the work process. A categorisation that resembles the original definition of AM by Lee et al. (2015), arguing that algorithms could allocate work, provide informational support for work optimisation, and evaluate worker performance. Based on this, Jensen et al. (2024) split AM into three categories: management of work input, management of work process, and management of work output. First, algorithms may

be used to assign tasks and recruit workers, determining which employees are needed for a given activity, in other words, deciding the 'who' of management decisions. Second, they can monitor and evaluate work processes by tracking activities and providing instructions, thereby shaping how tasks are carried out. Third, algorithms may assess workers' output, measuring productivity and performance against qualitative and quantitative standards to inform or execute decisions about rewards and sanctions.

As shown in Table 1, within these categories, specific AM functions and tasks can be identified. The list is not exhaustive, but it sums up the AM functions that appear most frequently in the literature.

Table 1: Overview of types of AM

Management of the work input	Management of the work process	Management of the work output
Allocation of tasks and distribution of orders Shift scheduling Assignment of workers to teams CV screening Interviewing job applicants Testing job applicants Some background checks	Monitoring of computer activity Location tracking Tracking of worker activity Screening of worker's communications (email, messages) Instructions for how to carry out tasks Social media screening	Assessment of workers' output and performance Consumer-sourced rating systems to evaluate performance Recommendations of whom to promote or award bonuses to Recommendations of disciplinary action terminating or withdrawing work

Source: Jensen et al., 2024.

The most recent OECD employer survey categorises AM tools into instruction, monitoring, and evaluation functions, aligning them with traditional managerial roles of directing, overseeing, and assessing workers (Milanez et al., 2025). This typology reflects the survey design: employers were asked whether their firms used software to partially or fully automate specific managerial functions, which were grouped into these three categories. For example, instruction tools automate functions such as allocating schedules, assigning activities, and providing task instructions. Monitoring tools track work time, task completion, work speed, the content of communications, or even health and safety conditions. Evaluation tools are used to set performance targets, apply rewards or sanctions, or rank workers through mechanisms like leaderboard ratings.

The categorisation builds on the foundational understanding that AM involves the automation of managerial functions through software, including tools not explicitly marketed as 'algorithmic' but which nonetheless serve similar purposes. Importantly, the grouping into instruction, monitoring, and evaluation also reflects differences in worker risk exposure. Monitoring tools typically involve the collection of more sensitive personal data, raising privacy concerns, while evaluation tools carry a higher risk of producing biased or unfair outcomes, such as inappropriate reward or sanction decisions.

Structure of the report

This paper opens with this **introductory chapter**, which discusses definitions of AM and seeks to unpack the constitutive elements of AM practices. It introduces a distinction between AI-driven and rule-based AM, as well as between full and partial automation of decision-making processes. In this context, AM may not only automate certain tasks but also augment managerial roles by providing data-driven insights and decision-support tools that reshape the exercise of management. Furthermore, AM connects in distinctive ways to the three vectors of change (i.e. automation, digitisation, and platforms) particularly in relation to governance functions, where it redefines how work is coordinated, monitored, and evaluated.

This introductory chapter is followed by three other chapters.

Chapter 1 presents prevalence rates of various forms of AM based on recent survey studies. Reported rates vary depending on how AM is operationalised -some studies specify the tools used or the specific purposes for which algorithmic systems are implemented. The available evidence indicates that AM practices have already entered workplaces across the EU, and this trend is likely to intensify given the rapid advancement of enabling technologies such as AI.

Chapter 2 explores the implications of AM for work organisation and job quality on the basis of the available evidence. An adapted version of the job quality framework developed by Eurofound is used to guide the review and structure the findings from the desk research presented in this chapter. This framework includes the following main elements of job quality: intrinsic quality of work (skills, autonomy and social support), working time and work-life balance (duration, scheduling, flexibility and intensity), safety and health (physical and psychosocial risks) and employment quality (career prospects, job security and earnings) (Eurofound, 2013; 2017). The chapter also examines potential moderating factors that can mitigate the negative effects of AM and considers key ethical implications, including potential infringement of workers' privacy and data protection rights, risks of discrimination and biased algorithmic decisions, and concerns around the transparency and accountability of outcomes.

Chapter 3 examines the role of social dialogue and collective bargaining in shaping the future of AM. It also draws attention to the challenge of ensuring meaningful worker participation in the implementation of complex IT systems - often introduced by external software providers and not always fully understood by the management teams deploying them. Involving workers not only helps mitigate the potential negative effects of AM on working conditions but can also enhance the effectiveness of these systems in delivering efficiency gains.

The report concludes by summarising the key findings of the review and linking them to relevant **policy pointers**.

1 - Prevalence of AM and tools used

Overview of key surveys and their methodologies

The adoption of AM software in European workplaces - now increasingly enhanced by advances in AI - has attracted growing scholarly and policy attention. In an effort to inform policy making, research increasingly focuses on quantifying the prevalence of AM practices among workers and organisations, as well as examining their effects on working conditions, organisational efficiency, and productivity. Between 2021 and 2025, eight major representative surveys were conducted across the EU and internationally to measure the prevalence and implications of AM practices in workplaces:

- The **seventh edition of the European Working Conditions Survey (EWCS 2024)**, carried out by Eurofound in 2024.
- The **Algorithmic Management at Work (AIM-WORK) survey**, conducted by the European Commission's Joint Research Centre across the EU, building on its predecessor, the **AMPWork pilot survey**, which was limited to two Member States (Germany and Spain).
- **Two waves of the Occupational Safety and Health (OSH) Pulse surveys** conducted by EU-OSHA: the first in 2022 (as a Flash Eurobarometer) and the second in April 2025.
- The **Special Eurobarometer 554 on Artificial Intelligence and the Future of Work**, fielded in April-May 2024, on behalf of the European Commission's Directorate-General for Employment, Social Affairs and Inclusion (DG EMPL).
- the **2024 European Survey of Enterprises on New and Emerging Risks (ESENER)** conducted by EU-OSHA, which collects information from employers and health and safety representatives on how European workplaces manage OSH risks, including psychosocial risks and challenges linked to digitalisation.
- As part of its study 'Algorithmic management in the workplace', the **OECD carried out in 2024 an employer survey** across four EU countries (France, Germany, Italy, and Spain), as well as Japan and the United States.

The eight surveys employ substantially different methodological approaches to operationalise and measure AM, reflecting both the core focus of each survey as well as the challenges of capturing such work management practices. These methodological differences have significant implications for interpreting prevalence estimates and for comparing findings across studies. Table 2 provides a summary of the core features and focus of each survey. A key distinction to be made concerns the sampling unit with surveys being either worker or establishment focused. Worker focused surveys sample individuals from the labour force, with prevalence estimates representing the percentage of workers affected across the entire workforce. In contrast, establishment surveys sample organisations as units, often relying on a respondent, typically from human resources or management, to report on technologies used across the entire establishment. Therefore, the prevalence estimates resulting from such surveys represent the percentage of establishments that have adopted these technologies rather than the percentage of workers exposed.

Table 2: Overview of surveys including indicators on use of AM

Survey	Year	Sample	Country coverage	Survey Mode	Target
European Working Conditions Survey (EWCS 2024)	2024	36,644 workers	34 European countries	Face-to-face	Workers
Algorithmic Management and Platform Work survey (AMPWork)	2021-22	7,000 workers	Spain & Germany	Telephone (CATI)	
Analysis on Impacts of Artificial Intelligence and Algorithmic Management in the Workplace (AIM-WORK)	2024-25	70,316 workers	EU27	Face-to-face	
Occupational safety and health in the era of climate and digital change (OSH Pulse)	2022	27,000 workers	EU27 + Iceland/Norway	Telephone (CATI)	
Occupational safety and health in the era of climate and digital change (OSH Pulse)	2025	28,220 workers	EU27 + Norway/Iceland/Switzerland	Telephone (CATI) + Computer-Assisted Web Interviewing (CAWI)	
Special Eurobarometer 554: Artificial Intelligence and the future of work	2024	26,415 respondents	27 EU Member States	Face-to-face + Computer Assisted Video Interviewing (CAVI)	General Public/Workers
European Survey of Enterprises on New and Emerging Risks (ESENER 2024)	2024	41,000+ establishments	EU27 + Iceland/Norway/Switzerland	Telephone (CATI) + Computer-Assisted Web Interviewing (CAWI)	Establishments
Algorithmic management in the workplace (OECD)	2024	6,047 managers	France, Germany, Italy, Spain, Japan, USA	Telephone (CATI)	

Source: Authors' elaboration based on reviewed studies.

The eight surveys employ different operationalisations of AM, reflecting different underlying conceptual frameworks and measurement strategies. The EWCS 2024 adopts an approach that measures the extent to which computer programmes are used to manage work tasks, asking workers 'To what extent does a computer programme do the following things?' with specific items on task allocation, work scheduling, and performance monitoring, using a four-point Likert-type scale ranging from 'to a large extent' to 'not at all'. This scale captures the intensity of workers' exposure to technology, though its coverage is limited to three core practices. In contrast, AIM-WORK questions emphasise reduced human oversight, asking whether management activities are 'carried out by automatic systems with little or no human input via a digital device such as a tablet, smartphone or app'. It covers eight distinct practices: roster allocation, task allocation, work speed determination, automated instructions, leaderboard ranking, gamification through points and prizes, customer rating-based allocation, and rating-based shift cancellation. These practices are measured using binary (yes/no) responses, which simplify reporting but limit information on frequency or intensity. The OSH Pulse surveys adopts an organisational technology adoption framing, building on

the approach developed for the EU-OSHA's European Survey of Enterprises on New and Emerging Risks (ESENER) surveys, asking 'Does the organisation where you work use digital technologies to...' perform various functions including automatic task or shift allocation, third-party performance ratings, automated instructions (added in 2025), supervision or monitoring of work and behaviour, environmental monitoring of noise and chemicals, and personal health monitoring of heart rate and blood pressure. Responses are recorded in a binary yes/no format, framing the question at the organisational rather than individual level. This design may capture technologies that workers are aware exist within the organisation, even if they have not personally experienced them.

The Special Eurobarometer 554 takes a distinctive public opinion approach with explicit AI framing, asking 'Have the following activities ever been performed by digital technologies, including AI, in your current or previous workplaces?. It covers six activities: hiring workers, allocating tasks, managing work time schedules, monitoring workers' activities, assessing workers' performance including sanctions and rewards, and enforcing safety measures, using a four-point frequency scale ranging from 'all the time', 'often', 'rarely', or 'never'. This design captures the intensity of technology use but conflates retrospective exposure to AM with exposure in previous workplaces. The explicit mentioning of AI in the question can influence how respondents conceptualise and report these practices, thus contributing to larger prevalence estimates.

From the employer perspective, ESENER 2024 uses a narrow operationalisation focused specifically on occupational safety and health concerns, asking two questions on AM: 'Does your establishment use any of the following digital technologies for work? Machines, systems or computers automatically allocating tasks, working time or shifts to workers' and 'Machines, systems or computers monitoring workers' performance and/or behaviour,' both with binary yes/no responses. Unlike the questions asked in worker surveys, the ESENER questions bundle together the use of algorithms for the allocation of tasks, working time and shifts.

In contrast the OECD Employer Survey employs a comprehensive employer-side measurement, using a three-dimensional framework covering instruction tools (allocating work schedules, allocating work activities, assigning clients to workers, giving instructions on how to perform work), monitoring tools (monitoring completion of work activities, monitoring working time, monitoring work speed, monitoring communications content and tone, tracking location, monitoring fatigue or alertness, monitoring health and safety), and evaluation tools (setting targets, rewarding good performance, sanctioning poor performance, providing public performance ratings or leaderboards). The survey asks respondents first whether the workplace provides such software and then, for adopters, whether the manager personally used each tool in the past month, creating a dual measurement of organisational provision versus individual managerial usage that enables more nuanced analysis than simple adoption measures.

These substantial methodological differences mean that surveys are measuring overlapping but distinct phenomena: technology-focused questions emphasise the mechanism, automation-focused questions emphasise reduced human control, organisational adoption questions capture availability rather than individual exposure, frequency scales distinguish intensive from occasional use, binary responses simplify but lose gradation. Furthermore, the presence or absence of explicit AI framing, specific practice coverage, and retrospective versus current reference periods all have implications what respondents report and how prevalence should be interpreted. Table 3 below summarises the key strengths and weaknesses of each of these surveys.

Table 3: Strengths and limitations of different approaches to measuring AM in different surveys

Name	Strengths	Limitations
European Working Conditions Survey (EWCS 2024)	• Clear technical focus • Nuanced extent measurement • Comparable to previous EWCS waves	• Less granular practice breakdown
Analysis on Impacts of Artificial Intelligence and Algorithmic Management in the Workplace (AIM-WORK)	• Comprehensive coverage of AM functions • Captures emerging practices • Emphasises autonomy reduction	• Binary responses lose intensity information
Occupational safety and health in the era of climate and digital change (OSH Pulse)	• Organisational perspective • Includes health/environmental monitoring	• Awareness-dependent reporting • Blurs personal vs. organisational exposure
Special Eurobarometer 554: Artificial Intelligence and the future of work	• Includes non-employed population • AI-specific framing captures public awareness • Frequency scale shows intensity • Awareness measurement	• AI framing may inflate/deflate estimates • Less specific to current employment
European Survey of Enterprises on New and Emerging Risks (ESENER 2024)	• Establishment-level data • OSH integration perspective • Risk assessment practices • Worker consultation measurement • Large sample (41,000+ establishments)	• Narrow AM definition (only 2 items) • Possible underreporting by employers • No intensity measurement
Algorithmic management in the workplace (OECD)	• Supply-side perspective • Distinguishes availability from usage • Manager accountability insights	• Potential managerial bias • May overestimate worker exposure • Limited geographic coverage

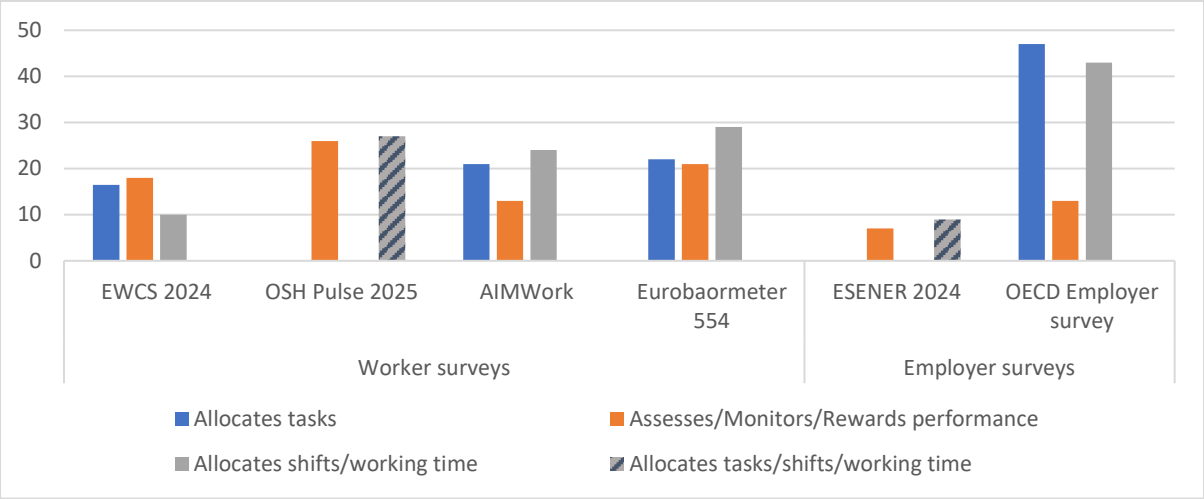
Source: Authors' elaboration based on reviewed studies.

Prevalence rate of AM practices in the EU

Synthesising across the various surveys and methodological approaches, a clear picture emerges that AM affects approximately one quarter to one third of European workers in various forms, though with important variations depending on how AM is defined and measured.

In the EWCS 2024, a significant share of workers in the EU report that a computer programme monitors their work performance (18 %), allocates their work tasks (16 %) and determines their work schedule (10 %) to a large or some extent. Other surveys find even higher prevalence rates of the most common AM practices in workplaces.

Figure 1: Estimates of prevalence of task allocation and assessing/monitoring/rewarding performance through automatic systems



Source: Own compilation based on publicly available survey reports.

Findings from the AIM-WORK survey, show that 24 %of EU workers report that their working time, rosters, or shifts are automatically allocated to them via digital devices, making this the single most common form of AM. Automated task allocation affects 21 % of workers, while automated reward systems through points, prizes, or stars affect 13 %. Automated benchmarking through leaderboards or dashboards affects 12 %, and 10 % of workers report receiving automated instructions or directions for completing their work. More invasive or consequential practices are less common but still impact substantial minorities: 7 % of workers report that their shifts could be automatically cancelled based on performance ratings, 5 % have their work speed automatically determined, and 4 % have tasks allocated based on customer ratings (González Vázquez et al., 2025).

The OSH Pulse 2025 data indicates that 27 % of workers in the EU report that their organisation uses digital technologies to automatically allocate tasks, working time, or shifts to them, representing a slight decline from 30 % in the 2022 wave. Similarly, 26 % report that these technologies are used for third-party performance ratings such as by customers, colleagues, or patients, and another 26 % report receiving automated instructions or directions to complete their work. A quarter of workers, report that digital technologies are used to supervise or monitor their work and behaviour. Less common are environmental monitoring, with 18 % reporting monitoring of noise, chemicals, or dust in their working environment, and personal health monitoring, with only 7 % reporting monitoring of heart rate, blood pressure, or posture (EU-OSHA, 2025).

The Eurobarometer 554 findings are notable because they explicitly mention AI in the question framing and include both currently employed and previously employed respondents reflecting on their workplace experiences. This survey finds that 29 % of EU residents report having experienced management of work time schedules through digital technologies including AI, either all the time or often. Monitoring of workers' activities affects 24 %, allocating tasks to workers affects 22 %, and assessing workers' performance including sanctions or rewards affects 21 %. Furthermore, 30 % report that digital technologies or AI are used for enforcing safety measures, and 18 % report their use in hiring workers. These somewhat higher prevalence rates compared to the other worker surveys may reflect the retrospective framing that captures both current and previous workplace

experiences or could also indicate that explicit mention of AI in questions affects how respondents report on these technology use (European Commission, 2024).

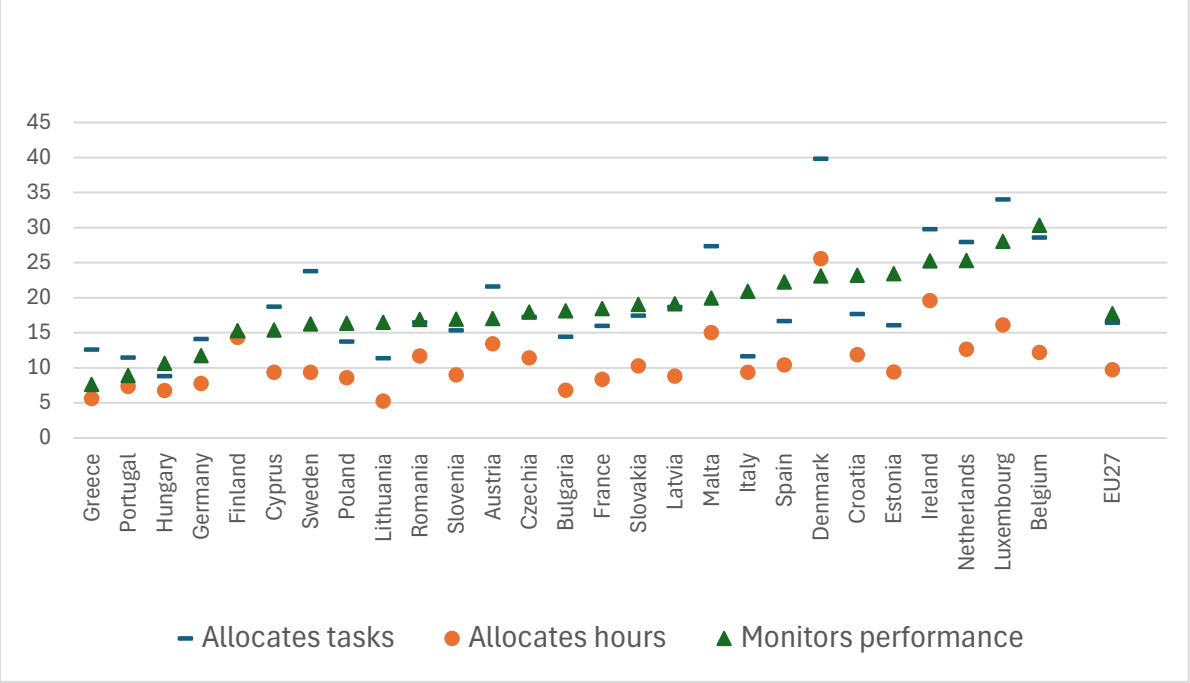
From the employer side, the ESENER 2024 survey reports that 9 % of establishments use machines, systems, or computers to automatically allocate tasks, working time, or shifts to workers, and 7 % use these technologies to monitor workers' performance or behaviour. In contrast, the OECD Employer Survey reports a markedly higher prevalence, with 79 % of organisations in the surveyed EU countries having adopted at least one AM tool, a figure that rises to 90 % in the United States. Among European employers, 69 % report using tools for giving instructions to workers, while 33 % use basic monitoring such as time tracking, and only 6 percent monitor conversations, calls, or emails. The substantially higher prevalence reported in the OECD survey compared to ESENER can be attributed to differences in sampling frames and question design. The OECD survey focused on managers in larger firms within selected countries, whereas ESENER employed a broader establishment-based sample across the EU. Furthermore, the OECD asked about the use of any AM tool, while ESENER applied a narrower definition. At the same time, the lower prevalence of AM use in ESENER compared to worker survey likely reflects the concentration of such tools in larger establishments.

Geographic, sectoral, and occupational patterns in worker surveys

The prevalence of AM varies across countries, sectors, and occupational groups, with worker surveys revealing convergent patterns, though the magnitude and specific country rankings differ.

The EWCS 2024 data show considerable geographic variation in the prevalence of AM practices, depending on the specific form of AM. However, most of the AM practices covered tend to be more prevalent in countries with a high concentration of knowledge-based industries, such as several Benelux and Nordic countries, as well as Ireland.

Figure 2: Reported prevalence of AM in workplaces by country in the EWCS 2024



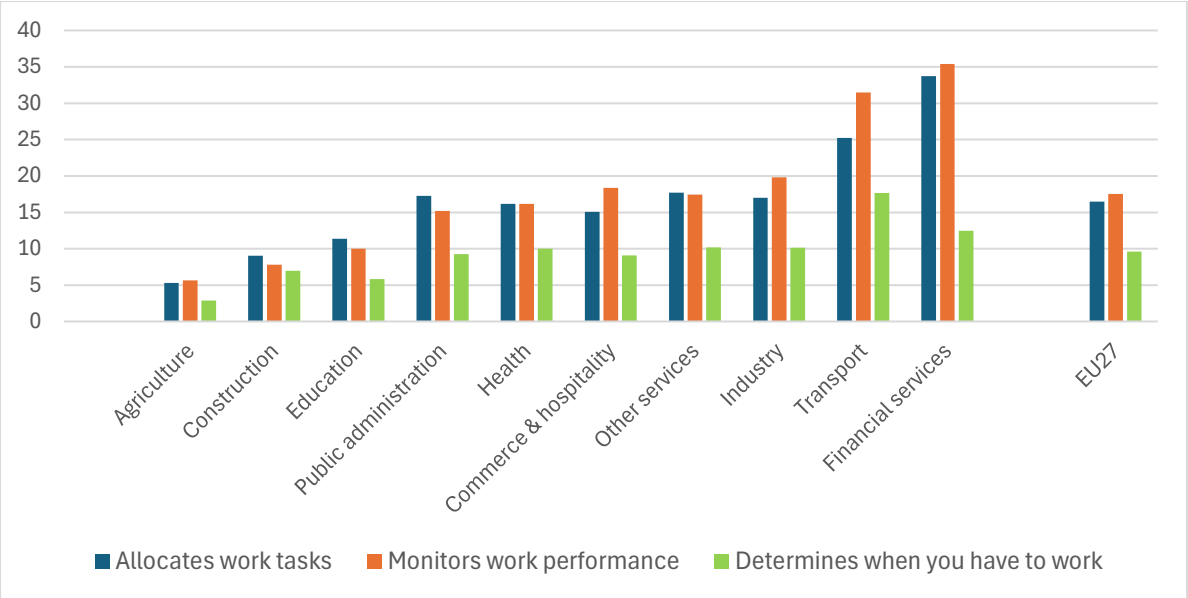
Source: EWCS 2024.

Note: Percentages refer to share of workers indicating use of computer programmes doing the above to a large or some of the time.

The AIM-WORK survey corroborates this substantial geographic heterogeneity, finding working time or roster allocation ranges from 10 % in Greece and Bulgaria to 32 % in Spain, 30 % in Ireland and Sweden, and 28 % in Belgium and Finland. OSH Pulse 2025 finds that automated task, working time, or shift allocation ranges from merely 11 % in Czechia to 37 % in the Netherlands (EU-OSHA, 2025).

Sectoral patterns across the surveys reveal a degree of consistency in identifying which industries experience the highest prevalence of AM, despite the surveys measuring different specific practices. In the EWCS 2024, financial services and transport stand out as having the highest shares of workers subjected to AM practices (Figure 3). Specifically, 34 % of workers in financial services report automated allocation of tasks, and 35 % report performance monitoring, while in the transport sector, the corresponding percentages are 25 % for automated task allocation and 31 % for performance monitoring. In the transport sector a higher-than-average share of workers (18 %) report that computer programmes determine their work schedules. These forms of AM in these two sectors may be driven by regulatory requirements, such as the need to prevent insider trading and ensure compliance with industry standards in financial services, and the need to enforce legal compliance and enhance safety for both passengers and drivers in the transport sector.

Figure 3: Sectoral prevalence of AM in the EWCS 2024



Source: EWCS 2024.

Note: Percentages refer to share of workers indicating use of computer programmes doing the above to a large or some extent.

Findings from the AIM-WORK factor analysis, identify two distinct patterns: algorithmic direction - involving automated allocation of working time, tasks, and instructions - is most prevalent in transport, health, and manufacturing; while algorithmic evaluation - involving automated rewarding, benchmarking, and customer ratings - is most prevalent in a range of sectors, including finance,

wholesale and retail, accommodation and food, and information and communication technology (González Vázquez et al., 2025).

In the OSH Pulse 2025, the sector reporting the highest prevalence for automated task allocation is utility and mining or quarrying sector at 33 %, followed by health and social care services at 30 %. Supervision and monitoring of work and behaviour by digital technologies is however more prevalent in commerce, transport, accommodation, and food services with 30 % of workers reporting being subject to such AM practices (EU-OSHA, 2025).

The Eurobarometer data identifies logistics and warehousing as the highest-prevalence sector, with 44 % of workers reporting work scheduling through digital technologies or AI. Manufacturing follows at 37 %, the public sector at 36 %, and the service sector including retail, accommodation, transportation, and food services at 32 %.

In terms of occupational patterns, according to EWCS 2024 data, the incidence of all three forms of AM (automated task allocation, scheduling of work and performance monitoring) is higher in low-to-mid skilled occupations (notably clerical workers and plant and machine operators) where employees may have less autonomy over their work. Similar occupational patterns emerge from the AIM-WORK analysis with industrial operators and clerical workers experiencing the highest overall intensity of AM[5] (González Vázquez et al., 2025). In contrast, the OSH-Pulse 2025 found that 30 % of skilled, semi-skilled or unskilled manual workers and farm workers are supervised or monitored with digital technologies (EU-OSHA, 2025). All three surveys find that managers and professionals experience lower exposure to AM practices, particularly regarding task allocation and automated instructions, though these occupational groups may still be subject to evaluation systems.

Summary points

- **Eight representative surveys conducted between 2021-2025 reveal that approximately one-quarter to one-third of European workers are exposed to AM practices in workplaces**, though prevalence estimates vary depending on the survey methodology and conceptualisation of AM. Worker surveys report between 16 % and 27 % for performance monitoring and task allocation, while establishment surveys such as the ESENER 2024 and the OECD Survey on AM that 7-13 % of establishments in the EU use digital technologies for these purposes.

- **Methodological differences across surveys result in overlapping but distinct measurements of AM practices**. The EWCS uses an exposure-based approach, measuring the extent to which computer programs are used to allocate and schedule work and to monitor performance. The AIM-WORK survey employs a binary, presence-based approach to measuring algorithmic management practices in workplaces. OSH Pulse survey uses an organisational adoption-based approach, emphasising the organisation as the unit of analysis. The Eurobarometer poll survey uses an explicit AI framing, that captures retrospective exposure to AM, while employer surveys (ESENER and OECD) measure establishment-level adoption rather than individual worker exposure.

[5] Monitoring intensity is defined as the total number of monitoring types to which each worker is subjected.

- **Geographic variation is substantial and consistent across surveys** with generally high prevalence in Nordic countries and lower prevalence in Eastern and Southern Member States.

- **Sectoral patterns converge across worker surveys** identifying transport, logistics, financial services, health, and manufacturing as high-prevalence sectors. **Occupational patterns identified in EWCS and AIM-Work surveys consistently identify clerical support workers and plant/machine operators as experiencing the highest AM exposure** while managers and professionals report lowest exposure levels.

2 - Implications for work organisation and job quality

Work organisation

Eurofound defines work organisation as the way labour is divided, tasks are allocated, and work processes are coordinated and controlled within companies, encompassing aspects such as job design, task assignment, scheduling, pace, and decision-making.

> *Work organisation […] refers to how work is planned, organised and managed within companies and to choices on a range of aspects such as work processes, job design, responsibilities, task allocation, work scheduling, work pace, rules and procedures, and decision-making processes.*[6]

AM directly intersects with this definition, as it introduces digital systems that automate or semi-automate many of these organisational functions. By assigning tasks, scheduling shifts, monitoring performance, and guiding decision-making through algorithmic outputs, AM represents a technology-driven mode of work organisation that reconfigures coordination and control processes traditionally carried out by human managers.

Changes in managerial functions

While much of the existing literature emphasises the impact of AM on workers' jobs, these new data-driven practices can have an equally profound effect on managerial tasks, as managers rely on these systems to steer and manage their teams. To varying degrees depending on implementation, AM automates, reshapes, and supports core managerial functions, including direction (e.g. task allocation), evaluation (e.g., performance monitoring), disciplining (e.g. contract non-renewal or dismissal), and rewarding (e.g. promotion).

While there is a risk that advances in AI may push AM towards fully automated management systems, Wood (2021) argues that current AM practices typically reflect a coordinated interplay between human actors and algorithmic systems rather than a fully automated form of management, with such tools generally requiring guidance and input from human managers to function effectively. However, as some scholars note (Lippert et al., 2023a), unlike earlier applications, AM does not merely support or guide managers in their tasks but increasingly delegates managerial responsibilities directly to algorithms.

Managerial decision-making

According to an OECD employer survey conducted in 2024 in six countries (France, Germany, Italy, Japan, Spain, and the United States) covering 6,047 firms (with 20 or more employees), managers generally perceive AM as significantly improving the quality of managerial decisions (Milanez et al., 2025). Approximately 60 % of surveyed managers reported that AM enhances decision-making by providing more information, increasing the speed of decisions, and allowing greater managerial autonomy. Among the responding European managers, 65 % report an increase in information availability, 58 % in decision speed, and 39 % in autonomy. The AM tools reduce repetitive tasks and

[6] See full definition at this address: https://www.eurofound.europa.eu/en/topics/work-organisation.

stress for managers, with 45% of European respondents reporting improvements in their job satisfaction. However, perceptions vary across regions: while U.S. managers often believe that AM reduces decision bias, their counterparts in Europe and Japan are more sceptical, reporting either no change or even an increase in bias.

A qualitative multiple-case study in two logistics companies in Sweden showed that AM substitutes for or augments traditional managerial functions by embedding decision-making into algorithmic systems, thereby reshaping direction, evaluation, discipline, and rewards (Nilsson et al., 2024). For instance, whereas workers previously received order-picking lists from managers, they now obtain automated, detailed instructions via handheld devices. The study found that workers largely perceived the shift as constraining and stressful, although participatory practices and organisational support could mitigate these effects. With respect to managerial functions, the replacement of quantitative outputs with qualitative assessments reshaped evaluation by reintroducing managerial judgment into performance appraisal, a change that was generally perceived positively by workers.

Managerial roles

In their position paper, CEC European Managers (2024) - the European social partner organisation representing managers - acknowledges the shift in managerial roles brought about by the rise of AM tools and the risks that accompany them. The paper cites, for instance, the use of Microsoft 365 Co-pilot, which automates some managerial activities such as monitoring tasks and controlling team members. While such tools can streamline tasks and improve efficiency, they also risk reducing autonomy, eroding trust, and narrowing work into micro-measured outputs. CEC therefore emphasises the continued importance of human leadership, advocating for a 'right to a human manager' to ensure accountability, ethical oversight, and participatory governance in AI-driven workplaces.

This aligns with scholarly perspectives which argue that, rather than replacing managers, algorithms are more likely to transform their roles, potentially turning managers into coaches, facilitators, or analysts who guide teams and interpret data-driven insights, rather than simply exercising control (Parent-Rocheleau and Parker, 2022). The OECD employer survey (Milanez et al., 2025) also found that the adoption of AM tools in workplaces is reshaping managerial roles by increasing demand for analytical and digital competencies, including skills like data literacy, with around 60% of managers reporting improvements in decision-making facilitated by these tools. While U.S. managers also reported rising expectations for social skills such as active listening, in several European countries (France, Germany, Italy, and Spain) some managers reported a decline in the need for such interpersonal skills, though the report does not establish definitively whether this reflects substitution by automation. This evolution suggests that AM can enhance efficiency but may also lead to deskilling or reskilling challenges depending on its implementation.

Complementing these survey-based insights, a large-scale field experiment on Amazon Mechanical Turk (n=1,500) provides evidence that algorithmic systems can substitute for traditional managerial tasks such as monitoring, evaluation, and task allocation, but this substitution comes at a cost (Margalit and Raviv, 2024). Workers who received identical positive feedback from an algorithm, rather than from a human manager, exerted less effort, were less thorough, and produced lower-quality work. The results highlight that human managers retain a distinctive role in providing recognition and motivation, functions that algorithms cannot replicate because workers do not ascribe genuine recognition to automated systems. In terms of managerial roles, the study shows that while algorithms can take over efficiency-oriented tasks, they diminish managers' capacity to

inspire discretionary effort through social presence and acknowledgment. Transposed to conventional workplaces, these findings suggest that full automation of managerial functions risks weakening motivation and commitment, especially where recognition and relational aspects are central.

Further insight into the implications of AM for managerial roles comes from an ethnographic study of Amazon fulfilment centres (Cheon and Erickson, 2025), which suggests that AM does not simply erode middle management but reconfigures it, shifting managers toward roles of data interpretation, mediation, and discretionary correction. Workers are subject to double monitoring - by algorithms and by human supervisors - whose judgments about attitude, work ethic, or data anomalies significantly shape outcomes. This intertwining of algorithmic oversight and managerial discretion reflects what Wood (2021) terms 'conditional algorithmic management', in which managerial and algorithmic authority are co-mingled.

Efficiency and productivity gains

AI-driven self-learning technologies offer employers the opportunity to gather and leverage more profound and granular insights into their business operations and workforce, optimising efficiency through automated or semi-automated decision-making (Jarrahi et al., 2023). A systematic literature review of 45 studies on AM across platform, hybrid, and traditional work contexts highlights that, while AM initially emerged to achieve efficiency gains in work platform organisations - enabling scalability and 'dramatic efficiency enhancements' - its mechanisms (e.g. algorithmic control through recording, rewarding, or replacing, and algorithmic matching for scheduling and task allocation) are now increasingly adopted in traditional firms (e.g. banks, logistics, retail, manufacturing) to improve operations and productivity, including the optimisation of call centres, delivery routes, and warehouse processes (Lippert et al., 2023a).

Another study conducted at a German manufacturing plant of an international automotive supplier, using linear mixed modelling on manufacturing error data, found that the use of AM accelerates problem resolution in traditional workplaces. Interestingly, the study also revealed that even with limited workforce involvement, AM continued to generate performance benefits in this highly standardised setting. The authors argue that in structured, routine work environments such as manufacturing, AM can deliver significant performance improvements even without strong participatory implementation (Schmid and Wiesche, 2024).

Examples of how AM influences productivity can be drawn from case studies, particularly in transport, retail, hospitality and business logistics. Based on their review, Mateescu and Nguyen (2019) illustrate common applications of AM across sectors, showing how algorithmic tools are increasingly deployed with the intent to optimise operations, cut costs, and boost productivity. From route optimisation and automated scheduling to customer rating systems, these technologies make workforce management more data-driven and efficient. However, while these systems provide clear efficiency gains for employers, Mateescu and Nguyen (2019) argue that they also raise important concerns about transparency, fairness, and the effects on workers' autonomy and stability. By reviewing AM tools and techniques across key sectors, Bernhardt et al. (2021) argue that, although employers frame these technologies as instruments of efficiency and accountability, in practice they often intensify managerial control in ways that undermine workers' wellbeing, through heightened surveillance, work intensification, erosion of privacy, and the reproduction of bias and discrimination.

Table 4: AM tools across selected sectors

Sector	Tools and techniques	Employer goal
Call centres	Webcam/computer vision monitoring of remote workers Real-time behavioural coaching software (e.g., Cogito) analysing calls and providing guidance Dashboards with customer experience scores	Ensure compliance with company rules; improve efficiency, sales conversions, and customer satisfaction; reduce customer churn
Food services	Tabletop tablets (Ziosk), consumer-sourced ratings, automated performance metrics, scheduling software for staffing	Automate evaluations; reduce managerial discretion; link customer feedback to performance; ensure consistent service levels; reduce labour costs through just-in-time staffing
Home care	Electronic Visit Verification (logs time, location, and services provided) Care platforms: worker profiles, ratings, response times	Assure clients of reliability and safety; create ranking systems to match “best” workers with clients
Hospitality	Housekeeping management software (Hotelogix), task sequencing via tablets, speed tracking	Increase efficiency of room cleaning, reduce managerial oversight, track performance
Logistics and transport	Gamification (leaderboards, performance scores) Task direction tools (voice-directed picking, ‘lead-me’ robots)	Maximise efficiency of routes, reduce mileage/costs, optimize daily workforce tasks,
Retail	Automated scheduling software (Kronos, Dayforce), automated hiring (background checks, theft databases, social media monitoring), grocery apps (Instacart, Shipt):	Lower labour costs, respond quickly to demand, standardize evaluations

	performance tracking, ratings, effort-based pay algorithms	
Transport	Route optimization (UPS ORION), predictive analytics, delivery apps (Amazon Flex, Instacart, Shipt); Sensors, dashcams, computer vision to track driving behaviours (fatigue, distractions, braking)	increase safety and minimize liability; optimize driver supply to match demand in real time

Source: Authors' elaboration based on Mateescu and Nguyen, 2019 and Bernhardt et al., 2021.

Some practical examples in logistics, as identified by Mateescu and Nguyen (2019), highlight the potential of AM to deliver significant efficiency gains and cost savings. In the United States, UPS's deployment of the ORION routing algorithm significantly enhanced delivery efficiency: within a year, it saved over 1.5 million gallons of fuel and cut 206 million minutes of driver idle time, enabling drivers to complete more deliveries in less time (Appleseed, 2016). In Europe, distribution centres and related sectors are increasingly deploying AI-based and AM systems to optimise workflows, such as route planning, warehouse automation, and real-time monitoring. As shown in a multi-country Nordic policy study (Cox and Oosterwijk, 2024), these tools are often introduced with the aim of improving efficiency, resulting in smoother operations, faster order fulfilment, and in some cases enhanced workplace safety. However, the study also points to recurring tensions around surveillance, loss of autonomy, and mismatches between algorithmic outputs and real-world conditions.

As part of this same study, case research in Finland's transport, logistics, and retail sectors shows that AM tools such as route planning systems, inventory management platforms, predictive shift-scheduling, and warehouse automation have been deployed to streamline operations and reduce inefficiencies. Crucially, however, the study found that productivity and welfare gains were most evident in workplaces where implementation was accompanied by strong collaboration and trust between workers, unions, and management (Cox and Anttila, 2024).

Further case study research in logistics and healthcare illustrates how AM tools are used to improve coordination, reduce idle time, align labour supply with demand, and optimise workflows and shift scheduling (Rani et al., 2024). These applications often generate efficiency gains or service quality improvements, particularly in contexts with fluctuating demand, interdependent tasks, and operational complexity, by enabling more responsive adjustment to changing conditions. However, the magnitude and sustainability of such gains depend heavily on regulatory and institutional frameworks (e.g., labour laws, worker protections, transparency) and on implementation choices such as the degree of monitoring, flexibility, and opportunities for worker participation. Where protections are weaker, initial efficiency improvements may be offset by adverse effects, including heightened stress, reduced morale, and higher turnover, which ultimately undermine long-term productivity.

AM tools are also spreading to knowledge-intensive sectors such as financial services. Case study research in Norway's finance industry shows that data-driven management tools enhance

operational efficiency by automating case-handling and reducing reliance on manual oversight, while enabling more targeted interventions in areas such as credit scoring, fraud detection, and customer service. Their adoption in finance is driven not only by incentives to optimise decision-making and risk management but also by the need to comply with strict regulatory requirements (Kuldova and Rudningen, 2024).

Other research points to algorithmic applications reshaping human resource management (HRM) more broadly. A systematic review of AI in HRM finds that employers primarily deploy such technologies to improve efficiency (Votto et al., 2021). In recruitment, AI is used to filter large applicant pools, sort résumés, and match candidates to job profiles, thereby accelerating hiring and reducing manual HR effort. In performance evaluation, AI-augmented HR information systems employ analytics and dashboards to monitor KPIs, highlight performance trends, and enable employee comparisons, reducing administrative overhead and supporting faster managerial decision-making. In training and development, AI tools recommend tailored learning opportunities, personalise career development, and automate elements of training management, thereby easing coordination burdens and guiding workers to address specific skill gaps.

Whereas the above reviewed studies emphasise the potential of AM to reshape management practices, findings from a 2025 European Commission's study highlight a divergence between employers' and workers' perceptions of AM in relation to productivity. In the employer survey (n=158, not statistically representative), more than half of respondents reported positive effects of AM on working time and productivity (61.8%), production efficiency (58.5%), and organisational competitiveness (52.5%), with only about 5% noting minor or moderate negative effects. By contrast, the worker survey (n=970) painted a less favourable picture: only 35% of employees felt that AM improved their productivity, while 22.2% reported that it harmed it. These negative perceptions may be linked to adverse effects such as increased performance pressure, the opacity of AM tools, or inaccuracies in algorithmic outputs that do not align with production needs. For instance, rigid scheduling or automated performance evaluation systems may reduce worker autonomy and morale, thereby undermining productivity (European Commission, 2025).

One aspect foundational to AM that is often viewed negatively - electronic employee monitoring - has been examined in a meta-analysis of 63 studies (Siegel et al., 2022). The findings show that it yields no average performance gains, while reducing job satisfaction, increasing stress, and even slightly raising counterproductive behaviour. This suggests that such management practices are far from being a guaranteed productivity booster.

Overall, the available evidence suggests that while AM can enhance organisational efficiency and support faster decision-making, the associated productivity gains are not guaranteed. These positive outcomes depend on the implementation context, as well as on factors such as the transparency of AM tools, their adaptability to shop-floor needs, and the extent of workforce acceptance. For AI-driven, self-learning AM tools, achieving transparency is more challenging than for rules-based systems. Drawing on a literature review, expert interviews, and analysis of ESENER survey data, EU-OSHA concludes that the effectiveness of AM in boosting productivity is contingent upon transparent design and practices, worker awareness and involvement, human-centred oversight, adherence to ethical standards, and safeguarding practices that also protect health, safety, and wellbeing, to ensure that technological advancements benefit both employers and employees (EU-OSHA, 2022).

Gamification of work

Work platforms were among the first to experiment with gamification and other 'psychological levers' to shape workers' behaviour, for example by deploying promotional rates and push notifications intended to keep them working longer than they might otherwise choose (Mateescu and Nguyen, 2019). Parallel mechanisms can be found in more conventional work settings: automated scheduling and customer rating systems in retail, tracking and client feedback in domestic and hotel work, and algorithmic routing in delivery and logistics (Mateescu and Nguyen, 2019). These systems similarly rely on nudges, scoring, incentive loops to shape worker behaviour or penalties, that can subtly sway workers to work more and increase performance (Kellogg et al., 2020; Eurofound, 2020; Briône, 2020).

A growing body of research on gamification linked to the use of AM systems focuses on warehousing and logistics. In the literature, Amazon is frequently cited as an example, though often not in an edifying way. For instance, Wood (2021) discusses Amazon's 'FC Games,' which transform pick-and-pack tasks into game-like challenges by awarding virtual pets and points based on performance metrics such as speed and accuracy. Ethnographic evidence from Amazon fulfilment centres further shows how tightly coupled tracking systems, metrics, and device workflows prompt workers to 'play' the metrics, revealing how AM can generate game-like behaviour even without overt badges or leaderboards. A more nuanced picture emerges from a study based on interviews with warehouse managers: Bahr et al. (2021) highlight a rising managerial interest in gamification as a means to boost engagement and throughput, while also pointing to barriers and ethical concerns, such as competition, surveillance, and fairness, that arise when performance is continuously monitored and compared.

Research from the Nordic countries shows that game-like mechanisms embedded in AM systems are being tested in financial institutions and manufacturing firms through individualised performance management systems that use real-time scoring and digital performance badges to boost productivity (Håkansta et al., 2024; Kuldova et al., 2024). These mechanisms are also increasingly present in retail and customer service companies (Cox and Oosterwijk, 2024), where digital dashboards publicly rank employees by sales figures or call resolution times, creating a form of algorithmic competition that closely mirrors leaderboard mechanics. However, public performance displays have been criticised for intensifying anxiety and pressuring employees to overwork, particularly when such metrics are directly tied to scheduling decisions or continued employment (Håkansta et al., 2024). Regulatory responses in Europe are emerging in response to these concerns; for instance, France has moved to restrict forms of gamified ranking that contribute to excessive employee competition and mental health burdens (Cox and Oosterwijk, 2024).

Most of the available studies show that gamification of work under AM is a double-edged sword: it may increase engagement and efficiency particularly in monotonous roles, but also brings significant risks. Studies indicate that algorithm-driven gamification can increase psychological strain as workers feel compelled to constantly outperform peers or maintain top rankings (Kuldova and Rudningen, 2024). This competitive dynamic may erode collaboration and workplace solidarity, as algorithms frame co-workers as competitors rather than team members (Cox and Oosterwijk, 2024).

An ethnographic study of Amazon fulfilment centres reveals that workers resist AM through what they call 'tricks', that is, everyday tactics that allow them to reassert some control within a tightly monitored environment (Cheon and Erickson, 2025). These tricks range from 'cherry-picking' easier

tasks, printing barcodes to scan instead of physically retrieving items ('virtual picking') or coordinating with colleagues to avoid being flagged for time off task, to stretching breaks by exploiting loopholes in the scan-to-scan system. Such practices grant workers small moments of autonomy and relief from constant pressure, yet they are deeply ambivalent: while they offer micro-freedoms and psychological respite, they also keep productivity levels high, reinforcing management's goals. The study shows that resistance is not straightforward opposition but is better understood as a form of 'work game' that blends resistance and consent, illustrating how workers contend with, subvert, and at times inadvertently sustain algorithmic control in the warehouse.

A more nuanced picture emerges from a qualitative, design-oriented study of AM in Swedish retail store-floor settings found that game-like mechanics, such as real-time feedback, dashboards, targets, and performance metrics, can shape motivation in both positive and negative ways (Arntz and Fältström, 2024). When well designed, these features can drive engagement; however, if perceived as controlling, unfair, or opaque, they risk undermining wellbeing. The outcomes depend on design features such as how performance is measured, how visible it is to others, how workers' input is incorporated, the levels of autonomy provided, the clarity of targets, the perceived fairness of the system, and the degree to which workers can understand how it functions.

Complementing this, Capatina et al. (2024) highlight the positive potential of gamification in corporate training programmes. Their research shows that structured game elements can improve knowledge retention and sharing, and that, when carefully designed, gamification can support learning and performance in traditional firms. Social interaction emerged as a key mediator between gamification techniques and knowledge sharing, highlighting the importance of collaborative learning environments.

Job quality

Intrinsic quality of work

AM can restrict workers' decision-making and control by issuing real-time, detailed instructions that dictate how tasks are performed, a dynamic frequently noted in the literature (Briône, 2020; Parent-Rocheleau and Parker, 2022; Abey et al., 2020; Laursen et al., 2021; Wood, 2021). By standardising and simplifying work into predefined, routinised components, task allocation systems risk making jobs overly simplified and less varied, thereby reducing discretion, judgment, and intrinsic skill use (Wood, 2021; Gilbert et al., 2021; Parent-Rocheleau and Parker, 2022). In logistics and warehousing, for example, handheld devices and scanning systems guide workers through minute-by-minute workflows, lowering cognitive demands but simultaneously curtailing autonomy and task variety (Wood, 2021). Similar patterns are observed in the transport sector, where algorithmic dispatching and route optimisation tightly control driver behaviour, turning jobs into fragmented sequences of instructions with minimal discretion (Parent-Rocheleau and Parker, 2022). Retail work is also increasingly governed by big data systems (e.g. Enterprise Resource Planning, Supply Chain Management, Customer Relationship Management) that monitor and regulate workers via algorithms. This shifts management from discipline (supervisors observing workers) to control (software and data continually modulating behaviour). As documented in an ethnographic study in a large retail store in Ireland, workers' tasks are tightly scripted, monitored, and objectified through KPIs and system-generated metrics (Evans and Kitchin, 2018).

Consistent with this, research conducted by the European Commission's Joint Research Centre, based on a representative survey in Germany and Spain, linked AM to monotonous work and detailed procedures, identifying a negative association with time flexibility and autonomy. This suggests that algorithmic systems not only constrain how workers perform tasks but also risk undermining their agency at work (Fernández-Macías et al., 2023). Using the same data source, an analysis of AM in home working settings found negative associations between AM and working time control, autonomy, and social support, and a positive association with stress (Adăscăliței and Riso, 2024). The findings suggest that AM offset many of the potential benefits of remote work.

Evidence from the most recent Joint Research Centre's AIM-WORK survey shows that algorithmic direction (automated allocation of tasks, schedules, instructions) and algorithmic evaluation (automated ratings, benchmarks, rewards) are negatively correlated with flexibility and autonomy at work, albeit only mildly. The findings also suggest that these practices are linked to reduced skill use, as AM tends to increase task standardisation, routinisation, and fragmentation of work, thereby limiting opportunities for workers to apply and further develop their skills.

AM functions are often embedded in robotic systems used in manufacturing, business logistics, and warehousing, even if it is not immediately apparent to workers that they are being managed through such systems. Based on EU-OSHA's OSH Pulse survey data, Eurofound research on advanced workplace robotics found that workers operating alongside robots are 7% more likely to report reduced autonomy, as automation tends to limit discretion over tasks and decision-making (Eurofound, 2024c). Case studies from the same research provide further evidence on this: the introduction of robotic shelving systems in warehouses reinforces a task-driven work organisation, reducing worker autonomy as workers are required to follow system-determined workflows rather than organise their own tasks (Eurofound, 2024c).

An even greater erosion of autonomy has been documented in several studies of AM particularly in logistics and warehousing. Research on Amazon's fulfilment centre in Italy shows how workers' tacit knowledge of inventory was extracted and encoded into algorithms, rendering jobs repetitive, fragmented, and alienating (Delfanti, 2019). Similarly, a mixed-methods study in the United States - combining survey data from a national sample of 700 Amazon employees with 46 in-depth interviews - found that digital tools such as 'time off task' monitoring and automated discipline reduced worker discretion while automating supervision (Vallas and Kronberg, 2023). These findings are also suggestive of broader deskilling effects of AM systems. As AI-driven AM systems increasingly assume more complex tasks, the risk of deskilling becomes a critical concern for system design (Balasubramanian et al., 2017). Another ethnographic study of a large brick-and-mortar retail store in Ireland (part of a multinational chain) found that algorithmic and big data systems in conventional retail shift management towards algorithmic control, making work increasingly data-driven and undermining the value of customer-facing skills (Evans and Kitchin, 2018). As staff 'work for the data' rather than for customers, aspects of work once considered central, such as customer service, troubleshooting, and interpersonal interaction - become undervalued or invisible because they are not captured by performance metrics.

This trend has been described as a form of 'digital Taylorism' (Noponen et al., 2023) that not only restricts day-to-day decision-making but also, over time, produces workplaces where individual workers are easily replaced and rendered interchangeable (Cox and Oosterwijk, 2024). As a result, they have less knowledge and oversight than before and increasingly feel like 'cogs within a

machine' directed by opaque systems rather than providing a service for customer (Evans and Kitchin, 2018).

These dynamics were also observed in other qualitative studies in logistics in other European countries. A study of four warehouses of the same multinational logistics firm in Belgium, Germany, and the Netherlands highlighted the negative impacts of digital monitoring and lean management practices on workers' skills and discretion (Dörflinger et al., 2021). Operating under a system known as Operational Excellence System (OES), these warehouses relied heavily on standardisation, digital monitoring, and continuous improvement, with real-time tracking of goods and individual performance measurement. Except in sites where unions or works councils were strong (e.g., Germany and Belgium), workers' discretion was sharply curtailed. Skill development and rewards were largely absent, promotion opportunities rare, and most tasks, such as picking, reaching, and packaging, remained low-skilled and tightly monitored by algorithmic tracking. In this way, OES reinforced the broader trend observed across contexts: the routinisation of work and the erosion of worker autonomy through the embedding of tacit knowledge into digital systems.

At the same time, institutional and contextual factors shape how these dynamics play out. In German logistics and manufacturing firms, Schaupp (2021) found that AM intersected with migration regimes: the availability of cheap, precarious migrant labour encouraged employers to adopt algorithmic tools that fragmented work and reduced training needs, thereby reinforcing the structural vulnerability of migrant workers, namely, their dependence on employers for residence status, limited access to training, and restricted bargaining power.

By contrast, a qualitative case study in Québec's aluminium industry shows how strong unions and collective agreements mediated these dynamics: while monitoring intensified, workers retained influence over task allocation, and digitalisation occasionally expanded skills and responsibilities (Dupuis, 2024).

There is a line of research also pointing to the enabling potential of AM to organise work differently in collaboration with employees (Noponen et al., 2023). Depending on implementation, real-time feedback from such systems can likewise be perceived positively (Wiener et al., 2023). Experimental studies show that workers often value clear performance metrics and constructive feedback, which algorithms can consistently provide, particularly when these are not directly tied to performance evaluation (Raveendhran and Fast, 2021).

Table 5: AM grid - Organisational uses of algorithms in workforce management

	NOVEL ORGANISING	TRADITIONAL ORGANISING
CONTROLLING	**Algorithm as a manager:** – cost efficiency – resources – process	**Algorithm as a controller:** – cost efficiency – performance – monitoring
ENABLING	**Algorithm as a mentor:** – augmentation – wellbeing – autonomy	**Algorithm as a servant:** – augmentation – performance – tools and methods

Source: Noponen et al., 2023

When supported with proper training, AM can increase engagement and help workers feel more prepared for the future. The 2025 OECD employer survey on AM highlights that training is crucial for building trust and boosting engagement with these systems. Targeted training for both managers and workers enables them to understand and use the tools effectively, reduces resistance, and ensures that skills keep pace with rising demand for digital and analytical capabilities (Milanez et al., 2025).

More specifically, in the context of AI use in the workplace, an OECD survey of over 5,000 workers in the finance and manufacturing sectors across seven countries (Austria, Canada, France, Germany, Ireland, the United Kingdom, and the United States) found that employees report exposure to AI in planning, project work, and production processes. In finance, AI is most commonly used for analytics, risk management, and reporting; in manufacturing, for planning, scheduling, and quality control. These applications shift employees' tasks toward higher-level planning and oversight (Lane et al., 2023).

As routine tasks are automated, both workers and managers can redirect their efforts toward more complex, creative, and meaningful activities. This suggests that AM has the potential not only to prevent deskilling but also to restructure work in ways that enhance job complexity and augment work. In the European retail sector, for instance, algorithm-driven tools automate inventory tracking and scheduling, enabling employees to concentrate on customer service tasks that are more complex and interpersonal (Cox and Oosterwijk, 2024). However, when algorithmic systems malfunction, impose unrealistic targets, or operate without transparency, workers may face new cognitive burdens, such as interpreting unclear feedback or correcting errors, thereby increasing job complexity in less constructive ways (Kuldova and Rudningen, 2024; Håkansta et al., 2024).

Working time and work life balance

Previous empirical analysis of the third EU-OSHA ESENER (2019) survey indicates that the presence of technologies enabling data-driven management, such as wearables and other devices that determine the content or pace of work or monitor worker performance, is associated with increased time pressure and longer or more irregular working hours (Urzì-Brancati et al., 2022). Preliminary analysis of the EWCS 2024 indicates that workers exposed to AM practices - particularly the use of computer programmes to monitor performance and allocate working hours - report lower levels of discretion in taking breaks. With regard to implications for working time duration and quality, the Joint Research Centre's AIM-WORK survey finds that the algorithmic direction practices, specifically the automatic allocation of working time, tasks, and schedules, are among the AM practices most clearly associated with longer working hours and more asocial schedules, particularly night work (González Vázquez et al., 2025).

At the same time, AM can also create opportunities to enhance working-time flexibility, particularly when systems allow employees to set or update their availability through digitalised scheduling tools, often via mobile applications (Cox and Anttila, 2024). However, scholars caution - and some empirical studies confirm - that when AM extends beyond scheduling to include goal setting, continuous monitoring, and performance evaluation, it frequently contributes to work intensification. In such cases, algorithmic control tends to drive higher work pace, tighter performance margins, and increased work pressure (Moore, 2018; Håkansta et al., 2023; Wood, 2021; Gilbert et al., 2021; Abey et al., 2020; Parent-Rocheleau and Parker, 2022; ILO, 2022).

Yet, empirical evidence directly demonstrating that AM accelerates work pace or increases workload remains limited. Notable exceptions include a large-scale survey in the Nordic countries, which shows a positive association between AM exposure and reports of higher workload, stress, and job insecurity, even after accounting for transparency and employee influence over technology implementation (Jensen et al., 2024). Similarly, evidence from the AMPWork survey (conducted in Germany and Spain, with approximately 6,500 respondents across platform and conventional sectors) indicates that higher exposure to AM is correlated with greater reports of increased workload and faster work pace (Fernández-Macías et al., 2023). Follow-up analysis using the same data further shows that exposure to AM in home-working contexts is negatively associated with workers' control over their working time (Adăscăliței and Riso, 2024).

Qualitative case study research further demonstrates that the effects of AM are highly context dependent. In logistics warehouses, algorithms that enforce strict picking and scanning rates have been associated with unsustainably high work speeds and performance pressure, potentially representing a hazard for workers health and safety (Vallas et al., 2022; Atkinson and Collins, 2024; Cheon and Erickson, 2025). By contrast, case studies of French emergency departments suggest that algorithmic systems designed to manage patient flows and predict surges can have positive effects, contributing to better workload organisation, reduced pressure, and lower stress for healthcare staff (Rani et al., 2024).

Although further empirical research is needed to clarify the mechanisms driving the negative outcomes of AM practices in workplaces and to establish causality, existing evidence on work intensification and accelerated work pace suggests that these systems may pose significant occupational safety and health risks. By pressuring workers to prioritise productivity in line with algorithmically defined targets, AM can foster unsustainable work rhythms, elevate stress, exacerbate psychosocial risks, and increase the likelihood of both mental and physical harm (Moore, 2018).

Safety and health

A review of studies on the effects of AM on platform-based workers, especially food and grocery delivery workers, found that AM contributes to heightened occupational risks, psychosocial stress, poor mental health, and inequities, particularly for low-wage, immigrant, and minority workers (Vignola et al., 2023). While the review focuses on platform gig work, the authors note that aspects of AM, such as digital surveillance, automated scheduling, gamification, and opaque pay structures, are increasingly being adopted in more conventional workplaces throughout diverse industry sectors. This suggests that the health and safety challenges identified among platform workers may also emerge in traditional employment settings as AM spread.

Anchored in EU-OSHA's body of work, another broad review of studies on digitalisation found that AM practices, when not responsibly and ethically implemented, tend to heighten psychosocial risks, contributing to stress, burnout, anxiety, depression, and other mental health disorders, as well as adverse physical health outcomes (Urzì-Brancati, 2024). Similar findings also emerge from a review of qualitative and empirical studies, drawing on the OSH Pulse 2022 survey and the JRC AMPWork survey, conducted by the European Commission's JRC and EU-OSHA on digital technologies driving AM practices (González Vázquez et al., 2024).

Based on data from the EU-OSHA's 2019 ESENER data, Urzì-Brancati et al. (2022) operationalise AM through the presence of digital systems that monitor workers' performance, determine the content

or pace of work, or use wearable devices; their analysis shows that these technologies are associated with greater feelings of insecurity and stress, mainly due to time pressure and fear of job loss. Other studies link AM practices to increased levels of stress and anxiety among workers due to the intensification of work and the drive towards higher efficiency (UNI Global Union, 2020; Jensen et al., 2024).

Call centres are especially vulnerable to AM practices, and several studies consistently find that work standardisation, scripted interactions, and intensive monitoring are associated with higher quit rates and stronger intentions to quit (Doellgast and O'Brady, 2020). In a review of studies, Christl (2023) describes call centres as 'prototypes of work environments subject to extensive surveillance and digital control' (p.4). Within these settings, algorithmic systems monitor nearly every aspect of work, including performance metrics, call handling times, scripts, keystrokes, emotions, and even tone of voice, thereby intensifying work and increasing stress (Christl, 2023). Examining the effects of performance monitoring - a core function of AM systems - on workers' health in call centres, Holman et al. (2002) conducted a cross-sectional survey (administered on site) to 347 customer service agents in two UK call centres and found that the intensity of performance monitoring was the most harmful factor, strongly predicting stress and strain.

Systems relying on customer evaluations - well documented in platform work (Wood, 2021) – are also increasing used in other service sectors such as retail and hospitality, where linking customer feedback to performance assessments may generate feelings of job insecurity; previous research has shown that such insecurity is a significant psychosocial risk factor, associated with heightened stress, poorer mental health, and even adverse physical health outcomes (Ashford et al., 1989; Sverke et al., 2002; Bonde, 2008; De Witte et al., 2015). Some AM can also lead to increased levels of stress and anxiety among workers, due to the intensification of work and the drive towards higher efficiency (UNI Global Union, 2020; Kellogg et al., 2020; Jensen et al., 2024).

Another important consideration is that employees often value positive feedback, recognition, and support from human managers - elements that algorithms can only complement, but never fully provide on their own. When performance is reduced to scores or rankings (such as a driver's customer rating or an agent's average call-handling time), workers may perceive their efforts as undervalued, which can contribute to frustration and disengagement. This highlights the importance of considering the social and emotional aspects of work when implementing AM tools, rather than solely focusing on efficiency and productivity.

More generally, evidence from Eurofound's European Company Survey (ECS) 2019 shows that workplaces employing data analytics for performance monitoring report lower levels of workplace wellbeing (Eurofound, 2020). This suggests that when employers adopt digital tools that prioritise monitoring through metrics and analytics, they risk undermining the social climate and negatively affecting employee wellbeing. Other research shows that the widespread application of workforce analytics can exacerbate work intensification and stress, especially in contexts where decision-making processes are experienced by workers as opaque or unpredictable (Kellogg et al., 2020; Moore, 2017).

By the same token, when applied responsibly and ethically, AM tools have the potential to enhance occupational health and safety. Advanced algorithms can analyse data from sensors and worker inputs to identify risks in real time and help reduce human error (CDC, 2020). EU-OSHA also acknowledges the potential of AI-driven management systems to prevent accidents and support

compliance with safety regulations (EU-OSHA, 2023, Martin et al., 2025). For example, in the logistics sector, digital route planning and driver monitoring algorithms can be used to enforce mandatory rest breaks and optimise driving patterns, thereby reducing fatigue-related incidents (Antilla and Cox, 2024). However, ethical implementation requires transparency, worker involvement, and safeguards to prevent excessive surveillance or misuse of data (see section son 'moderating factors' and 'ethical implications' in this chapter).

Drawing from existing empirical and conceptual studies, Parent-Rocheleau and Parker (2022) propose a conceptual framework - building on the Job Demands-Resources model or JD-R (Demerouti et al., 2001)[7] - to illustrate how AM affects job resources (such as autonomy, social support, feedback, etc.) and job demands (such as workload, physical and emotional demands), ultimately impacting employee wellbeing and motivation. However, only a few studies to date have built on the JD-R model to analyse the impacts of AM on work outcomes. For example, Lippert et al. (2023) employed such a model as a theoretical framework to systematically examine AM-specific job demands and resources. They identified six job demands (e.g., digital surveillance, opaque system logic, standardised interactions) and four job resources (e.g., intelligent task distribution, adaptive pay systems), highlighting how these factors influence workers' stress and motivation in digitally managed work environments. The JD-R model was also used as a central framework to interpret how AM affects occupational safety and health in a review of 39 studies published between 2022 and 2024 (Martín et al., 2025). This framing allows recognition of both risks (stress, burnout, safety incidents, fatigue, anxiety) when demands outweighed resources, and potential opportunities (motivation, engagement, wellbeing) when resources buffered or surpassed demands.

Employment quality

AM can make workers feel disposable and insecure, particularly when systems issue warnings, generate performance improvement plans, or reduce available hours under zero-hours contracts through shift scheduling (Wood, 2017). Through predictive scheduling, AI enables firms to dynamically adjust shifts in response to weather forecasts, historical customer traffic, and online reviews. While this reduces costs for employers, it exposes workers to last-minute cancellations or shortened or fragmented shifts. According to Nguyen (2021), this is a form of *refractive surveillance*: although the data is collected to monitor customers' behaviours, the negative consequences fall on workers. Such data-driven systems, including AM and performance tracking, are often designed to optimise profits or enhance costumer experience by tying workers' pay and performance to fluctuating demand, customer ratings, and algorithmic evaluations. In doing so, they exacerbate the insecurity of low-wage employment, resulting in unstable income, unpredictable schedules, heightened job insecurity, and greater worker vulnerability as economic risks and costs are transferred from employers to individual workers.

The AIM-WORK survey finds that workers exposed to physical platformisation of work - accounting for around 7 % of workers in the EU, mainly in sectors such as transport, logistics, and mining - report lower employment quality. Physical platformisation refers to the combination of digital physical monitoring (e.g. tracking workers' presence, location, or movements) and algorithmic

[7] The JD-R model proposes that every job has demands (aspects requiring sustained effort) and resources (factors that help achieve work goals and reduce strain). When job demands are high and prolonged, and resources are insufficient, negative outcomes such as stress and burnout are more likely.

direction of work (automatic allocation of tasks and schedules). These AM practices are associated with negative working conditions, particularly increased stress and diminished autonomy and flexibility, as well as lower pay and shorter job tenure on average (González-Vázquez et al., 2025).

This pattern of negative effects is mirrored in public opinion. A Special Eurobarometer survey shows widespread concern about AM: 78% of respondents worry about AI being used to automatically dismiss workers, 63% express concern about the use of AI for monitoring employees, and 57% are concerned about AI-driven performance assessments or its use in job applicant selection. These figures highlight that anxieties about AM are not limited to those directly exposed to it but are shared more broadly across the general population.

Evidence that some of these concerns can materialise and become concrete realities in the workplace comes from studies in the warehousing, retail and transport sectors. A mixed-method study of Amazon warehouse employees (n = 558), complemented by 46 in-depth interviews, shows that AM, particularly through digital surveillance systems such as scanners and automated 'time off task' tracking, undermines aspects of employment quality through the poor working conditions these systems create. At Amazon, AM intensifies the pace of work, enforces continuous monitoring through performance metrics, and limits workers' discretion and skill use. These conditions translate into structural degradations of employment quality: job security is weakened by the constant threat of termination for failing to 'make rate'; opportunities for advancement and skill development are constrained by highly routinised, scanner-directed tasks; and perceptions of fairness and stability are eroded by opaque performance assessments and disparities between temporary and permanent staff. Collectively, these dynamics reveal how algorithmic control embeds insecurity and dependence, thereby undermining core features of employment quality (Vallas et al., 2022).

These technologies can intensify managerial coercion by enforcing strict quotas and exhausting work rhythms, leaving many workers feeling alienated and describing themselves as 'robots' or mere extensions of the machinery. At the same time, Vallas and Kronberg (2023) note that Amazon's recruitment from precarious labour markets means that for some employees the job represents stability and survival rather than oppression.

In a qualitative study of workers and worker representatives in retail, warehousing, and transport in Sweden, participants reported significant concerns about job security (Håkansta et al., 2024). In retail, data-driven scheduling compelled workers to 'chase hours', reducing opportunities for full-time contracts and increasing risks of layoffs or reduced hours, with insecurity exacerbated by irregular schedules. In transport, workers mainly responded with resignation because customers, not employers, controlled the algorithmic systems.

There is also evidence of intensified workers' vulnerability due to the intense use of AM systems in call-centre environments. Drawing on secondary empirical studies, a literature review, and a technical analysis of call-centre software, particularly those enabling digital surveillance. Christl (2023) finds that such systems can exacerbate poor employment conditions in call centres, which are characterised by low wages, short-term employment contracts, and weak bargaining power. AM tools that record communications, enable constant monitoring, analyse performance metrics, and automate scheduling heighten job insecurity, intensify managerial control, and limit opportunities for resistance and collective bargaining.

Moderating factors

AM systems, like most digital tools, are not inherently good or bad. Their effects depend both on the context and the manner of implementation, with outcomes shaped to a large extent by organisational structures, governance practices, and workplace cultures. Potential negative implications should be understood as risks arising from the design and use of AM tools, while potential positive effects represent opportunities to increase efficiency and support worker wellbeing (Fernández Macias et al., 2022; Lippert et al., 2023).

Another way of looking at this is to recognise that several factors can moderate the effects of AM (Parent-Rocheleau and Parker, 2022). In this context, a moderator is a condition or variable, such as workplace culture, the strength of worker representation, or the degree of transparency in system design, that influences the extent to which AM produces positive or negative outcomes. Such moderators can dampen or intensify adverse effects, amplify risks, or help stimulate more beneficial impacts.

The literature on AM highlights the importance of certain **design and governance features**, such as transparency, fairness, human oversight, and the possibility to override or contest algorithmic decisions, in moderating its effects on workers (Parent-Rocheleau and Parker, 2022; Martin et al., 2025). While these elements can moderate some negative outcomes, evidence suggests they are not sufficient on their own, and their design should incorporate OSH and ethical safeguards from the outset. Large-scale survey research across the Nordic countries (covering warehouse and customer service/telemarketing sectors, with more than 5,000 unionised workers in Denmark, Sweden, Norway, and Finland) shows that transparency - alongside employee influence over technology implementation - only partially alleviate AM's negative impact. Specifically, while this helped sustain trust in leaders, they did not offset persistent negative effects on workload, stress, and job insecurity (Jensen et al., 2024).

Another study using an online scenario-based survey experiment on Amazon Mechanical Turk found that, beyond fairness and trust (attributed to managerial authority for humans vs. efficiency and lack of bias for algorithms), people's perceptions were also shaped by **task characteristics** (mechanical tasks reduced negative perceptions, while human-skill tasks amplified them) and by **emotional framing** (social recognition from humans or viewing algorithms as helpful tools versus dehumanising mechanisms) (Lee, 2018). Similarly, a multi-method study combining laboratory and field experiments showed that when HR decisions like promotions or layoffs were made by algorithms rather than managers, employees perceived them as less fair, reducing organisational commitment (Newman et al., 2020). AM was framed as **reductionism**, emphasising quantification and decontextualisation that overlook qualitative aspects of performance. This explains why algorithm-driven decisions, even if accurate, were seen as unfair and demotivating, undermining job quality in conventional workplaces.

Closely connected to system design features is the notion of **algorithmic dependence**, which reflects how the system is designed and implemented. High dependence emerges when systems are rigid, opaque, and prescriptive, leaving little room for workers to deviate, improvise, or override decisions. A survey study with 329 employees from a large Chinese IT services firm found that algorithmic dependence - the extent to which workers rely on algorithmic systems in their daily tasks - moderates the relationship between AM and improvisation (Liu et al., 2024). Under high dependence, AM exerted stronger negative effects on employees' improvisation capability, which in

turn reduced both adaptive and creative performance. By contrast, when dependence was low, workers retained greater flexibility to improvise, thereby weakening the negative impact.

Focusing on performance monitoring, a survey of 347 customer service agents in two UK call centres found that **work context** - specifically job control and supervisory support - buffered the negative effects of monitoring intensity on wellbeing, while a beneficial **purpose for monitoring (developmental rather than punitive)** was associated with lower exhaustion and depression, and higher job satisfaction (Holman et al., 2002).

The broader body of research suggests that **worker involvement and participation** remain the most extensively documented moderators of the negative impacts of AM. When workers are clearly informed about what aspects of their work are being monitored and how this data is used, negative outcomes can be mitigated, especially when AM serves legitimate and well-communicated purposes (Parent-Rocheleau and Parker, 2022; Jeske, 2022). Workers' acceptance and trust in algorithmic systems depend not only on the perceived fairness, legitimacy, and soundness of the decisions, but also on the extent of human oversight - that is, whether workers or their managers can exercise judgment and intervene to correct or overrule algorithmic outcomes, maintaining a meaningful 'human in control' role (De Stefano, 2018; Parent-Rocheleau and Parker, 2022). Allowing employees to contribute to the design and operation of AM systems with qualitative insights that complement the data, and to challenge or override decisions when appropriate, helps reduce potential harm and fosters a more supportive and empowering work environment (Nilsson et al., 2025; Parent-Rocheleau and Parker, 2022; Abey et al., 2020). In three different case studies of logistics companies in Sweden, Nilsson et al. (2025) identify how organisational practices that involve workers with the AM technology positively shape their workers' experiences of these tools.

A comparative study by EU-OSHA of two automotive companies - one in Belgium and the other in Italy - shows that although AM systems perform similar functions such as task allocation and performance monitoring, their design and implementation lead to very different outcomes (EU-OSHA, 2024). In the Belgian company, AM was top-down and opaque, with systems like assembly line balancing used primarily for control and productivity enforcement. This limited transparency and lack of worker involvement contributed to high work intensity, low autonomy, and increased psychosocial stress, particularly within a workforce marked by high turnover and temporary contracts. In contrast, the Italian company adopted a participatory and transparent approach, using algorithmic tools to support collaboration and continuous improvement. Workers were actively involved in shaping and using these systems, which resulted in greater autonomy, skill development, and improved occupational health and safety, all reinforced by a stable and committed workforce.

Further insights come from qualitative case studies of AM in conventional work settings across Finland, Sweden, and Norway. Covering sectors such as transport, retail, warehousing, finance, and journalism, these studies reveal highly varied outcomes, shaped largely by how the technologies are introduced and governed (Cox and Oosterwijk, 2024). The impact of these systems was found to be strongly moderated by contextual and procedural factors - most notably, the extent of worker and trade union involvement in their design, implementation, and oversight. Where workers were meaningfully engaged in decision-making processes, outcomes tended to be more positive. In such cases, technologies were more likely to support rather than control human labour, and digital tools were adapted in ways that promoted worker wellbeing and fostered organisational trust.

Another study drawing from a survey of 1,894 union-represented call centre workers and qualitative interviews found that **effective union action** reduces burnout by ensuring performance monitoring is fair and developmental (using performance data for training and skill improvement) (Doellgast and O'Brady, 2020). Qualitative evidence collected in this study showed unions achieve this through collective bargaining provisions, grievances/arbitration, and informal campaigns, which pressured employers to adopt fairer and more supportive monitoring practices. Where unions were perceived as effective, workers reported lower burnout and better wellbeing, showing the importance of collective voice in stressful service settings.

While research on AM consistently points to the value of worker participation, it also points to its limits. An OECD laboratory experiment in three German firms found that structured consultation among workers, managers, and representatives reduced conflict and fostered agreement on design features that enhanced learning, communication, and productivity, although autonomy-related features remained the hardest to resolve (Milanez, 2025). Similarly, a survey of 6,769 union members in the Nordic countries showed that employee influence in decision-making and workplace transparency can ease negative effects on autonomy, trust, job satisfaction, and motivation (Jensen et al., 2024). Yet, this study also demonstrates that participatory practices do not offset increased workload, stress, or job insecurity.

Table 6: Regression estimates of the effect of AM under low vs. high employee Influence and transparency

Outcome	Low Employee Influence	High Employee Influence	Low Transparency	High Transparency
Autonomy	-0.25	0.06	-0.28	-0.07
Trust	-0.21	0.04	-0.19	-0.09
Job satisfaction and motivation	-0.12	0.04	-0.14	-0.03
Workload	0.14	0.07	0.17	0.09
Stress	0.22	0.12	0.22	0.18
Job insecurity	0.15	0.19	0.17	0.17

Source: Jensen et al., 2024

These findings suggest that while consultation and influence are effective in moderating concerns linked to autonomy and acceptance, they are insufficient on their own to address the broader occupational health and safety risks posed by AM, highlighting the need for complementary interventions. The OECD employer survey shows that many firms already adopt governance measures, such as consultation with workers, audits, and risk or impact assessments, to promote the trustworthy use of algorithmic systems, demonstrating that such **governance measures** or **internal safeguards**, are not merely theoretical but are increasingly entering practice (Milanez et al., 2025).

However, while these internal governance instruments represent important first steps, they can be further reinforced to ensure consistency, legitimacy, and accountability. Mokander et al. (2021) propose **ethics-based auditing** as a complementary governance mechanism for automated decision-making systems, including AM. Unlike conventional compliance audits, ethics-based auditing examines whether systems respect broader normative principles such as fairness, transparency, and fundamental rights, steering organisations toward more socially responsible and worker-centred applications of AM.

Beyond workplace governance measures, joint ILO/JRC research, based on case studies of AM practices in conventional workplaces in healthcare and logistics, highlights the importance of **regulatory frameworks and social dialogue mechanisms** in shaping outcomes (Rani et al., 2024). Without such institutional safeguards, AM tends to amplify managerial control and weaken workers' voice, with particularly severe effects in weaker institutional contexts.

Ethical implications

Worker privacy and data protection

AM systems cannot function without data; they are underpinned by the broader processes of digitalisation (Jarrahi et al., 2023) and the rise of datafication (Meljas and Couldry, 2019), a process where various aspects of human activities, including those concerning workers themselves, are transformed into analysable data for work monitoring, decision-making, and control. Responses to AM challenges cannot be considered in isolation from these broader processes, since the data collected provides the foundational layer on which algorithms are built and refined (Mateescu and Nguyen, 2019). Survey data from the Special Eurobarometer (No. 554) confirm that, despite the safeguards provided by the GDPR framework, worker privacy remains a central concern for EU citizens (European Commission, 2024). A substantial 82% of respondents reported being worried about privacy in AI-driven workplaces. Moreover, 77% believe that managers, leaders, and employees should be actively involved in the design and implementation of AI technologies, underlining the importance of participatory governance and trust in the deployment of algorithmic systems at work (CEC European Managers, 2025).

Many systems collect granular data on workers, from keystrokes and mouse movements for remote office workers to GPS location and speed for delivery drivers, in order to feed the algorithms that evaluate performance (Mateescu and Nguyen, 2019; Mateescu, 2023). In response to these developments, several EU countries have adopted new rules on employee monitoring in telework and remote work (Eurofound, 2024d). Some, such as Cyprus and Greece, have opted to ban outright the use of webcams to track teleworkers' performance, while others, such as Bulgaria, now require employers to verify algorithmic decisions in work management to ensure human oversight.

The continuous surveillance and monitoring through digital means makes workers feel as though they are constantly being watched (Berggren and Wrangborg, 2022; Ball, 2021). In some warehouses and offices, cameras and sensors track employees' movements or even analyse facial expressions. Such data collection intrudes into personal space and can spill into off-work hours. Privacy erosion is thus a key harm, with trade unions arguing that workplace digital surveillance poses threats to dignity and fundamental rights (Moore 2022; Moore, 2023a).

The EU General Data Protection Regulation (GDPR) applies in the employment context, providing workers with rights to privacy and protection of their personal data. However, compliance with the GDPR's principles of data minimisation and transparency is challenging to enforce in the workplace, where AM systems collect and process large amounts of data. Article 88 of the GDPR allows Member States to provide more specific rules on the protection of data of employees by law or collective agreements. Some EU Member States have made use of the option provided by Article 88 to introduce more specific workplace data protection rules, reflecting their national employment law frameworks. Germany has among the most developed national rules: Section 26 of the Federal Data Protection Act sets detailed conditions for processing employee data. Moreover, the German government is now advancing a draft Employee Data Protection Act to provide a more comprehensive and tailored legal framework. Spain's Organic Law 3/2018 similarly includes provisions on digital rights at work, covering issues such as monitoring and surveillance. France and Italy have also clarified aspects of employee monitoring through legislation and guidance from data protection authorities (Eurofound, 2023). In many other Member States, however, workplace data protection remains governed mainly by the general GDPR provisions rather than tailored national rules.

Abraha (2023) highlights that while the GDPR offers some safeguards, it is insufficient to address the challenges of AM in the workplace. Article 22's protections against automated decision-making are weakened by broad exceptions, while reliance on employee consent is problematic given the structural power imbalance at work. The framework also treats harms as individual rather than collective, failing to capture group-level effects of AM. Divergent national rules under Article 88 create fragmentation, and vague standards of 'meaningful information' combined with trade secret exemptions limit transparency.

Bias and discrimination in algorithmic decisions

Although often presented as objective, algorithms can inadvertently perpetuate bias and unfairness in the workplace, increasing the risk of discrimination (Mateescu and Nguyen, 2019; UNI Global Union, 2020). Datasets used in algorithmic systems may be non-representative, incomplete, incorrect, or outdated (Salvi del Pero et al., 2022). If the data or assumptions on which algorithms are built reflect societal biases, their decisions can disadvantage certain groups of workers. Evidence from gig platforms shows how racial and gender biases from customers can seep into worker ratings, which are then used by algorithms to allocate jobs or trigger disciplinary action, effectively automating discrimination (Botelho et al., 2023).

The limited human oversight of AM systems makes it difficult to detect and correct embedded biases. Safeguards against discriminatory outcomes from the processing of personal data are enshrined in the GDPR, and these apply equally to the workplace context. Employers therefore have an obligation to ensure that AM systems used to manage workers are fair, accurate, and non-discriminatory (Agosti et al., 2023). This obligation was made explicit in the Glovo-Fodinho case in Italy in 2019, where the company was fined €2.6 million for failing to comply with GDPR requirements in the use of its AM tools (EDPB, 2021)[8].

[8] European Data Protection Board, 5-07-2021, RIDERS: ITALIAN SA SAYS NO TO ALGORITHMS CAUSING DISCRIMINATION A platform in the Glovo group fined EUR 2.6 million

One known high-profile example of algorithmic discrimination based on historical data came from the recruitment of Amazon workers, where a hiring algorithm trained on past data downgraded resumes containing the word 'women's', as in 'women's chess club', reflecting gender bias in its recommendations (Dastin, 2018). Another example of how AM can discriminate is the 'clocking' of algorithmic shift management systems, where standardised timings for key tasks were inputted to calibrate its calculations (Cox and Oosterwijk, 2024). These timings were identified as a potential source of contention, holding the potential to discriminate against older or less-able-bodied workers if based on the time taken by younger, fitter workers to carry out tasks.

Drawing on a literature review on fairness and bias in algorithmic hiring and management systems, Fabris et al. (2024) argue that these systems often reproduce or even intensify existing inequalities, as biases are not only embedded in historical data and entrenched social patterns, but also reinforced through organisational practices and technological design, thereby disadvantaging women, ethnic minorities, older workers, and people with disabilities. Brône (2020) makes a similar point, noting that even when protected attributes such as gender or race are excluded, algorithms may still rely on proxies like neighbourhood or name, thereby perpetuating unfair outcomes. Furthermore, removing 'protected' characteristics like race or gender from an algorithm does not automatically eliminate bias (Broecke, 2023). However, if carefully designed, algorithmic tools also hold potential to mitigate certain forms of human bias, for instance by reducing the impact of stereotypes or time-pressured decision-making in recruitment. Sunstein (2021) argues that algorithms, unlike humans, do not rely on mental shortcuts and instead use statistical predictors that can counteract or even eliminate cognitive biases. Properly designed, they hold the promise of reducing discrimination. In recruitment, for example, AI tools can anonymise applications and apply consistent criteria, thereby widening the candidate pool and improving diversity. Similarly, algorithms can allocate shifts and evaluate performance more consistently, reducing favouritism (Cox and Oosterwijk, 2024). Yet, such fairness gains are not automatic; they depend on careful design, transparency, and worker consultation to ensure equitable outcomes. Addressing the well-known problem of bias in the datasets on which AM systems rely can be pursued at three levels: through the data used to train models (pre-processing), the model itself (in-processing), or the predictions it generates (post-processing) (Milanez et al., 2025).

Insights on views among workers and employers about discrimination and bias arising from the use of AI and AM tools in workplaces show different but largely critical perspectives. A non-representative OECD survey of over 5,000 workers in the manufacturing and financial sectors in selected countries[9] found that a majority expressed concerns about AI-related data collection at work (Lane et al., 2023). Around six in ten reported feeling increased pressure to perform and raised worries about privacy, while more than half were concerned that too much of their data was being collected, with a similar share fearing that such data could be used to make biased decisions against them. These worries were particularly pronounced among workers under 35. A more recent OECD employer survey found that most surveyed managers (in France, Germany, Italy, and Spain) believed AM tools either had no effect on bias or, on balance, increased it (Milanez et al., 2025).

https://www.edpb.europa.eu/news/national-news/2021/riders-italian-sa-says-no-algorithms-causing-discrimination-platform-glovo_en

[9] Austria, Canada, France, Germany, Ireland, the United Kingdom, and the United States.

Lack of transparency and accountability due to 'black box' decisions

Machine learning-based AM systems are frequently criticised for their opacity and there can be a lack of accountability when decision-making becomes detached from human managers (Briône 2020; Mateescu and Nguyen 2019). Because algorithmic systems are opaque, adaptive, and correlation-driven, their decisions are hard to interpret or explain, making it difficult to satisfy the GDPR's transparency and explainability requirements (Broecke, 2023). According to the Special Eurobarometer survey (No. 554), transparency in human resources decision-making emerges as a major concern. The data show that 75% of respondents believe there should be greater openness in how such decisions are made, while 74% advocate prohibiting fully automated decision-making processes (European Commission, 2024). Another 72% support placing limits on automated employee monitoring, reflecting widespread public unease about the unchecked use of AM in the workplace.

One potential approach to addressing the challenge of the black box is the use of 'counterfactual explanations', as proposed by Wachter et al. (2018). Counterfactual explanations provide individuals with information about the minimal changes to input variables that would have resulted in a different, more favourable outcome. This approach can help reduce informational asymmetry, support contestability, and align with principles of fairness and transparency by enabling affected individuals to see what factors might alter a decision. However, counterfactual explanations also have limitations, including the fact that they do not reveal the underlying logic or potential biases embedded in the system, and their usefulness depends on which input features are realistically changeable. Furthermore, in high-stake contexts where decisions have serious consequences for workers, counterfactual explanations may not fully capture the broader ethical concerns raised by algorithmic decision-making.

Furthermore, the digital transformation of workplaces often unfolds subtly, producing impacts that may not be immediately visible, even to those directly affected (Cox and Oosterwijk, 2024). The results can form a complex and opaque web of systems, rendering them unintelligible and difficult to navigate for workers and their representatives, thereby limiting their ability to challenge algorithmic decisions. Workers often do not know how or why an algorithm made a particular decision, which leads to frustration and a sense of powerlessness (TUC, 2020). For instance, in large retail chains and call centres, scheduling software automatically allocates shifts based on opaque criteria. Workers may receive irregular or unpredictable schedules without understanding the factors that shaped these decisions, leaving them unable to contest outcomes that disrupt their income or employment stability. Similarly, an employee might be placed on a performance improvement plan after receiving a low algorithmic 'engagement' score, and yet be given no explanation of how that score was calculated or which behaviours contributed to it. The complexity and secrecy of the algorithms make it difficult to appeal against errors or unfair outcomes. This lack of transparency is likely to impact several dimensions of job and employment quality.

Disruption to psychological contract and reduced trust

Research suggests that excessive work monitoring - a foundational feature of AM systems - can erode workers' trust in management. Evidence from a large-scale survey of 6,003 Norwegian employees shows that direct and detailed monitoring practices (e.g., surveillance of emails, computer use, and web activity) are widely perceived as uncomfortable, with employees' trust in employers' regulatory compliance declining between 2010 and 2019 (Bråten, 2019). Similar concerns

are reflected in findings from other surveys. Drawing on data from the 2012 Australian Electronic Workplace Survey of 500 employees, Holland et al. (2015) found that electronic monitoring and surveillance is, on average, negatively associated with trust in management, with the effect particularly pronounced among manual workers.

Qualitative evidence from 50 interviews with UK professionals also shows that employees often interpret workplace monitoring as a signal of managerial distrust and disloyalty (Lockwood, 2018). Building on this, McParland and Connolly (2019) argue that such perceptions can undermine the psychological contract - the implicit set of expectations between employee and employer - by fostering a sense of contract breach and, ultimately, diminishing employee trust in management. Similarly, Cefaliello and colleagues (2023) highlight how AM can disrupt the psychological contract, potentially engendering feelings of betrayal or being undervalued. They emphasise that intensified surveillance, opaque decision-making, and the absence of meaningful worker voice can fracture trust and erode workers' sense of dignity at work.

Experimental evidence shows that people tend to trust workplace decisions less when an algorithm (rather than a human) is in charge. In two experiments on personnel selection (one vignette-based, one with real incentives), participants reported lower trust and acceptance when the decision-maker was an algorithm (Wesche et al., 2024). Consistent with this, classic lab work finds that algorithmic decisions are often perceived as less fair and trustworthy and evoke more negative emotion than human decisions, especially for 'human-skills' tasks (e.g., creative evaluations) rather than mechanical ones. Participants attributed algorithms' drawbacks to a perceived lack of intuition and judgment (Lee, 2018). In another experimental study, Tomprou and Lee (2022) examined how AM influences the psychological contract. Participants were presented with organisational promises about either relational inducements, such as opportunities for skill development, networking, or personal support, or transactional inducements, which refer to tangible, economic commitments like pay raises, bonuses, or a competitive salary. The findings showed that employees perceived greater employer commitment when a human agent communicated relational inducements during recruitment (for example, in a video-based interview), whereas transactional inducements were perceived similarly regardless of whether they came from a human or an algorithmic agent. Furthermore, when inducements were under-delivered, participants reported stronger perceptions of psychological contract breach and greater turnover intentions when the promises had been made by human rather than algorithmic agents.

Large-scale survey research across the Nordics (warehouse and customer service/telemarketing sectors; union members in Denmark, Sweden, Norway, Finland) links the use of AM to lower trust between employees and leaders. Importantly, the study shows these negative trust effects are mitigated when transparency is high and employees have influence over technology implementation (Jensen et al., 2024).

One reason trust suffers is opacity: ethnographic research in retail shows how 'coded' systems allocate and evaluate work through processes that conceal the rationale for decisions, leaving workers unable to understand how or why tasks are assigned, which in turn fosters dissatisfaction and alienation (Evans and Kitchin, 2018). However, Lee's experimental study (2018) show that in certain settings (e.g., tasks framed as highly rule-based or 'mechanical') algorithmic decisions can be judged as equally or even more fair/trustworthy than human ones, reminding that perceptions hinge on task type, familiarity, and explanation design.

It is not only workers who voice concerns about trust issues stemming from the surveillance needed to generate the data underpinning AM systems. Managers also recognise these challenges when deploying monitoring and evaluation tools within such systems. According to the OECD employer survey (Milanez et al., 2025), managers often report worries about unclear accountability (28 %), the opacity of algorithmic decision-making (27 %), and insufficient safeguards for workers' mental and physical health (27 %).

Summary points

- **AM drives automation**, **or more often semi-automation**, **of various organisational functions** such as task assignment, scheduling, and performance monitoring. This reconfigures traditional managerial roles by **raising demand for data literacy and analytical skills**. If not handled responsibly, **AM may lead to deskilling or necessitate reskilling also among those in management positions**.

- AM can enhance organisational efficiency and support faster decision-making, but the associated productivity gains are not guaranteed. The effectiveness of AM in boosting **productivity depends on factors such as the transparency of AM tools, their adaptability to shop-floor needs, and the extent of workforce acceptance and influence over design and implementation**. Studies have shown that AM can lead to significant efficiency gains and cost savings in various sectors, including logistics, retail, and finance.

- The use of **AM systems can lead to the gamification of work**, where workers are encouraged to compete with each other to achieve performance targets. Depending on implementation, **gamification can increase engagement and efficiency, but it also brings significant risks**, such as increased psychological strain, erosion of collaboration and workplace solidarity, and mental health burdens. Workers may resist AM through everyday tactics, to reassert control, but these practices can be ambivalent, reinforcing management's goals while providing micro-freedoms and psychological respite.

- **AM can limit workers' decision-making and reduce autonomy by standardising tasks, simplifying work into predefined routines, and tightly controlling behaviour through real-time monitoring and feedback**. Evidence, largely from qualitative case studies in warehousing, manufacturing, retail, and logistics, indicates that AM tends to exacerbate deskilling and erode discretion, with particularly negative effects in contexts where work is already highly structured and repetitive.

- Evidence from both empirical studies and qualitative research indicates that the introduction of **AM in workplaces is often associated with greater time pressure, longer or more irregular working hours, and reduced control over working time**. AM can drive work intensification by increasing pace and pressure, particularly when its functions extend beyond scheduling to encompass goal setting, continuous monitoring, and performance evaluation. However, its effects are highly context-dependent and vary by implementation and sector.

- The reviewed evidence suggests that **the use of AM systems, particularly in retail, business logistics, and transport, tends to exacerbate the already poor working conditions of low-paid occupations in these sectors**, leading to reduced employment quality through lower pay and heightened job insecurity.

- **AM practices, particularly those involving performance monitoring and digital surveillance, are linked to heightened occupational risks, psychosocial stress, and adverse mental health outcomes among workers**. In low-wage sectors especially, these practices can exacerbate job insecurity, accelerate work intensity, and erode autonomy, thereby further undermining workers' wellbeing and the long-term sustainability of work environments.

- The **use of AM systems in workplaces raises significant ethical concerns**, including the potential for **bias and discrimination**, **erosion of worker privacy and data protection, and lack of transparency and accountability in decision-making processes**. The implementation of AM systems can also disrupt the psychological contract between workers and employers, leading to reduced trust, feelings of betrayal, and erosion of worker dignity. However, research suggests that **transparency, worker influence, and human-centric design of AM systems can help mitigate these negative effects and promote more positive outcomes**, such as increased fairness, accountability, and trust in the workplace.

3 – Implications for social dialogue and collective bargaining

The role of collective bargaining in regulating AM

There is currently no unitary EU legislative framework on AM; existing EU rules focus mainly on transparency and information duties, leaving gaps to be addressed through collective bargaining and social partner initiatives. Several studies identify collective bargaining and worker consultation as essential mechanisms to deal with the challenges posed by AM (De Stefano and Taes, 2021; De Stefano and Doellgast, 2023; ILO, 2023, Molina et al., 2023; Brunnerová et al., 2024, Cox and Oosterwijk, 2024; European Commission, 2025).

Collective agreements can define rules around how AM influences wages, performance targets, promotions, work monitoring, and the use of employee data. Despite the critical importance of collective bargaining for the regulation of AM at work, a survey of trade union representatives (n=148) conducted in 2023 across multiple European countries found that collective bargaining over AI and AM remains limited: only around 20 % of survey respondents reported the inclusion of AI-related provisions in existing collective agreements (Brunnerová et al., 2024). Where such provisions do exist, they often focus on information rights, consultation mechanisms, and protections against unfair algorithmic decision-making, but they are far from being widespread.

In a French study, Greenan et al. (2024) similarly found that AI is beginning to feature in company-level collective agreements, though only marginally, with around 240 agreements mentioning AI out of nearly 285,000 signed between 2017 and 2024. Beyond employment protection and training, these agreements also engage with issues central to AM, such as the automation of managerial functions and the risks of surveillance and control. In finance and insurance, provisions on AI in collective agreements relate to decision-making and monitoring tasks being delegated to algorithms, raising concerns about job substitution, while in manufacturing and transport, AI is framed as an extension of automation but linked to performance tracking and reorganised workflows.

AM presents unique challenges compared to traditional HR and work management systems, particularly due to the opacity and autonomous (or semi-autonomous) decision-making capacity of algorithms, which complicates negotiations over work pace, monitoring, and performance evaluation (Aloisi and Gramano, 2019). Empirical research reviewed in this paper suggests that collective bargaining and worker involvement in decisions around AM can mitigate risks of excessive control and protect workers' rights. De Stefano and Taes (2023) argue that adapting collective bargaining frameworks is essential to address AM's evolving impact on job quality and labour standards and is vital for addressing the risks posed by AM on workers, from bias and data misuse to privacy intrusions, by enabling workers to demand transparency, oversight, and protective protocols. They emphasise that even without technical expertise, union representatives can play a key role in identifying worker concerns and negotiating safeguards such as human oversight, disclosure requirements, and ethical usage protocols.

Collective agreements, information and consultation rights, and co-determination can be ex-ante controls - that is, preventive measures applied before the introduction of new technologies - to limit risks and curb abusive practices (De Stefano and Taes, 2023). Such measures are supported by the cross-industry European Social Partners' *Framework Agreement on Digitalisation* (2020), a soft-law

instrument that promotes a 'human-in-control' approach. It calls for transparency when AI is used in HR decisions and recommends the inclusion of workers and their representatives in shaping AI policy through dialogue and bargaining processes. This agreement signals that both trade unions and employer organisations share a common understanding of the need to keep humans in the decision-making loop, ensuring that key decisions are not fully delegated to machines.

Yet, since the adoption of the framework agreement on digitalisation in 2020, national and sectoral initiatives have mainly focused on digital skills and modalities for connection / disconnection, while progress has lagged on other areas of the agreement more directly related to AM, such as ensuring the human-in-control principle and safeguarding human dignity and protection from surveillance (Eurofound, 2023).

Several sector-level joint texts highlight the role of social dialogue, such as the Ceemet-IndustriAll Europe joint position on digitalisation (2020) and the joint conclusion on AI (2023); the ETNO–UNI Europa ICTS joint declaration on AI (2020). While guidance documents are helpful, they are often high-level. Trade unions emphasise the need for binding national policies and robust social dialogue to ensure ethical, safe, and worker-centred digitalisation, whereas employers, including BusinessEurope, argue that existing EU legislation already provides adequate protections (Eurofound, 2023). They caution that additional binding rules could risk stifling innovation and competitiveness, and stress instead the importance of simplification and better implementation of the current regulatory framework.

Alongside soft-law instruments, existing EU legal provisions provide a framework to support collective bargaining on AM and related workplace transformations. Broadly speaking, national legislation reflects the principles of Directive 2002/14/EC by ensuring that employee representatives are informed and consulted about significant workplace changes, including those driven by digitalisation and AM (Eurofound, 2023; 2024). Some EU Member States - including Denmark, France, Germany, and the Netherlands - make explicit reference in their legislation to new technical means and the obligations employers have to consult employees about their introduction and use. Denmark requires consultation on changes arising from new technologies, linking these to both employment terms and health and safety obligations. In France, the Labour Code grants information and consultation rights to social and economic committees over recruitment technologies, automated personnel management systems, and employee monitoring tools. Germany's Works Constitution Act provides works councils with co-determination rights on the use of monitoring devices, extended under the Works Council Modernisation Act to cover AI systems, with access to external ICT expertise if needed. Similarly, the Netherlands' Works Council Act obliges employers to consult councils on technological changes and allows councils to appeal decisions. Spain has gone further by requiring employers to disclose to worker representatives the parameters and logic of algorithms or AI systems affecting working conditions, employment, and worker profiling. These regulatory responses reflect growing national efforts to ensure transparency, consultation, and worker protection in the face of increasing digitalisation of work.

Legal provisions in the Occupational Safety and Health Framework Directive (89/391/EEC) also establish general rights for worker information and consultation, including in the context of new technologies. Article 6(3)(c) of the OSH Directive requires employers to consult with workers or their representatives when planning and introducing new technologies that have implications for safety and health, which is particularly relevant in the case of AM systems.

Despite these legal frameworks, implementation varies across EU Member States. Collective consultation is often weak or absent in the sectors most affected by AM, such as retail, transport, business logistics and warehousing. Workers on non-standard contracts face particular barriers to exercising their rights, and the application of consultation rules is often uneven (Klengel and Wenckebach, 2021). Moreover, as De Stefano and Taes (2023) observe, a further limitation lies in the fact that current European legislation does not adequately or explicitly recognise the role of collective bargaining in the regulation of AM.

Views of the European social partners

While trade union organisations tend to take a critical view of AM, highlighting risks of surveillance, erosion of worker autonomy, and the need for binding safeguards, employer organisations tend to emphasise the potential benefits of digital tools for efficiency, productivity, and workplace organisation. Despite these differences, there is also common ground: both sides highlight the importance of transparency, governance frameworks, and social dialogue as prerequisites for the legitimate and sustainable use of AM in the workplace.

In its *Policy Orientation Note on Algorithmic Management*, BusinessEurope (2023) presents their stance on the integration of AI-based management systems in European workplaces. Employers recognise the substantial promise of AM, citing enhanced productivity, more efficient task organisation, improved decision-making, and inclusive outcomes, but only when these systems are correctly designed and governed. They highlight the critical need for clear governance frameworks and robust transparency, emphasising that algorithmic decision-making must remain explainable and trustworthy to both workers and managers. In parallel, BusinessEurope (2023) highlights the importance of upskilling and reskilling initiatives, advocating for investments in digital competencies to enable employees to adapt effectively to new technologies (e.g., interpreting algorithmic outputs and ensuring responsible oversight). A further priority is maintaining strong social dialogue: the employers' organisation supports involving worker representatives in discussions around the deployment of AI and AM tools to foster acceptance, mitigate risks, and address ethical and workplace wellbeing considerations.

As social partners, trade unions at the EU level have consistently highlighted the potential risks of AM for workers' rights and working conditions arising from the use of AM systems (ETUC, 2022; UNI Europa, 2020; 2024) and they have called for AI and algorithmic systems to be included in collective bargaining agreements (IndustriALL, 2023). In its 2022 resolution, the European Trade Union Confederation (ETUC) called for a dedicated EU Directive on algorithmic systems at work to safeguard workers' rights. The resolution demands binding rules ensuring transparency and plain-language information for workers, mandatory algorithmic impact assessments with the involvement of trade unions, and the right for worker representatives to seek external expertise. It also emphasises the need to address structural power imbalances between employers and employees and to include robust safeguards for equality, non-discrimination, and data protection.

The role of worker involvement in shaping outcomes

Research has shown that representative worker voice, whether expressed through informal workplace consultations or formal mechanisms such as collective bargaining, is associated with reduced risks from AI for employment and working conditions (Krämer and Cazes, 2022)

Evidence from the OECD employer and worker survey in the manufacturing and finance sectors highlights the crucial role of worker consultation in shaping workplace outcomes associated with the adoption of AI and AM tools (Lane et al., 2023). In both sectors, employers who consulted workers or their representatives were significantly more likely to report positive impacts of AI on performance, working conditions, and - specifically in manufacturing - on job stability.

Worker consultation was associated with better outcomes as perceived by both employers and workers, including gains in productivity, satisfaction, and health and safety. In firms where consultation occurred, 60-65 % indicated that the process led to tangible results such as the adoption or revision of internal guidelines, the development of AI strategies, or the conclusion of collective agreements. Despite these benefits, only 43 % of employers in finance and 45 % in manufacturing reported engaging in such consultations. The most frequently discussed topics were skills and training, followed by data use in finance and working conditions in manufacturing. These findings reinforce prior OECD research linking direct worker-manager dialogue to higher-quality working environments (OECD, 2019). Moreover, consultation was more prevalent in countries with strong traditions of social dialogue, such as Germany, and was significantly more common in firms with formal worker representation.

Building on these findings, a subsequent OECD laboratory experiment conducted in three German manufacturing firms, with participation from workers, managers, and works council representatives, found that structured consultation processes can facilitate agreement on system design features that simultaneously preserve firm-level productivity gains and enhance job quality (OECD, 2025), thus highlighting the importance of embedding social dialogue and representative voice into the governance of AM.

Worker involvement in AM carries broader implications for industrial relations. According to Cox and Oosterwijk (2024), these implications concern the structural distribution of power between labour and capital, operating on two interconnected levels: (1) worker rights and wellbeing, and (2) the balance of power between labour and capital. From this perspective, reduced worker influence not only shapes individual outcomes such as autonomy and motivation but may also limit the collective capacity of employees to coordinate and engage constructively with employers on matters of mutual interest.

Other research underlines this connection. For instance, Jensen et al. (2024) find that higher levels of worker influence are associated with mitigating adverse effects on autonomy, trust, and job motivation. Conversely, studies suggest that when AM is implemented in a controlling manner - automating managerial tasks and enabling surveillance and micromanagement - it can weaken worker agency and professional discretion (Noponen et al., 2023; Cox and Oosterwijk, 2024). While AM has the potential to support and enhance human work (Noponen et al., 2023), evidence also indicates that in practice, systems often delegate residual tasks to workers, leading to a dynamic where humans act as extensions of the machine rather than the other way around. This tension has consequences not only for job quality but also for the efficiency and sustainability of production processes, reinforcing the importance of embedding co-determination and social dialogue into the governance of AM.

These two levels are interconnected and may contribute to a reinforcing cycle, where reduced labour influence is associated with less favourable working conditions and lower wellbeing, which in turn can make collective organisation more challenging. The individualisation of work can lead to

competition and conflict among workers, further undermining their organising capacity (Cox and Oosterwijk, 2024).

AM and social dialogue: priorities for action

The increasing use of AM systems in the workplace has significant implications for workers, trade unions, and employers. As these systems become more widespread, it is important that workers and their representatives are informed about their deployment, understand their implications, and are equipped to participate in negotiations with employers over their use. Yet, research indicates that awareness and understanding of AM systems among workers and their representatives remains limited, and that their introduction frequently sidelines them in decision-making processes.

Employers, for their part, face substantial challenges in implementing AM and in engaging in open discussions with workers about how these systems truly function. Many systems are purchased as off-the-shelf solutions or rely on proprietary software, which restricts employers' ability to adapt functionalities to their organisational context or to increase transparency towards workers. This can create tensions between efficiency goals, legal compliance, and the need to maintain trust. In addition, employers must adapt to complex regulatory frameworks, alongside rapid technological developments that often outpace formal standards or guidance. These pressures can complicate efforts to align the design and deployment of AM systems with the practical realities of diverse workplace contexts. Despite these challenges, AM systems may also offer opportunities. When introduced responsibly and with appropriate safeguards, they can contribute to improved efficiency, productivity, and even employee engagement, especially when supported by transparent communication and dialogue with worker representatives.

Strengthening social dialogue on AM

Building common ground on AM involves trade union and employer organisations bringing the issue into their social dialogue agendas at European, national, and workplace levels, where the practical implications of AM can be discussed and negotiated. A recent pan-European survey by UNI Europa found that 42 % of trade unions in the services sector are already engaged in negotiations and collective bargaining over the implementation of AI in their workplaces (Brunnerová et al., 2024). The topic has also been taken on by the workers group in the European Economic and Social Committee (EESC), which led to an opinion on pro-worker AI to harness the potential and mitigate the risks of AI (EESC, 2025)[10]. The report emphasises the importance of social dialogue and worker involvement as central to ensuring trustworthy and rights-respecting AI in the workplace and it advocates for an EU legal instrument to strengthen social dialogue and safeguard rights through mechanisms such as enforcement of GDPR Article 88. However, the opinion did not receive unanimous support from the employers' group within the EESC. Due to differing perspectives, a counter-opinion was submitted, which - although ultimately not adopted - was appended to the final opinion after receiving more than a quarter of the votes cast. This example of social dialogue at the European level illustrates the complexity of achieving consensus on AM. It highlights that, while

[10] EESC, own-initiative opinion, January 2025, Pro-worker AI: levers for harnessing the potential and mitigating the risks of AI in connection with employment and labour market policies, https://www.eesc.europa.eu/en/our-work/opinions-information-reports/opinions/pro-worker-ai-levers-harnessing-potential-and-mitigating-risks-ai-connection-employment-and-labour-market-policies.

there is shared interest in developing an enabling approach, aligning the views of workers and employers requires ongoing dialogue and mutual understanding.

Raising awareness of AM among workers and their representatives

A crucial aspect of negotiating the implementation of AM at the firm level is the degree of awareness among workers and their representatives. A recent survey of trade union members across Europe (Holubová, 2022) provides insights into the extent of worker awareness regarding AM practices in their workplaces. The study found that 32 % of workers in various sectors were unaware of the use of algorithmic technology in their workplace. Furthermore, the study examined the responses of trade unions and employers to mitigate the risks associated with AM, revealing that while most respondents reported that their trade union had addressed AM-related risks, most had not experienced their employer taking any action to mitigate these risks (Holubová, 2022). These findings are particularly relevant considering the various factors that can moderate the effects of AM, as discussed in Chapter 2 of this report.

Similar findings regarding worker awareness were reported by Gilbert et al. (2021) in their survey of members of the British union USDAW[11], which explored exposure to, awareness of, and concern about different workplace technologies. The results indicated a general lack of awareness among workers regarding how personal data was being used by their employer, as well as a lack of trust in the employer's ability to protect their rights in this regard (Gilbert et al., 2021).

Case studies conducted in the Nordic countries (Cox and Oosterwijk, 2024) also highlighted a widespread lack of awareness among workers regarding the digital systems used in their workplaces. Notably, the informants in these studies reported that their participation in the research was the first time they had reflected on these issues, and they expressed uncertainty about the extent of data collection practices in their workplaces. The interviews also revealed a lack of time for critical reflection on the implications of digital tools for their work and rights, highlighting the need for greater awareness and engagement among workers regarding AM (Cox and Oosterwijk, 2024).

Renegotiating the Big Tech version of AM

A critical factor in evaluating the feasibility of negotiating the implementation of AM is the EU's reliance on foreign technology, which shapes both opportunities and challenges for workplace practices (Caffara, 2024). Many AM systems are developed outside the EU, often reflecting the worldview of Silicon Valley companies rather than the European socioeconomic model, which emphasises worker participation and social dialogue (Kuldova and Rudningen, 2024; Cox and Oosterwijk, 2024). Embedded in proprietary, off-the-shelf products, such systems can limit the capacity of employers and workers to adapt them to local workplace contexts, while raising concerns about transparency and accountability. Where developers fail to account for the role of trade unions and participatory mechanisms, EU regulation has a role to play in establishing safeguards that enable meaningful worker-employer dialogue and give trade unions the ability to negotiate over the design and use of AM systems. The AI Act, through Article 26, requires employers to inform workers and their representatives before deploying high-risk AI systems in the workplace. This is tied to existing EU rules on informing and consulting workers.

[11] UK's trade union representing workers primarily in retail, distributive, manufacturing, and service sectors.

Experiences across countries demonstrate that the impact and governance of AM are mediated by national institutional contexts. A comparative analysis of the banking sector in Norway and the United Kingdom reveals marked differences: Norwegian unions have been more successful in negotiating conditions around digital monitoring, control and surveillance of workers than their UK counterparts, pointing to significant 'country effects' (Lloyd and Payne, 2023). Similarly, research in Denmark, Germany, Hungary, and Spain highlights the role of strong participatory institutions and collective agreements in shaping the introduction of AM. Success stories from countries such as Denmark (Molina et al., 2023) show that constructive negotiation can help ensure AM supports both business performance and worker wellbeing.

Dealing with the black box and function creep

A fundamental prerequisite for negotiating the specifics and application of AM tools is that both workers' representatives and employers possess a thorough understanding of the tools being implemented. However, this is often not the case, particularly with complex and technical AM systems that are designed and developed outside the company. These systems can be opaque, functioning as a 'black box' for both managers and workers alike, making it challenging to understand their inner workings and decision-making processes (Bunge, 1963). The quantitative and data-driven nature of AM can further exacerbate this issue, as the algorithms used are increasingly 'black-boxed' and only processable by machines, rather than humans (Pasquale, 2015). To mitigate this, it is essential to introduce greater transparency into the EU legislative framework, particularly with regards to the algorithms used in AM systems. The AI Act includes transparency obligations for high-risk AI systems in work management (Articles 13 and 26, Annex III 4), but these are geared towards enabling proper use and oversight by employers, with limited direct transparency rights for workers. Similarly, the GDPR requires that data subjects receive 'meaningful information about the logic involved', yet this obligation remains vague and contested. Since the law does not guarantee access to the algorithm itself, and technical disclosure would rarely be comprehensible to workers, the GDPR also falls short of ensuring genuine transparency or accountability in complex AM systems (Abraha, 2023).

Another significant challenge arising from the use of AM systems in workplaces is *function creep*, where data collected for one purpose - such as human resources - is gradually repurposed for another, such as performance management or surveillance. According to Kuldova and Rudningen (2024), this is a fundamental feature of AM systems, highlighting the need for careful consideration and negotiation of the terms of use for these systems. In principle, the GDPR addresses this risk through its requirements of purpose limitation and data minimisation (Art. 5), while the AI Act introduces obligations of transparency and risk management for high-risk AI systems. However, neither framework fully resolves the problem. The GDPR's notion of compatible processing (Article 5(1)(b); Article 6(4)) leaves significant scope for interpretation, and in practice, employers may define purposes broadly enough to permit further data use or repurposing. Similarly, the AI Act's transparency provisions are aimed primarily at informing deployers and affected workers, without granting meaningful insight into how systems evolve or how data is reused. Scholars have therefore highlighted that legal safeguards alone cannot prevent function creep, especially given the opacity of algorithmic systems, the difficulty of detecting incremental repurposing, and the asymmetry of power between employers and workers (Koops, 2021; Ebert et al., 2021; El Bouchikhi et al., 2024).

Building capacity to evaluate AM systems

The introduction of extra rights to negotiate on AM will bring additional responsibilities for workers' representatives, who may lack the necessary capacity to effectively evaluate and negotiate AM systems. Evaluating these systems requires specialised technical knowledge, which may not be readily available within trade unions. To address this gap, capacity-building and training programmes for union representatives, such as those offered by the 'Why Not Lab', a consultancy that equips workers and their unions with skills, strategies, and practical tools to safeguard collective rights in the digital age - can be implemented. Exchanging best practices on AI clauses in collective agreements, as done by UNI Europa in cooperation with the WageIndicator Foundation and Friedrich-Ebert-Stiftungh, can also be beneficial[12].

Another possible solution is to enable trade union representatives to consult with external experts who can provide technical assistance in evaluating AM systems. This approach has already been successfully implemented in the PWD, which grants platform workers the right to access external expertise under Article 13. Applied to the workplace context, some national legal frameworks already provide examples. For instance, Germany's Works Council Modernisation Act grants trade unions and employee representatives the right to access external technical expertise when AI-powered technologies are introduced or used for HR purposes, thereby strengthening transparency and explainability rights for workers. By facilitating access to external expertise, a new market for algorithmic specialists could emerge, offering guidance to both workers and employers on designing AM systems that balance efficiency with equity and social responsibility.

Alternatively, companies could establish dedicated digital trade union experts, such as the 'data shop steward/data trade union representative' role recognised in the main agreement (2022-2025) between the Norwegian Confederation of Trade Unions and the Confederation of Norwegian Enterprise (Jeugo et al., 2024). Despite the importance of involving workers in AM implementation, research has shown that employee representatives are often sidelined in decisions regarding the introduction of new algorithmic and digital systems in the workplace (Cox and Oosterwijk, 2024). Addressing this issue is crucial to ensuring that workers' interests are represented and that AM systems are designed and implemented in a fair and transparent manner.

Summary points

- **Collective bargaining is a crucial mechanism for addressing the challenges posed by AM, enabling workers and their representatives to negotiate rules on wages, targets, promotions, surveillance, and data use**. Similarly, collective bargaining can also benefit employers by providing a framework for negotiating the implementation and use of AM systems, allowing them to balance their business needs with the need to protect workers' rights and interests. **The opacity and autonomous decision-making of algorithms can complicate negotiations**, making adapted bargaining frameworks essential to safeguard job quality, transparency, and fairness for all parties involved. By engaging in collective bargaining, worker representatives can play a central role in ensuring human oversight, disclosure, and

[12] See the database developed by UNI Europa, in cooperation with the WageIndicator Foundation and the Friedrich-Ebert-Stiftung, which compiles clauses in collective bargaining agreements addressing AI and algorithmic management, available at: https://www.uni-europa.org/news/a-database-of-ai-and-algorithmic-management-in-collective-bargaining-agreements/.

ethical safeguards, even without technical expertise, while employers can ensure that their business needs are met in a way that is fair and sustainable.

- **The European social partners' framework agreement on digitalisation advocate for a 'human-in-control' approach, emphasising transparency in algorithmic decision-making and the active involvement of workers in shaping workplace AI policies**. However, implementation at national and sectoral levels has primarily focused on developing digital skills and promoting work-life balance, with issues such as AI ethics, surveillance, and worker dignity receiving relatively less attention.

- **EU and national legal frameworks give employee representatives information and consultation rights on significant workplace changes, including new technologies and monitoring systems, but implementation varies across Member States**. Worker consultation is shown to benefit both employees and employers, with firms engaging in dialogue more likely to report positive outcomes such as improved performance, job stability, satisfaction, and health and safety.

- **Social partners hold differing perspectives on the impact of AM in the workplace, yet they concur on the importance of promoting transparency, establishing sound workplace governance, and supporting skills development to achieve fair and inclusive outcomes.** Employers highlight the potential of AM to enhance productivity, innovation, and inclusiveness. Trade unions, on the other hand, caution against risks such as stress, excessive control, discrimination, and the erosion of workplace solidarity, and stress the importance of co-determination and collective capacity to address power imbalances.

- **European reliance on technologies developed by global corporations outside the EU poses risks to established systems of co-determination**. Addressing the 'black box' nature and potential 'function creep' of algorithmic tools is a key condition for meaningful negotiation, requiring greater transparency. **Worker representatives need stronger technical expertise and resources to evaluate algorithmic systems, supported by capacity building, training, and external experts**. Despite the importance of worker involvement, unions can still be sidelined in decisions about the adoption and use of algorithmic systems in workplaces.

Conclusions and policy implications

Conclusions

There is evidence that AM practices have entered conventional workplaces and are expanding beyond platform-based work, particularly in sectors such as transport, warehousing, and financial services, particularly in low to mid skilled occupations. The literature review - drawing mainly on case studies - shows that AM functions span a broad range of management-related activities and can significantly affect job quality, with important implications for workers' wellbeing. They also transform managerial roles and functions, reconfiguring the job of managers and restructuring their responsibilities. Adverse effects can be mitigated by system design and governance features and active worker involvement, leading to better outcomes not only for workers but also for the actual efficiency gains that motivate employers to implement AM tools in the first place.

Building and maintaining worker trust in such systems is supported by the involvement of trade unions and worker representatives through meaningful consultation or co-determination in the implementation of AM. Significant challenges emerge when AM practices erode workers' capacity to organise and engage in collective negotiation. The fact that AM - now increasingly enabled by AI technologies - often operates as a black box for both management and workers and is typically developed by external tech companies as off-the-shelf solutions, poses a significant challenge to adapting these systems to the specific needs of the workplace in a transparent manner.

Ultimately, the technology itself is not the problem; rather, it is the way firms adopt and implement it that creates risks for job quality and may undermine long-term efficiency gains for organisations. A less controlling and more enabling use of AM tools has the potential to enhance and empower workers in their jobs, while supporting managers by automating repetitive tasks, freeing their time to support workers in a more meaningful way. This is a realistic scenario if the EU maintains its commitment to a human-centric vision for AI in the workplace, supported by the implementation of the AI Act and the personal data and privacy rights enshrined in the GDPR. Rooted in the European social model, implementing adequate safeguards against the unintended consequences of AM is essential to ensuring the fair treatment of workers while promoting the sustainable and effective use of these technologies across European businesses.

Policy implications

The European Commission is considering additional rules on AI in the workplace and, more specifically, AM in more conventional work settings. The chapter of the PWD that sets rules for AM systems that are affecting platform workers may serve as an example for developing similar provisions applicable to all workers. According to some scholars, provisions concerning the transparency of algorithmic tools, the prohibition of using certain categories of personal data in algorithmic decision-making, the requirement for human oversight and recourse in such decisions, and the obligation for companies to cover the costs of external experts on algorithmic tools engaged by workers' representatives, could also be applied in traditional workplaces (Jensen et al., 2024).

Enhancing the trustworthiness of AM requires maintaining meaningful human oversight of the algorithm. This concept was codified in the EU AI Act through the human oversight requirement for high-risk AI systems, as set out in Article 14 of the AI Act, which applies to workplace use cases of AI

for work management. This human oversight requirement aims to prevent risks to health, safety, and fundamental rights through output correction, while also preserving human agency and fostering trust in AI systems (Fink, 2025). It remains to be seen how this principle will be implemented in practice by companies and what specific obligations will be outlined in the forthcoming guidelines from the EU AI Office. However, as Fink (2025) emphasises, human oversight itself is not a flawless safeguard: empirical studies demonstrate that overseers face cognitive constraints and are prone to automation bias, often deferring excessively to AI outputs. This suggests that without careful institutional design - such as adequate training, realistic workloads, and meaningful decision-making authority - human oversight risks becoming a mere formality rather than an effective control mechanism (Fink, 2025).

Since AM systems rely on workers' data to function, the GDPR is relevant, and personal data and privacy rights should be respected. According to Articles 13 and 14 of the GDPR, employers must inform employees about the collection of personal data and the existence of automated decision-making systems. Also, Article 22 of the GDPR applies in the employment context and grants workers the right not to be subject to decisions based solely on automated processing that produce legal effects concerning them or similarly significantly affect them. To a large extent, the issues associated with AM could be mitigated through the strict application of the GDPR; however, in practice, some scholars argue that there has been insufficient enforcement of these general data protection rules (Jensen et al., 2024). Abraha (2023) provides a comprehensive overview of the various aspects of the GDPR that apply to AM, highlighting the challenges associated with the notion of consent and the focus on individual personal data rights in the workplace. Trade unions from across the EU have put forward recommendations for the improvement of the GDPR and the directive's relevance to the circumstances of working life under AM (Del Castillo and Naranjo, 2022).

There is also a body of EU secondary law on anti-discrimination that applies to the workplace, which is highly relevant to the regulation of AI-based or algorithmic systems used for work management, particularly in addressing risks of bias and discrimination. Some countries, such as Portugal[13] and Spain[14], have already introduced legislation that explicitly refers to decision-making based on algorithms and AI systems. However, proving algorithmic discrimination remains particularly challenging, given the complexity and opacity of such systems.

When considering job quality and the potential adverse effects on workers' health and wellbeing, existing national and EU occupational health and safety (OSH) regulations must be applied to the conditions shaped by AM in the workplace. The European Framework Directive 89/391/EEC on the Safety and Health of Workers at Work, along with the related 'daughter' directives, such as those on chemicals (Directive 98/24/EC) and personal protective equipment (Directive 89/656/EEC), expand on the core principles[15] by addressing specific hazards, risks, and work environments, thereby

[13] See update of legal instruments for Portugal in the context of algorithmic management in Eurofound's Restructuring Legal database - https://apps.eurofound.europa.eu/legislationdb/algorithmic-management/portugal.

[14] See update of legal instruments for Spain in the context of algorithmic management in Eurofound's Restructuring Legal database - https://apps.eurofound.europa.eu/legislationdb/algorithmic-management/spain.

[15] The Framework Directive establishes fundamental principles for ensuring occupational safety and health, including the employer's responsibility to protect workers, the prevention and assessment of risks, and the adaptation of work to the individual. It sets out general principles for preventing risks at their source, while also emphasising worker participation, training, and information.

providing more detailed regulations. While directives on working time and work-life balance are also applicable, they do not specifically address the impacts of AM.

The EU Directive on Transparent and Predictable Working Conditions (TPWC) Directive does not directly address the specific challenges posed by AM, but certain provisions do apply in contexts where algorithmic scheduling software are used, helping to mitigate some of its harmful effects on workers. This legal framework introduces safeguards that reduce the unpredictability inherent in AM. When a worker's schedule is mostly unpredictable, Article 4(2)(m) of the Directive requires that workers receive clear information on reference hours and days, the minimum notice for assigning work, and the rules around shift cancellation. This ensures that workers are not kept in the dark about when they might be expected to work and under what conditions. Further protection is provided by Article 10, which gives workers the right to refuse work offered outside of their agreed reference hours or assigned with insufficient notice, without suffering any adverse consequences. In some cases, workers are also entitled to compensation if shifts are cancelled without due warning. The Directive also mandates that any changes to key aspects of the employment relationship, including scheduling arrangements, must be communicated in writing by the employer no later than the day those changes take effect. This helps preserve a level of transparency and predictability in an otherwise fluid and automated system. While these protections are not as extensive as those found in the EU's Platform-to-Business (P2B) Regulation, which requires at least 15 days' notice for contractual changes - they nonetheless represent an important step in shielding workers from the instability that can result from algorithmic control (Adams-Prassl, 2022). Furthermore, Member States have the flexibility to adopt more stringent and explicit rules when transposing the TPWC Directive.

A notable example is Italy, where Legislative Decree 104/2022 implementing the TPWC Directive introduced specific provisions addressing AM systems. The law requires employers to explicitly disclose the use of such systems in any aspect of the employment relationship, including recruitment, work organisation, performance evaluation, and dismissal (Eurofound, 2024). Employers are also required to provide information on the types of data used to train these systems, as well as the cybersecurity measures in place to protect the data from potential breaches. As algorithmic scheduling software becomes more widely adopted and available at low cost, other governments may follow Italy's lead in implementing similar regulatory measures.

Continued investment in robust, EU-wide monitoring instruments is essential to gain a comprehensive understanding of the prevalence and impact of AM practices across European workplaces. As algorithmic systems become increasingly integrated into organisational decision-making - affecting task allocation, performance monitoring, and scheduling - it is critical to assess how these technologies are reshaping working conditions and influencing job quality. The EWCS 2024 marks a significant advancement in tracking the prevalence of AM, with the introduction of new, dedicated indicators. Other European and international organisations are also enhancing their efforts to monitor these developments.

Complementing worker surveys with employer surveys is equally important, as they provide crucial insights into how AM tools are embedded in organisational practices and how they transform managerial functions. Such surveys should not only measure the extent to which these tools are used in organisations, but also examine how well managers and leaders are prepared and trained to adopt them, the metrics used to assess productivity linked to their deployment, whether job

redesign strategies are implemented, and whether human-in-the-loop mechanisms and governance frameworks are in place to ensure transparency, ethical use, and inclusiveness. Reliable and comparable data remains the cornerstone of sound, evidence-based policymaking. Strengthening monitoring instruments and expanding data collection on AM will equip policymakers to address emerging challenges, uphold workers' rights, and promote the development of fair, transparent, and human-centric AI governance in the world of work.

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