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Algorithmic management and occupational health: A comparative case study of organizational practices in logistics

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ABSTRACT

Algorithmic Management (AM), which refers to technologies that use algorithms to oversee and direct workers, is increasingly being introduced across various sectors and workplaces. While previous research has focused on AM's impact on job quality in platform work, its effects on worker well-being in non-platform workplaces remain underexplored. This study seeks to deepen our understanding of the impact of AM on occupational health within non-platform workplaces. Drawing on the socio-technical lens and the Pressure, Disorganization and Regulatory Failure (PDR) model (Quinlan et al., 2001), it aims to identify organizational practices that shape the interplay between AM and employees' work experiences, health, and overall well-being. We conducted a comparative case study with two Swedish logistics companies and collected data from observations and semi-structured interviews. Our analysis focused on the interplay between organizational practices, AM technology, and worker experiences to understand key differences between the cases. Workers at both sites reported a low sense of autonomy and task significance. However, physical and psychological strain from AM was more pronounced in the e-commerce company, a disparity potentially explained by factors of the PDR model. We identified organizational practices that appear to positively influence workers' AM experiences: i) involving workers with the AM technology; ii) integrating AM considerations into occupational safety and health management; iii) designing AM applications that allow worker control; and iv) managerial practices that add qualitative assessments to AM's quantitative evaluations. Our research highlights the critical importance of designing organizational practices that incorporate AM in ways that promote occupational health alongside operational efficiency.

1. Introduction

Algorithmic management (AM), a term coined by Lee et al. (2015), refers to algorithmically driven technologies that take on managerial functions across various sectors and workplaces (Baiocco et al., 2022; Fernández-Macías et al., 2023; Kellogg et al., 2019; Urzi Brancati et al., 2020; Wood, 2021). Algorithms can process data and make decisions using rules or through machine learning and statistical models. This enables them to perform specific functions at scale, such as managing a workforce (DRCF, 2023). Kahneman et al. (2021) argue that humans are prone to an array of cognitive errors and biases in their judgments and that algorithms and AI could represent viable alternatives in decision-making. Indeed, AM systems are suggested to outperform humans in delegation of tasks in certain contexts (Yu et al., 2017), promising an increase in productivity and a fairer distribution of tasks, compared to human managers who can exhibit patterns of favoritism (Bai et al., 2021). However, concerns have been raised about who AM benefits. Kellogg et al. (2019) argue that the primary function of AM is to maximize the value of labor by reshaping and increasing organizational control of the work process. Because of similarities to earlier regimes of

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rational control, such as the assembly line (Kellogg et al., 2019), AM is sometimes referred to as digital Taylorism (Howard, 2022; Liu, 2023; Noponen et al., 2023). A growing body of research raises concerns about the deleterious effects of AM on job quality aspects, including job security, opportunities for development, autonomy, job content, and the social work environment (Baiocco et al., 2022; Christenko et al., 2022; Fernández-Macías et al., 2023; Howard, 2022; Jarrahi et al., 2021; Vignola et al., 2023).

As technology is contingent upon social actors' implementation and utilization, it is argued that contextual factors on the micro-, meso-, and macro-level, such as individual traits, organizational characteristics, and global trends, play a role in the interplay between AM and job quality (Jarrahi et al., 2021; Parent-Rocheleau & Parker, 2022). Parent-Rocheleau and Parker (2022) argue that worker involvement and transparency are paramount for a sustainable implementation of AM, thus drawing attention to how AM and organizational practices interact.

While much of the burgeoning research on AM in relation to workers' perceptions and health consists of theoretical frameworks and focuses on platform work (Parent-Rocheleau & Parker, 2022; Vignola et al., 2023), empirical studies examining the relationship between AM and health in conventional work settings remain scarce. There is no common definition to conventional or standard employment, but we use the term to refer to direct employment with formal contracts, and legal protections, where the employer maintains direct responsibility for working conditions, pay, and management, distinguishing it from agency, or platform work (ILO, 2017). Although some researchers argue that occupational risk factors associated with AM are fundamentally similar in platform and non-platform work (Nielsen et al., 2022), we contend that there are fundamental differences between the two contexts, as the latter operates within established regulatory frameworks and institutional traditions that can mediate or moderate the influence of AM on work organization and psychosocial risk factors, while the responsibility for the OSH is unclear (Nielsen et al., 2022). Due to the lack of regulatory frameworks and clear employer's obligations, platform workers often face additional job-quality deficiencies, such as the absence of worker rights and income insecurity (Kreshpaj et al., 2020; Taylor et al., 2023; Westregård, 2024). It is also suggested that the implementation and intention of different AM mechanisms and functions differ between platform mediated work and work in conventional work settings (Lippert, Kirchner, & Wiener, 2023). Thus, further empirical research is needed to understand how AM influences the organization of work, the work environment, and, ultimately, the occupational health in workplaces outside of the platform economy. Additionally, more research is needed to understand and identify organizational practices of importance in this context, understood as the processes, routines and behaviours within an organization.

This study seeks to deepen our understanding of the impact of AM on occupational health of workers in conventional work settings, outside the platform economy. Drawing on the socio-technical lens and the Pressure, Disorganization and Regulatory Failure (PDR) model (Quinlan et al., 2001), it aims to identify organizational practices that shape the interplay between AM and employees' work experiences, health, and overall well-being. We employ a comparative case study approach to understand the similarities, differences, and patterns between two logistics companies in Sweden. Case studies can provide in-depth understanding and nuanced insights into the interaction between a phenomenon and its context, and this is especially relevant in the study of the interplay between technology and organization, where the lines are often blurred and sometimes inseparable. The logistics sector was chosen because of its prominence as an early and prevalent adopter of AM outside of the platform work context while also adopting all, or many, of the different functions of AM (Fernández-Macías et al., 2023; Wood, 2021).

This paper begins by outlining the functionality and adoption of AM in the logistics sector. We then delve into its implications for workers' well-being, drawing from previous research on job quality effects and framing AM as a socio-technical process, followed by details of our method. The results section presents a cross-case synthesis and themes emanating from the interviews. We conclude with a discussion addressing study limitations and highlighting key contributions and conclusions.

2. Background

2.1. Features of AM and its implementation in the logistics sector

There is no common definition of AM. Mateescu and Nguyen (2019) define AM as "a diverse set of technological tools and techniques to remotely manage workforces, relying on data collection and surveillance of workers to enable automated or semi-automated decision-making". This definition is suitable for our inquiry as it captures both fully automated decisions of AM and semi-automated ones, with the latter being more prevalent in conventional work settings, where human managers still play a significant role overseeing the organization of work (Wood, 2021). It also emphasizes how algorithmic technologies have the power to extend management control rather than replacing managers with these technologies (Jarrahi et al., 2021; Sullivan et al., 2024; Wood, 2021).

Fernández-Macías et al. (2023) suggest that AM consists of primarily two functions: direction and evaluation of workers. Direction entails the allocation of tasks, and instructions about the pace and process of how to complete a certain task through automated decision-making. Evaluation is dependent on monitoring and continuous data collection about each workers' productivity. The assessment is then delivered as feedback to the workers and managers and can be used for the allocation of tasks and/or awards (Fernández-Macías et al., 2023). Automized instructions are often conveyed to the worker via a headset, a tablet, or a smartphone, through which the workers also receive the performance feedback (Delfanti, 2021; Wood, 2021). The extent to which these functions are fully automated differs between companies and sectors, and Wood (2021) proposes a classification based on the level of automation of managerial functions. According to Wood (2021), the logistics sector, which is the focus of this study, relies heavily on conditional automation. In this system, algorithms direct, evaluate, and discipline workers, while human managers intervene only when prompted by the software. A report by the Swedish Commercial Employees' Union (CEU) found that approximately 80 % of warehouse workers picked items with the help of a digital device, though it is difficult to say if these devices entailed AM. The larger enterprises in this report were also more likely to have adopted more technological solutions in their operations (Wrangborg & Söderberg Talebi, 2023).

2.2. AM's impact on the psychosocial and physical work environment and health

Technological advancements hold the power to reduce risks and increase worker safety through, for example, proactive warning systems with instant feedback to workers regarding safety hazards through virtual reality (Zhang et al., 2025), machine learning algorithms for risk assessment and accident predictions (Niu et al., 2024; Qi et al., 2025), and wearables to detect and alert workers to potential bodily harm (Cannady et al., 2024). There are also indications that algorithmically driven management systems hold potential benefits for workers, as research has shown that tasks delegated by algorithms may be perceived as fairer and result in higher productivity compared to tasks delegated by humans (Bai et al., 2021; Yu et al., 2017). However, many scholars in the field of AM and workers' well-being have raised concerns about the intrusive nature of the technology, the strict management it often imposes on the workers (Kellogg et al., 2019) and the possibly detrimental effects on workers' well-being, and job satisfaction (Christenko et al., 2022; Fernández-Macías et al., 2023; Howard, 2022; Jarrahi et al., 2021; Vignola et al., 2023). Previous forms of technology implemented to maximize the output of labor, such as the assembly line, induced feelings of alienation in workers, who were locked in one place (Edwards, 1979) and exerted little control over their work in the face of specialization and de-skilling (Braverman, 1974). Kellogg et al. (2019) argue that the new rational control of AM is more comprehensive, opaque, instantaneous, and interactive than previous regimes of technical control, and thus, the implications of AM for the working conditions of affected workers may be grave. While research on the association between AM and health outcomes is limited, it is widely believed that AM may have adverse effects on various job quality factors, such as work intensity, skills development, use and discretion, the social work environment, autonomy, and perceived fairness (Baiocco et al., 2022; Christenko et al., 2022; Fernández-Macías et al., 2023; Howard, 2022; Jarrahi et al., 2021; Nilsen & Kongsvik, 2023; Sloth Laursen et al., 2021; Vignola et al., 2023).

In the logistics sector, collected data is used to calculate and optimize routes and to provide timeframes for the workers to finish their tasks (Delfanti, 2021). In his ethnographic study of an Amazon warehouse, Delfanti (2021) argues that these deadlines are narrow, forcing the workers to sometimes run to finish a task in time. Additionally, the algorithms often operate on the assumption that the work process is linear and uninterrupted, leaving little room for unforeseen events or disruptions. However, unexpected challenges in the warehouse or on the road frequently arise, disrupting workflow and causing delays. These interruptions, in turn, intensify time pressure for workers, as they must compensate for lost time within rigid algorithmic schedules (Delfanti, 2021).

Constant monitoring of workers is another aspect of AM that has received attention and criticism from scholars. The threat monitoring poses to workers' integrity is not new, but technological advances have enabled more intrusive and comprehensive forms of surveillance. These innovations allow for detailed mapping of worker productivity as well as monitoring activities and behaviors on and off the job (Fairweather, 1999; Kellogg et al., 2019). This surveillance and assessment also raise concerns beyond issues of integrity. Drawing on their experimental studies, Newman et al. (2020) suggest that algorithmic evaluation and decision-making could be perceived as reductionistic, as they ignore qualitative and contextual factors that many workers perceive to be crucial for a fair assessment of their productivity. The numeric evaluation of workers, also known as datafication (Schafheitle et al., 2020), may reduce the task significance workers ascribe to their work.

Another potentially problematic aspect of AM is its opacity, meaning that workers lack access to its functions and workings. Jarrahi et al. (2021) employ two concepts in this context: "organizational opacity", describing companies safeguarding their systems as proprietary components of their business model, thereby limiting access to data and algorithms for workers or unions; and "technological opacity," which arises from the complexity of these systems, sometimes confounding even experts' ability to discern why a particular decision has been made (Jarrahi et al., 2021).

Many job quality factors believed to be negatively impacted by AM have been identified in previous research as predictors of work-related ill health (Alarcon, 2011; Aronsson et al., 2017). The impact of workload on mental and physical health has been extensively documented (Harvey et al., 2017; Nahrgang et al., 2011; van der Molen et al., 2020), as well as the correlation between low decision authority and work-related psychological strain (Harvey et al., 2017; van der Molen et al., 2020). And the limited empirical literature on the association between AM, psychosocial risk factors, and health do indicate that implementation of AM to monitor performance and decide the content of the work has negative effects on, for example, perceived time pressure, communication and cooperation, autonomy, meaningfulness, fear of job loss, and perceived wellbeing (Doellgast et al., 2023; Kinowska & Sienkiewicz, 2023; Urzí Brancati & Curtarelli, 2021).

To sum up, it is widely believed that AM exacerbates or introduces psychosocial work environment risks to the workers affected, and thus, AM may also pose a threat to the health of these workers. While existing research acknowledges the potential harmful effects of AM, empirical studies specifically examining the intersection of AM and health in conventional work settings are scarce. Additionally, there is a need for research that moves beyond the notion of these technologies being inherently harmful or beneficial.

2.3. *Algorithmic management as a socio-technical process*

The socio-technical systems theory by Emery and Trist (1960) posits that an organization should balance the optimization of both social (humans within and around the organization) and technical (technologies supporting work processes) systems. Meanwhile, scholars have pointed out how the fast advancement of AI and digitalization of work has created an imbalance between these two systems, thus posing a threat to job quality and workers' wellbeing (Makarius et al., 2020; Parent-Rocheleau & Parker, 2022; Parker & Grote, 2019). Kochan et al. (2024) raises this issue in their article and presses the need to bring worker voice into generative AI, and a "bottom-up" approach to the implementation of advanced technologies in the workplace to mitigate this imbalance. Two socio-technical frameworks contribute important insights on the organizational level about how AM could be implemented and utilized for a more worker-friendly approach (Parent-Rocheleau & Parker, 2022; Vignola et al., 2023). Parent-Rocheleau and Parker (2022) emphasize the importance of organizational resources such as system transparency, fairness, and human influence in moderating AM's impact on job quality. In contrast, Vignola et al. (2023) identify individual, organizational, and societal factors—including collective organization, training opportunities, and health and safety standards—that shape AM's effects. Both frameworks provide valuable insights into organizational practices, their potential impact on workers' perceptions of AM, and how they may influence occupational health.

2.4. *Occupational safety and health management and the PDR model*

Occupational Safety and Health (OSH) management refers to the "work done by the employer to investigate, carry out and follow up activities in such a way that ill-health and accidents at work are prevented and a satisfactory working environment achieved" (Arbetsmiljöverket, 2001:1). Despite definitional and quantifiable problems related to OSH management, OSH performance, and related outcomes (Gallagher et al., 2003), studies suggest that effective OSH management must include high levels of involvement of workers, senior and line management, and integration of the OSH management system into existing processes and procedures of the workplace (Gallagher et al., 2003). Gallagher et al. (1998) named this kind of effective OSH management "adaptive hazard managers", which they found was associated with lower risk of injuries.

The PDR model by Quinlan et al. (2001) is used to understand how the organization of work impacts workers' health and safety, with a particular focus on how organizational practices influence OSH management. The model was originally created to explain how precarious or contingent employment affects OSH but has also proven useful in other settings (Bohle et al., 2015), such as subcontracting and workplace disasters (Quinlan et al., 2013), downsizing and OSH effects (Quinlan & Bohle, 2009), occupational health of older workers (Bohle et al., 2015) and bullying in the hospitality industry (Bohle et al., 2017). The PDR model highlights three key elements of the organization of work:

> Pressure refers to job insecurity, long and irregular work hours and financial and/or reward pressure facing workers, such as irregular income or payment systems that push them to work harder, often compromising their well-being. These risks can result in hazardous work practices, such as cutting corners and work intensification.
> Disorganization refers to inefficiency and disruption due to poor training, inexperienced workers, inadequate supervision, or a lack of

communication between workers and management. This can negatively impact OSH management and hamper workers' ability to organize.

Regulatory failure refers to challenges in enforcing labor standards and laws, especially in work environments where worker protections are weak. Workers may face limited knowledge of their rights, making it difficult to recognize or report injustices. This factor also includes barriers workers face in demanding fair conditions, whether due to inadequate understanding of rights, lack of access to reporting mechanisms, or fears of retaliation.

Some of these risk factors relate to the employer, while other factors may be attributed to the workers, such as inexperience or limited knowledge of legal rights, however, worker-related risks are often tied to employer practices (Underhill & Quinlan, 2011). The PDR model (Quinlan et al., 2001) addresses organizational processes and procedures that, while not directly related to AM, still influence the well-being of workers exposed to it. The model is not a socio-technical framework per se but instead addresses various organizational practices essential for effective Occupational Safety and Health (OSH) management, which is a key focus of our study. The PDR model provides a robust platform to examine not only the processes within an organization and its influence on psychosocial hazards, but also the industrial context in which the organization operates (Quinlan et al., 2001). In contrast, the Job Demands–Resources (JD-R) model (Demerouti et al., 2001), which has been used by others to understand how AM may influence occupational health (Lippert, Kirchner, & Saunders, 2023; Parent-Rocheleau & Parker, 2022), has been criticized for having a too narrow organizational focus and neglecting the industrial relations context (Dollard et al., 2019; Quinlan, 2023a). In this study, the PDR model, alongside the socio-technical frameworks of Vignola et al. (2023) and Parent-Rocheleau and Parker (2022), are used to understand how organization of work, and organizational practices impacts workers' safety and health in relation to AM in the two cases, while the PDR also provide a helpful lens to analyze potential differences between the cases considering the differing industrial contexts.

2.5. Study Context: AM in logistics in Sweden

In logistics, which spans multiple sectors, the culture, network of actors, economic conditions and the overall operational context can vary significantly (Gutelius & Theodore, 2019). A fast-growing segment is e-commerce, where direct deliveries to consumers demand agility and responsiveness to rapidly changing market conditions and high expectations for quick, accurate service (Gutelius & Theodore, 2019). E-commerce warehouses, driven by high volumes, labor-intensive operations, fierce competition, and slim profit margins, face significant pressure to optimize efficiency, which may be achieved by reorganizing work with technology that streamline production processes (Gutelius & Theodore, 2019). In contrast, traditional warehouses serving stable business networks with predictable demand can likely adopt technology more cautiously, allowing them to balance efficiency with stability and uphold stronger, institutionalized worker protections.

Swedish labor laws, particularly the Act on Co-Determination in Working Life (SFS, 1976:580), require that significant changes in work conditions or organizational practices be negotiated with unions. Swedish trade unions and employers' organizations hold significant influence over the working conditions and to some extent how work is organized through collective agreements (Anxo, 2021). The Employment Protections Act (SFS, 1982:80) imposes protective measures to ensure that decisions regarding terminations are justified, fair, and involve due consultation with unions and affected employees. Although union density in Sweden has been declining, it remains relatively high. In 2023, the union representing warehouse workers, CEU, had a union density of 52 %, while Transport Workers' Union (*Transportarbetarnas förbund,* TWU), had a union density of 57 % (Kjellberg, 2024). Systematic OSH management is legally mandated (Arbetsmiljöverket, 2001:1), and employers must routinely investigate, implement, and follow up on activities to address work environment issues, aiming to prevent ill-health and injuries. The law requires employers to involve employees and OSH representatives in these activities. OSH representatives address health and safety threats by alerting management or the labor inspectorate (Frick, 2014). As a member of the European Union, Sweden is also subject to EU regulation, including the EU Artificial Intelligence (AI) Act (EU, 2024). The AI Act establishes risk-based regulations, requiring stricter oversight for high-risk AI applications while promoting accountability, fairness, and human oversight in their deployment. During the EU negotiations, the Swedish government advocated for national flexibility in implementing these laws, emphasizing self-regulation through collective agreements rather than legislative measures (Ilsøe et al., 2024). However, because this study was carried out before that AI Act came into force, it did not affect the results.

3. Method

This multi-case study (Yin, 2018) uses cross-case synthesis, combining data from observations with semi-structured interviews. Case studies are well suited when we wish to understand the "how" and "why" concerning a complex phenomenon, such as organizational practices (Eisenhardt, 1989; Yin, 2018).Multi-case studies allow for investigating differences, similarities, and patterns of a certain phenomenon between cases (Kaarbo & Beasley, 1999; Yin, 2018). Inferring that the area lacked empirical research, an explorative and theory-refining approach (Kaarbo & Beasley, 1999) was taken.

3.1. Recruitment and case selection

Inclusion criteria in the recruitment process were non-platform companies in transport and warehousing in Sweden using AM systems to plan work, direct and monitor workers, and provide performance feedback. The recruitment process took place March – July 2022 and was mostly informed by media and a reference group to the project consisting of representatives from logistics companies as well as employers' and workers' organizations. Two companies accepted the invitation to participate. The cases in the study, one e-commerce company and one food-producer, used similar AM technology but diverged significantly in other aspects; one being a young e-commerce company with a fast pace, the other being an old, traditional food producer transitioning to AM about ten years ago, thus offering a compelling opportunity for comparisons (see Table 1 and 2 below).

3.2. Data collection

We mainly used two data sources: 1) observations of the facility and the work processes; and 2) interviews. We also read documentation describing the operations of the organizations deriving from their

Table 1
Basic facts about the two companies.

	Food producer	E-commerce company
Company type	Manufacturing industry	Online
Customer type	Grocery stores, schools, etc.	Individual persons
Establishment	100 + years ago	10 + years ago
Production sites in Sweden (N)	8	2
National/ international	International	National
Site location	City	Village
Site N of workers	550 (warehouse 300, drivers 250)	900 (warehouse)
Distribution by sex among workers	Male dominated	Even distribution

Table 2
Interviewee characteristics in the two cases.

	E-commerce company	Food producer		Total
		Transport	Warehouse	
Women	9	0	3	12
Men	8	8	6	22
Total	17	8	9	34
Position				
Worker	11	3	5	19
Middle management/line manager	3	1	1	5
Higher level management	3	0	1	4
Coordinator/technician	0	4	2	6
Tenure (years)				
Less than 1	2	0	1	3
1–3	6	0	1	7
4–9	9	5	1	15
10 years or longer	0	3	6	9

official websites. Together, these information sources were used to understand the characteristics of the cases (see Fig. 1). At both companies, contact persons organized guided tours of the premises with presentations on the AM technology and work processes, allowing us to make four visits to each site to observe how the workers applied the AM technology while also inspecting the facilities (Kaarbo & Beasley, 1999; Yin, 2018). From June 2022 to February 2023, 34 semi-structured interviews were conducted (Table 2), including questions about AM technology, known psychosocial and organizational risk factors inspired by the Copenhagen Psychosocial Questionnaire (COPSOQ) (Burr et al., 2019), and OSH management at the sites. The interviews were also informed by observations made during the visits. In the e-commerce company, the HR department assisted with the selection of higher-level managers. Workers, first-line managers, and OSH representatives were mainly recruited using a snowball sampling procedure. At the food producer, the warehouse manager and the transport manager sent out an email to employees at the site, informing them about the project and the possibility of being interviewed. All workers who showed an interest contacted an assigned colleague and were subsequently interviewed. To deepen our understanding of the AM technology, we also interviewed coordinators and technicians. Although only the food producer had in-house drivers for their operation, we decided to include both warehouse workers and drivers at this case as it gave a fuller and more complete picture of how the AM technology was used in the organization.

3.3. Research ethics

The study was approved by The Swedish Ethical Review Authority (2022-00169-01). Participants received details about the project, data storage procedures, and contact information for queries or data withdrawal. The interviewees signed consent forms. The two interviewing researchers made a conscious effort to maintain the anonymity of the interviewees but participants had to leave the floor to join the interview, thus risking that the participant identity would be revealed to coworkers and managers. We discussed this issue with our contact person but due to the intense work tempo and short breaks of the employees, the best available solution was to conduct the interviews in secluded rooms at both workplaces.

3.4. Analysis

Fig. 1 presents a flowchart outlining the five-step data collection and analysis process. Step one involved site visits to both warehouses, where researchers gathered field notes, photographs, and information, later compiled into interim research documents. These documents helped synthesize relevant insights and identify emerging patterns before cross-case synthesis (Eisenhardt, 1989). Step two included four follow-up visits, leading to revisions of the write-ups and further inquiry. Feedback from an HR manager, a line manager, and employees refined the analysis by incorporating multiple perspectives.

Step three focused on interview analysis, where audio-recorded

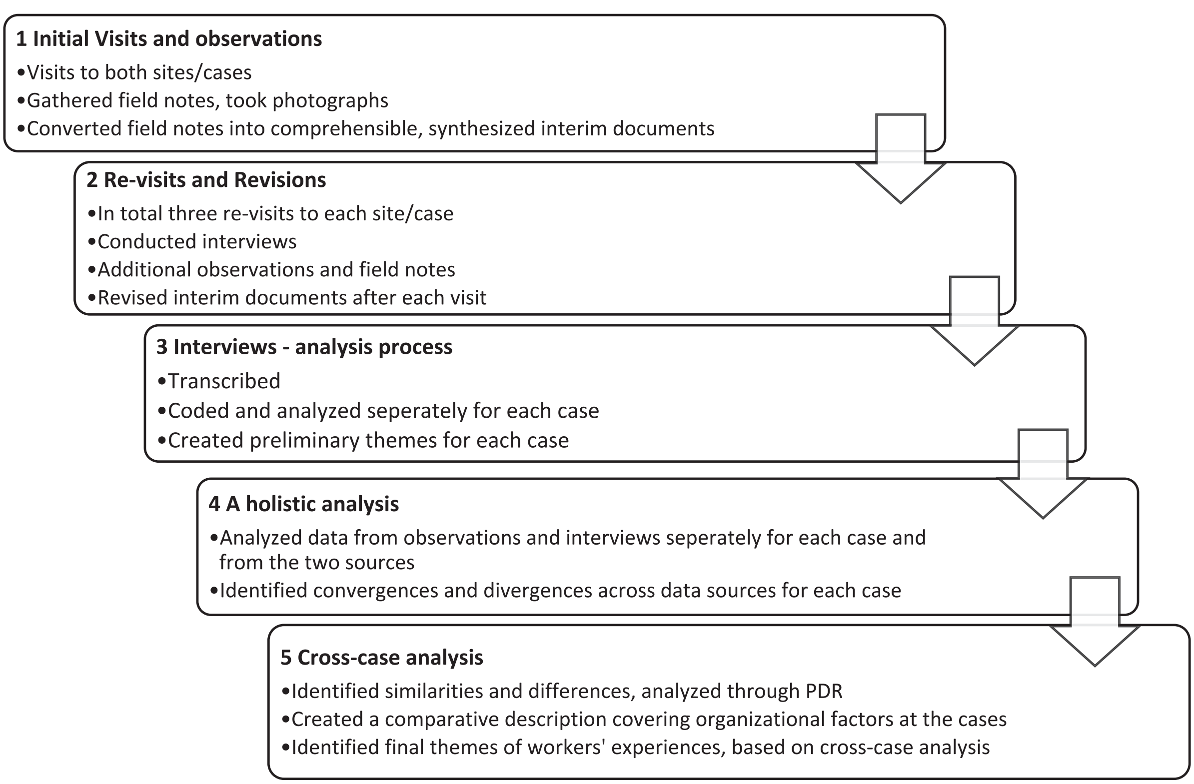

Fig. 1. Flowchart of the data collection and analysis process.

interviews were transcribed mostly in "intelligent verbatim" (McMullin, 2021) and analyzed using thematic analysis (Braun & Clarke, 2006). Each case was coded separately, and an iterative process led to code refinements and preliminary themes. Step four consisted of a holistic analysis, where observation and interview data were examined separately within each site (Yin, 2018). Interim research documents complemented the interview data, helping identify convergences and divergences across sources. Observations further contextualized workers' perceptions and organizational practices.

Step five was a cross-case analysis, identifying within-case similarities and between-case differences (Eisenhardt, 1989). The results were analyzed through the PDR model (Quinlan et al., 2001) to compare the implementation and development of AM, work organization, and OSH management across cases. This led to i) a comparative description of the two companies, presented in the first part of the results, and ii) the final themes of workers' experiences, detailed in the second part of the results section.

4. Results

The results section is divided into two parts. The first part (section 4.1) is a descriptive comparison of the two cases, specifically focusing on the AM technology used, the organization of work, and the OSH management. The second part (section 4.2) presents the themes derived from the interviews and observations.

4.1. Comparative descriptions of the two cases

4.1.1. Technology and IT assistance

The AM system used in the e-commerce company was built in-house, and technicians in a facility removed from the warehouse worked continuously on updates and developments. The food producer had purchased their system from an international tech company, and technicians were on site to help with problems. Although the two companies used similar AM technologies that direct, monitor and deliver feedback to the workers, three main differences were identified: 1. *Performance feedback*. While e-commerce workers were subjected to real-time task performance feedback by green and red lights appearing on their tablets, exposing them to unprompted feedback, workers at the food producer could request the feedback by logging into a central computer, thus, feedback was not delivered to them in real-time. The assessment of the workers' productivity was available to the managers in both cases; 2. *Productivity goals*. While these were set up through the AM system per task at the e-commerce case, they were set up for the whole day at the food producer case; 3. *Interaction mode*. While tablets (visual information about what to pick) and pick-to-light (picking items according to a green light present by an item) were used at the e-commerce company, pick-to-voice (where instructions are given through a voice in a headset) was used at the food producer. At the food producer, drivers used GPS for route planning and tracking, and an app to monitor driving behavior, including aggressive driving, sudden braking, and fuel consumption. See Table 3 for an overview of the AM technologies used in the two companies.

Table 3
Overview of AM technologies used in the two companies.

	Food producer	E-commerce company
Picking systems	Pick-2-voice	Pick-2-light, tablet, automated A-frame
Areas/stations	Trolleys, picking, forklift unloading	Picking with tablets and trolleys, pick-2-light, A-frame, packing, unloading to trucks
Created in-house/ bought	Bought	Created in-house
Direction of pace	Yes	Yes
Direction of route	Yes	Yes
Feedback to worker	Yes, but only if requested	Yes
System reprimands/ rewards	No	Yes, red light if worker is lagging, green otherwise.
Performance rating available to manager	Yes	Yes
Productivity measurement	Per day	Per task/pick

4.1.2. Work organization

The two cases had a similar flow of goods arriving and departing from the warehouse. There were, however, many differences in how this was organized. The food producer had three deadlines a day when company-owned trucks left the warehouse with the goods, compared to 31 deadlines a day at the e-commerce company, with trucks owned by external companies leaving the warehouse. At the e-commerce, a visual board showing the status of the deadlines and information about individual workers' tasks and performances was available to senior management, enabling them to follow the production in real-time, remotely. The senior managers could override decisions made by the system instantaneously by shutting down functions in the system and redirecting workers to different tasks.

There were also differences in the companies' approaches to implementing new technology. In the e-commerce company, changes were swiftly introduced without prior notification to workers or trade unions. Conversely, at the food producer, new features were communicated to workers and unions well in advance, who were involved throughout the process, and workers were encouraged to provide feedback on system features.

Training procedures differed between the cases. At the food producer, new warehouse employees underwent a comprehensive five-day introductory training course, which included familiarization with the pick-2-voice system and warehouse processes. Each employee was assigned a mentor for guidance, and on-site technicians were available for support. Training for new employees at the e-commerce company was less structured and lasted only 1–2 days. See Table 4 for a brief overview of work organization and safety and health aspects in the two companies.

4.1.3. Occupational safety and health management

Managers from both cases reported that they had an OSH management system in place, but there were significant differences in how the system was handled. At the time of our visit to the e-commerce company, the site had 11 OSH representatives in total, with safety committee meetings every third month. However, the work related to OSH management was not apparent to all groups and individuals. Most of the e-commerce company worker interviewees were unaware of any measures taken by the management to investigate the work environment or to rectify issues, and many workplace meetings were routinely canceled due to production pressure.

At the food producer, OSH management was considerably more systematic and well-integrated. Workers had regular individual check-ins with the managers to discuss work, productivity, and well-being,

Table 4
Overview of how work was organized, and safety and health aspects in the two companies.

	Food producer	E-commerce company
Shifts	3, open 24/7	3, open 24/7
Deadlines per day	3 (own trucks leave)	31 (external trucks leave)
Physical work strain	Lifting, bending, cold warehouse (+5C/+41F)	Repetitive, bending and turning, lifting above shoulders
OSH representatives	Yes	Yes
OSH management	Well-integrated	Limited

including looking at the data collected by the system. The OSH representatives also met regularly with the management. Managers continuously investigated workers' perceptions of the work environment through questionnaires and meetings. Risks to the work environment were assessed and rectified promptly, according to the interviewed workers.

4.2. Experiences of AM in the two cases

The thematic analysis of data gathered through interviews and observations resulted in four themes. Table 5 below provides an overview of the themes, the organizational practices and worker perceptions identified in the two companies that together make up the themes. Columns three and five illustrate how these practices and perceptions relate to the three factors of the PDR model: Pressure, Disorganization, and Regulatory Failure. Arrows indicate whether each organizational practice or worker perception likely intensified (arrow up) the disruptive factor, suggesting a less favorable situation, or mitigated (arrow down) it, suggesting a more favorable outcome.

The first theme; **Digital Taylorism** describes risks of work intensification, the alienation of the workforce and feelings of precariousness, while AM also created experiences of inclusion at the workplace. At the e-commerce company, we found factors related to both pressure and regulatory failure within this theme pertaining to production pressure, automated feedback and job insecurity. Workers from both cases described that they felt that their experience and knowledge were no longer valued, and that AM took over the cognitive aspects of the work (such as planning the work process), leaving only the task execution to workers. In addition, many described how the work was monotonous and strenuous, offering little control over the work process. Some who had been working at the sites before AM was introduced or became as comprehensive expressed sadness about no longer exerting control over the finished product, and only being presented with one task at a time. A restricted view of the work process and standardizing properties of AM were grievances of workers at both sites that reportedly caused the workers to feel less connected to their work.

As described in 4.1, the two companies had different productivity time frames, with a higher pace and production pressure in the e-commerce than in the food producer company. Additionally, the reward system embedded within the feedback provided to e-commerce workers is comparable to piecework, driving work intensification through pressure to hit productivity targets (Quinlan et al., 2001). The deadlines and task performance feedback provided by technology were perceived by many as intrusive and stressful at the e-commerce company. Despite their permanent employment status, many feared that their productivity metrics could influence their job security. The automatic shutdown of the tablets after 10 min of inactivity made a brief bathroom break a risk. The following quote illustrates this psychological strain in the e-commerce company warehouse:

"Well, there is a lot of stress… when you pick, you have a green light… it should be green and if it's not green, you get a scolding from the managers. And if you walk at a normal pace, it turns red, so it is forcing you to run." – Worker e-commerce company.

At the food producer, feedback from the system could be a source of worry for some. However, as they only accessed the feedback voluntarily, by logging on to a computer or during the check-in with their manager, this was not aired as an overall issue or particularly distressing.

An aspect with perceived positive and negative consequences at the e-commerce company was how the standardization of AM acted as an equalizer by enabling new employees to get swiftly introduced to the work. According to the interviewees, this lowered the bar for hiring personnel, such as people with limited knowledge of the Swedish language. However, the bar for letting workers go was also lowered, enabling managers to quickly replace them since not much training or introduction was needed. This replaceability was reported as a source of worry among several interviewees at the e-commerce company, and swift introductions of new semi-automated or automated technology led some workers at the e-commerce company to worry about being pushed out by the next technological advancement, indicating perceived labor market vulnerability and job insecurity (Underhill & Quinlan, 2011). Although the Employment Protection Act (SFS, 1982:80) prohibits termination without due process, the regulatory failure of the e-commerce company likely resulted in poor knowledge among workers of their legal rights.

A worker in the e-commerce company illustrates this job insecurity:

> "Every time a new machine is introduced, you think, like 'this one will replace me'." – Worker at e-commerce company

The second theme, **Technological Opacity: Insight and Involvement** describes how a lack of transparency of the technology and limited worker influence pose a threat to workers' sense of control and well-being. Restricted information and restricted access to data is indicative of disorganization, but also regulatory failure. Issues with technological opaqueness emerged more frequently in the interviews at the e-commerce company than in the food producer, and there were

Table 5
Organizational practices and worker perceptions in relation to the PDR model.

Themes	E-commerce company	Impact on PDR	Food company	Impact on PDR
Digital Taylorism	Performance feedback continuously	Pressure ↑	Performance feedback per day	Pressure ↓
	Low awareness of legal rights among workers	Regulatory failure ↑	Worker knowledge of rights, strong union presence	Regulatory failure ↓ Pressure ↓
	Fear of losing job	Pressure ↑		
Technological opacity	Lack of transparency regarding data and functioning of system for workers	Disorganization ↑	Access to data for workers, transparency regarding functioning of system	Disorganization ↓
	Lack of worker/union involvement	Disorganization ↑Regulatory failure ↑	Worker involvement regarding technology	Disorganization ↓
	Poor induction	Disorganization ↑	Thorough induction	Disorganization ↓
	Ineffective communication between management and workers	Disorganization ↑	Well-functioning platforms for communication between worker and management	Disorganization ↓
	Ineffective OSH management	Disorganization ↑ Regulatory failure ↑	Functioning OSH management	Disorganization ↓ Regulatory failure ↓
Algorithmic blind spots	Work disruptions	Disorganization ↑	Occasional work disruptions due to failing Wi-Fi	Disorganization ↑
	Impossible deadlines	Pressure ↑		
	Ordered overtime	Pressure ↑		
Human in the loop	Continuous surveillance through technology	Regulatory failure ↑	Adherence to regulations regarding surveillance/worker integrity	Regulatory failure ↓
	Non-routinized communication between worker and manager	Disorganization ↑	Regular worker-manager check-ins and workplace meetings	Disorganization ↓

discrepancies between how workers believed the system worked. Workers with a positive view of the system believed it was very advanced and included all parameters affecting productivity in the calculations. This could lead to experiences of frustration and anxiety if they did not keep to the stipulated time limit. Workers with a more sceptical (and sometimes realistic) perception of which parameters were included in the algorithm, could more easily ignore the negative feedback. The following quote about "red numbers" (reprimanding feedback) illustrates the mismatch between perceived productivity and feedback from the system, resulting in confusion and frustration:

> "I found it very stressful at the beginning [of my employment].– I saw that…'Shit, now I've got red numbers, I'm lagging two minutes'. Back then I did not understand why. I had done what I was supposed to, how could I end up with red numbers?" – Worker at e-commerce company

Many e-commerce company workers expressed concern about their lack of involvement in decisions related to new technology and the - absence of forums where they could share concerns or seek clarification on technological matters. The lack of basic understanding and involvement of the workers concerning the technology in the e-commerce company aligns with the construct of workplace disorganization of the PDR model, which poses that poor introduction of workers and ineffective communication are key factors of understanding how organization of work may contribute to occupational ill-health. This experience of disinvolvement was further fuelled by new features being introduced to the system, sometimes resulting in unforeseen production stops. Without warning, workers became aware of them when the work came to a sudden halt. Figuring out what the system needed to start up again could halt production for long stretches of time, which caused frustration. This points to regulatory failure in the e-commerce company, as the Act on Co-Determination in Working Life (SFS, 1976:580) posits that workers should be informed and involved in changes to their work. In the following quote, one of the OSH representatives at the e-commerce company describes how the company continuously underestimated the impact these changes had on the workflow:

> "New functions are introduced, for which our employer has not done any risk analysis. They say that it is not needed 'because it is just a small thing in the system'. Yes, but it affects so much… " – Worker at e-commerce company

Workers' inability to raise issues with the technology and the fractured OSH management described by workers and safety representatives may be attributed to both disorganization and regulatory failure. A well-functioning OSH management system relies on effective communication within the organization and clearly defined roles and responsibilities for identifying, assessing, addressing, and following up on workplace risk factors. The e-commerce company's lack of this clarity, however, contributes to disorganization. While the lack of opportunities for workers to report problems indicates regulatory failure of the company (Quinlan & Bohle, 2009; Quinlan et al., 2001).

At the food producer, transparency (or lack thereof) of the system was not aired as an issue and there was no apparent confusion or discrepancy between workers surrounding what was being measured, or what variables went into the calculations.

The third theme, **Algorithmic Blind Spots: Navigating the Limitations of Automated Management Systems,** describes how perceptions of shortcomings of AM systems hinder and disrupt the work of employees dependent on the technology to do their jobs; factors pertaining to both pressure and disorganization. In both companies, algorithms calculated the work process by relying on data from previous production volumes to distribute tasks with various deadlines in mind. However, workers at both sites described how some variables were not considered in these calculations, sometimes resulting in workers having to run or work at a fast pace with the prospect of hitting an impossible deadline. In the case of the e-commerce company, however, this may not be a result of limitations of the system, but by design, as their customer value proposition promises deliveries within 24 h to keep its competitiveness. This creates production pressure for the workers, resulting in work intensification and feelings of hopelessness, as portrayed in this following quote from a worker in the e-commerce company:

> "Every time someone places an order, and we say, 'we will send it today', we must do that. It does not always match reality or our capacity… we can see already in the morning that there is no chance we are going to finish all this stuff. Because the parameters'how much time we have' or 'how many we are', or 'how many hours we have' – those parameters do not exist." – Worker at e-commerce company

One missing variable at the e-commerce company was the number of workers present on a particular day. Another missing variable from both sites was the number of items to be picked: the time allocated was the same for picking one box of paper tissues as for picking 20 boxes. Furthermore, the system at neither site considered stops in production, thus creating a situation where work risked piling up. All these factors would contribute to an increase in workload, as the system did not reconfigure the deadline or timeframe to take these factors into account.

Work disruptions were another source of frustration. E-commerce company workers described standstills in the process when the system locked certain tasks and directed the worker to another task that the system deemed prioritized. However, sometimes, this task was dependent on the locked task, thus creating a Catch-22 scenario that could cause standstills for extended periods of time. This caused frustration for workers who were restricted from working and sometimes ordered to work overtime to make up for lost productivity. This too could indicate pressure, as working long and irregular hours is one of the factors of the pressure dimension of the PDR model. The work disruptions of the e-commerce company could also be caused by the disorganization of the establishment, as some of these standstills were intentional, but not communicated to the workers, thus causing confusion and frustration for the workers.

Some workers at the food producer described the shortcomings of the system as a lack of "common sense". The system would direct the workers to stack soft and fragile products at the base of the trolley and heavier packages on top, resulting in poorly stacked trolleys. Consequently, workers had to repack the trolley manually afterwards, as they were unable to "opt-out" of the system to pack it a stable way in the first place.

In both companies, the algorithms ignored tasks that workers considered essential to keep the operation afloat, such as cleaning the aisles of empty cartons or helping a colleague. But, because these tasks go unnoticed by the system, performing them hurt the performance rating of the worker. One person from the e-commerce company reported being questioned by the manager when allocating time for these tasks, as the person appeared to be inactive in the system during the duration of the task.

The fourth theme, **Human in the Loop: The Dual Impact of Managerial Involvement** illustrates how the involvement of managers can have positive and negative ramifications on workers' perceptions of the technology. Our findings in this theme point to both regulatory failure and disorganization, related to a disregard for worker protection and poor supervision. In the e-commerce company, several workers described how data monitoring had become a tool for real-time surveillance and micromanagement used by higher-level management – something that was absent in the food producer interviews. A high-level manager, who exercised total control of the production line through the technology, was even able to stop sections of production remotely. This created the illusion of an omnipresent manager who was always watching, leading to fear of reprisals among workers and first-line managers with detrimental effects on their trust in the organization and higher-level managers. The intrusive managerial involvement enabled by AM in this case can be understood as a regulatory failure of the PDR model, as continuous real time surveillance for the purpose of monitoring employees could violate the European Convention of Human Rights (1988). The following quote illustrates the perceived lack of trust:

> "If we miss a deadline a text message will come 'What's up?' If someone takes five minutes to clean up (…) then there's a text; 'Why don't you pack?' So, that can be… quite stressful." – Group leader at e-commerce company

The quantification of productivity was another aspect of AM where the human in the loop could play a pivotal role in workers' perception of the technology. Workers at the food producer seemed quite unaffected by the quantitative data collection and trusted the managers to add a qualitative dimension during face-to-face check-ins. At the e-commerce company, the lack of individual meetings suggested poor supervision, a marker of disorganization according to the PDR model. In their interviews, several workers expressed distress about their efforts being reduced to a number and reported little faith in the human manager to keep the context in mind when evaluating their productivity, as they reported few or no individual check-ins with their manager. This, in combination with a lack of feedback on their productivity and access to their data, opened for paranoia and conspiracy theories among workers surrounding the usage of the data, such as performance data being used to punish workers by shifting them to another workstation:

> "Sometimes, for example, you're at a station, and then if things go badly that day, you get moved to another station [the next day] as a kind of punishment." – Worker at e-commerce company

5. Discussion

This study aimed to deepen our understanding of AM's impact on work and occupational health within non-platform workplaces. Drawing on the socio-technical lens and the PDR model, we sought to explore how varied organizational contexts shape this interaction, focusing on the organizational practices that influence how AM affects employees' work experiences and health.

Our comparative case study resulted in four themes: 1. *Digital Taylorism*; 2. *Technological Opacity: Insight and Involvement*; 3. *Algorithmic Blind Spots: Navigating the Limitations of Automated Management Systems*; and 4. *Human in the Loop: The Dual Impact of Managerial Involvement*.

The experiences captured in these themes confirm previous research, where aspects of work intensification, monitoring, standardization of work, system opaqueness, and the incontestable nature of management are believed to negatively affect the job quality and well-being of the workers in a string of different sectors (Baiocco et al., 2022; Christenko et al., 2022; Fernández-Macías et al., 2023; Howard, 2022; Jarrahi et al., 2021; Kellogg et al., 2019; Vignola et al., 2023). These adverse experiences were more prominent among workers at the e-commerce company, who described an overwhelming workload and problematic work environment, which is known to jeopardize physical and mental health (Badarin et al., 2021; Harvey et al., 2017; Nahrgang et al., 2011; van der Molen et al., 2020).

In addition to psychosocial and physical work environment problems, workers of the e-commerce company also emphasized that AM played a significant role in their perceived job insecurity. On the one hand, the equalizing properties of AM, described by workers at the e-commerce company, held some positive effects on the inclusion of an ethnically diverse workforce in the workplace. Moreover, a significant proportion of women were employed at the site, which is a departure from the traditionally male-dominated workforce typically found in warehouses (SCB, 2022). AM was thus seen as some sort of "great equalizer" where everyone was given a chance, regardless of their background and sex; a phenomenon also witnessed and described by Zanoni and Miszczyński (2023) in their study about workers managed by AM in a warehouse in Poland. On the other hand, AM also introduced job insecurity for many of the workers, as the lowered threshold for hiring people also lowered the threshold for laying them off. Zanoni and Miszczyński (2023) refer to this phenomenon as 'post diversity' governmentality. They argue that AM and other forms of novel management practices contribute to a shift from a segregated workforce, in which groups and individual workers are marginalized if they do not fit the norm of the "ideal worker", to an interchangeable workforce of precarious workers in which all are equally disposable.

5.1. Comparison between the cases

The standardizing properties of the AM system negatively affected both the autonomy and task significance of workers at both sites. However, AM drove work intensification at the e-commerce company to a higher degree than at the food producer. This can be attributed to differing organizational practices of the companies, such as the technology of the e-commerce company providing tighter deadlines and continuous feedback, while the technology at the food producer gave deadlines per day and feedback only when prompted. We also propose that human involvement in monitoring and technology-enabled micromanagement exacerbate the potentially harmful effect of AM, which caused work intensification and strain for the e-commerce company workers.

Workers at the e-commerce company provided disparate descriptions of the AM technology's functionality, underscoring their limited understanding of the system. This lack of clarity often led to anxiety and frustration, especially when their perceived productivity did not align with the system's feedback, a feeling that intensified with the sudden introduction of new features. The two companies differed markedly in how they involved workers in understanding the technology. At the e-commerce company, recurring themes included limited organizational transparency, rapid changes without communication, brief onboarding, few channels for discussing the technology, and insufficient information about data usage—contributing to a disconnect between workers and the technology. Conversely, the food producer regularly consulted with unions and workers on system functionality, encouraged feedback through meetings and surveys, and provided onsite technical support. Workers received regular check-ins, and access to their own data, and new hires received comprehensive introductions, thus fostering familiarity with the technology.

Workers at both sites reported that system shortcomings sometimes disrupted their work and increased their workload. However, these issues were more pronounced in the e-commerce company, where workers regularly faced impossible deadlines and prolonged production standstills due to intentional or unintentional production stops. At the food producer, regular check-ins with managers and consistent communication about both technology and the work environment seemed to mitigate these disruptions. In contrast, e-commerce workers were often unprepared for production stops, as system updates were rarely communicated in advance.

Management's involvement in work processes through technology, particularly through real-time surveillance and monitoring, was perceived as distressing by workers at the e-commerce company. Many interviewees described feelings of being constantly scrutinized by managers who could intervene in the production process through technology, resulting in a work environment that was both psychologically and physically strenuous, while workers at the food producer did not report similar practices. Interviewed workers at the food producer reported to value human involvement, not for real-time monitoring, but when analyzing and evaluating their performance data together with the worker, as this offered an opportunity to provide context to their numerical data.

5.2. PDR and the context

We propose that the disparities in worker experiences between the two cases can be attributed to both their organizational practices and operational contexts. Through the lens of the PDR model, we underscore that pressure, disorganization, and regulatory failure at the e-commerce company likely influenced how AM was utilized and how the workers perceived their work and occupational health. Some PDR factors were likely exacerbated by the utilization of AM, while others were more likely an effect of the AM system. We found that the e-commerce company implemented a more stringent and volatile AM system than the food producer, which led to production pressure and strenuous work while simultaneously compromising worker participation, communication, and adherence to regulations. This further resulted in a largely uninformed and inexperienced workforce, with an inability to report workplace issues and organize to demand a better work environment. Our findings suggest that to fully understand how AM influences occupational health, we need to consider a broader range of factors beyond just work design. The PDR model offers a comprehensive lens for analyzing the effects of AM on occupational health, extending beyond factors tied solely to the technology's implementation and use.

Pressure: The economic challenges faced by the e-commerce sector—characterized by unpredictable demand, labor-intensive operations, high operational costs, and narrow profit margins—drive companies to implement labor augmentation systems that shift these pressures onto their workforce (Gutelius & Pinto, 2023; Gutelius & Theodore, 2019). Thus, the economic pressure of the enterprise can be seen as the cause of implementing AM. Although the workers at the sites did not face the same economic pressure as temporary agency workers or precarious workers described in the PDR model, the cost pressure of the enterprise and the threat of further automation (Quinlan, 2023b) resulted in similar work intensification and job insecurity at the e-commerce company, as workers worried their performance metrics could influence their employment status. This pressure is comparable to reward pressure in piecework, driving workers to constantly keep up with the system's demands (Quinlan et al., 2001).

Disorganization at the e-commerce company was evident through the lack of worker involvement, ineffective communication, lack of supervision and absence of managerial feedback. Workers reported receiving minimal introduction to new technologies, restricted access to information about the system, and limited avenues to voice concerns. This contributed to a poor understanding and limited influence over the AM technology, likely leaving workers feeling disconnected from their work. Without a sense of ownership or agency, they became passive participants, focused solely on task execution with little understanding of the broader context of their work. The access to, or restriction of, knowledge could also have implications beyond the individual worker's sense of coherence and control and impact worker and union influence on a broad scale. Kellogg et al. (2019) argue that the restriction of workers' insights into the workings of the technology restricts their possibilities to challenge technology-made decisions, thus eroding Swedish workers' right to co-determination at the workplace regulated by law (SFS, 1976:580). The disorganization factor of the PDR model makes a similar argument, stating that ineffective communication and inadequate worker induction hinder employees' ability to organize (Bohle et al., 2015) as well as hindering an effective OSH management (Quinlan et al., 2001). The shorter tenure and higher staff turnover in the e-commerce company could also be indicative of disorganization, as companies with a high degree of disorganization typically show little commitment to maintaining a stable workforce (Underhill & Quinlan, 2011).

Regulatory failure: The lack of worker involvement in decision-making and technology implementation, combined with poor OSH management, indicated a failure to adhere to legal frameworks like the Act on Co-Determination in Working Life (SFS, 1976:580). Workers at the e-commerce company described a lack of risk analysis for new system features, creating disruptions in production and increasing stress. The real-time surveillance and micromanagement enabled by AM also represented a regulatory failure, as it violated workers' privacy and contributed to a pervasive sense of being constantly monitored, eroding trust in management. In contrast, the food producer faced more stable workflows and operates in a less competitive market, reducing the need to intensify work through AM. The food producer had internalized labor regulations and fostered a stronger union presence, thereby significantly influencing how AM is utilized and received by workers. These institutional protections likely contributed to a more balanced, worker-friendly technology integration, promoting worker voice and occupational health, compared to the more pressured e-commerce sector.

Although Sweden has a stable and robust legislation regarding workers' rights and work environment, through the Work Environment act (SFS, 1977:1160), the Act on Co-Determination in Working Life (SFS, 1976:580) and through the mandatory systematic OSH management (Arbetsmiljöverket, 2001:1), the introduction of the fast paced, highly pressured e-commerce sector in Sweden seems to challenge those protections, and it is unclear how the legislation will withstand this expanding newcomer. The EU AI Act was not in effect during the data collection for this study, and its impact on the regulation of AM remains uncertain. It is thus yet to be seen how the legislation will influence the safety, transparency, and accountability of AI-driven systems and whether AM will be classified as a high-risk application under the Act.

5.3. Proposed organizational practices for a worker-friendly utilization of AM

In the cross-case analysis, several favorable organizational practices emerged that could contribute to shaping worker experiences with AM. One of them is worker involvement. Our results illustrate how transparency—achieved through regular consultation, feedback channels, and data access—helps create a sense of control and acceptance among workers, even without detailed technical knowledge. For example, food producer employees gained insights into their own productivity data via manager check-ins, achieving a level of both organizational and technological transparency. According to Backhaus (2019), even such relatively small interactions with the technology can foster a sense of control and facilitate acceptance of digital monitoring. This aligns with the framework by Parent-Rocheleau and Parker (2022), which suggests transparency as a critical job resource to shield AM workers from psychological strain. The food producer workers did not have full insight into system intricacies but received structured onboarding, feedback opportunities, and functioning involvement practices, which seemed to foster more positive AM experiences compared to the e-commerce company. This finding aligns with previous research by Saghafian et al. (2025), who claim that transparency is not just visibility regarding automated processes, but stresses the importance of understandability.

Another potentially important identified organizational practice is the role of human supervision within the AM framework, which the literature often terms "human in the loop." This approach emphasizes human presence in algorithmic operations to foster trust and balance decision-making (Aoki, 2021; Grønsund & Aanestad, 2020). While fully automated management might seem dystopian, workers may find it preferable to the partial automation of AM, where managers can remotely intervene in real-time, as experienced by e-commerce employees. Our findings emphasize that balancing algorithmic tracking with substantive human oversight is essential. Continuous remote surveillance and interventions by managers have a unique potential to increase stress, whereas research suggests that algorithmic-only tracking might feel less judgmental, preserving a sense of autonomy for workers (Raveendhran & Fast, 2021). However, human involvement in analyzing and contextualizing performance data seems to add value by providing a holistic view, which workers at the food producers perceived as fairer and more comprehensive. This is consistent with Newman et al. (2020) and Lee (2018), who argue that algorithmic evaluations alone may feel reductionistic and less trustworthy, as qualitative nuances are often overlooked. Newman et al. (2020) suggest that "people will resist algorithmic evaluations and, instead, have a deep need for qualitative considerations and holistic contextualization of their performance." Therefore, regular check-ins at the food producer likely contributed to a more positive perception of AM among workers.

A third organizational practice identified in this study is the implementation of well-functioning and integrated OSH management, adapted to address the specific challenges introduced or exacerbated by the technology. This aligns with the findings of Gholamizadeh et al. (2025) who emphasize the importance of customized approaches to OSH in complex socio-technical systems. At the food producer, negative effects from a worker vantage point were addressed by having a close dialogue with the workers about their experiences and grievances regarding the technology and otherwise. This resembles the "adaptive hazard managers" described in the background (Gallagher et al., 1998), enabling system adjustments rather than forcing changes in worker behaviors and practices to accommodate the technology.

A fourth identified organizational practice is type and features of used technology. Providing workers with options as to when to receive feedback, as witnessed at the food producer, could represent a form of worker control over the system and an ability to "opt out", which according to Parent-Rocheleau and Parker (2022) is a key resource for workers under AM. Governing productivity per day, as opposed to continuously at the ecommerce company, likely offered more autonomy for the workers at the food producer as they had the flexibility to adjust their pace throughout the day, allowing them to work more or less intensely as needed without it affecting their overall productivity.

In conclusion, the disparate testimonies from the two cases regarding how workers perceived both work itself and its impact on their psychological strain, along with the disparate organizational practices, indicate that companies implementing AM can work proactively to mitigate potential occupational health risks.

5.4. Methodological considerations and future research

As the study is limited to two companies and exploratory in nature, we do not claim that our results are generalizable. It nevertheless expands the understanding of an underexamined phenomenon, especially in relation to organizational practices and the operational context, where the business model of the enterprise may have substantial effects on how the technology is implemented, utilized, and developed.

Holding interviews at the workplace may have influenced the willingness of workers to participate and to disclose unfavorable aspects of their work, out of fear of reprimands. However, we believe that the access we gained to the facilities is quite unique, and workers provided many insights into work under AM. Our impression was that the workers spoke quite freely and uninhibited, as many raised issues, concerns, and criticisms at both sites.

We included interviews with in-house drivers from one of the cases despite the lack of a direct comparison between the two sites, as their perspectives provided a fuller and more in-depth understanding of how AM was used and experienced across different roles within the organization.

While we believe that our study adds valuable insights regarding occupational health under AM, the association between AM and health outcomes remains understudied, with a glaring gap in quantitative, empirical research. There is also a need for quantitative studies that investigate if the organizational practices described here and elsewhere (Parent-Rocheleau & Parker, 2022; Vignola et al., 2023) have the potential to moderate such associations.

6. Main contributions

We claim that this paper makes three contributions to existing knowledge. First, it adds empirical evidence to the understanding of how AM affects job quality and occupational health in non-platform work. We were able to get detailed insights into the workings of two companies, allowing us to investigate and compare the experiences of workers and organizational practices of an e-commerce company and a traditional company, thereby advancing the understanding of, and providing new insights into the risks of AM to occupational health in different contexts, while also providing actionable insights about important organizational practices in this interaction. By using the PDR model to analyze the differences between the companies, we extended the application of the model to economic pressures beyond the individual, and the enterprise, partly conceptualizing "Pressure" as the economic strain of the e-commerce industry. And presented how this pressure trickles down onto individual workers through work intensification and fear of job loss. Second, we suggest that our findings can inspire ongoing and future research on the effects of AM in non-platform work. The suggested organizational practices and the potential risk factors influenced by AM could furthermore support the development of surveys and other initiatives to quantitatively capture the effects of AM on workers' health in non-platform work. Third, our findings suggest that AM is not deterministically detrimental to job quality and workers' health. Instead, our findings demonstrate the importance of seeing AM as socio-technical and a fundamental organizational change with potential risks to workers' safety and health, which needs to be introduced and developed in cooperation with workers and unions.

7. Conclusion

This cross-case comparison of companies, although we cannot draw any conclusions regarding moderating effects, suggests that AM is not deterministically harmful to workers' health; the risk factors potentially associated with AM are instead likely influenced by organizational practices. Conversely, the introduction of AM may also shape existing OSH practices and worker involvement, potentially altering how occupational risks are managed and experienced. In both companies, AM seemed to cause deterioration of certain aspects of job quality, such as task significance and autonomy, related to the inherent standardization of work under AM. However, negative experiences were more salient in the e-commerce case, with workers describing an overall strenuous work situation, with anxiety inducing surveillance. We suggest that these differences can be explained by the economic pressure, workplace disorganization and regulatory failure of the e-commerce company. Although workers at the sites were not precarious per se, we suggest that the economic pressure of the enterprise, the standardizing properties of AM, and the reward system embedded in the AM technology at the e-commerce led to perceived job insecurity and pushed work intensification at the site. Based on our results, we propose that the involvement of workers and systematic OSH management are important organizational practices with the potential to mitigate potentially harmful effects of AM on workers' health and wellbeing. We also propose that AM applications allowing for increased worker control, along with managerial practices that incorporate qualitative insights into the otherwise purely quantitative assessments generated by AM, could play a crucial role in this interplay. Our research underscores the importance of a thoughtful implementation of AM, advocating strategies that prioritize employee well-being alongside operational efficiency.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the first author used ChatGPT to improve readability and clarity, it was only used for smaller revisions of paragraphs and sentences. After using this tool, the author reviewed and edited the content thoroughly and takes full responsibility for the content of the publication.

CRediT authorship contribution statement

Karin Hennum Nilsson: Writing – review & editing, Writing – original draft, Investigation, Formal analysis, Data curation, Conceptualization. **Nuria Matilla-Santander:** Writing – review & editing, Conceptualization. **Min Kyung Lee:** Writing – review & editing,

Validation, Methodology. **Emma Brulin:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Theo Bodin:** Writing – review & editing, Supervision, Conceptualization. **Carin Håkansta:** Writing – review & editing, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

Data will be made available on request.

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