ALGORITHMIC MANAGEMENT: EXPERIENCES AND RESPONSES

EXPLORATIVE STUDY OF COMPANIES AND TRADE UNIONS IN THE SWEDISH WAREHOUSING, RETAIL AND TRANSPORT INDUSTRIES

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The aim of this study was to explore the use of algorithmic management (AM) in companies with standard employment (not platform workers) in the retail, warehousing and transport sectors in Sweden, with a specific focus on how algorithmic technologies affect work and workers' rights; the response of workers to issues linked to AM; and the implications of our findings for trade unions, solidarity and policy.

Four persons from the Karolinska Institutet and Stockholm University conducted semi-structured interviews with 21 informants in March-May 2024, including five full-time trade union employees and 16 workers/trade union representatives at various workplaces. An abductive approach was applied based on the research questions of the project.

We found that the effects of digital technologies and AM entailed both improvements and degradations in work. Whether working conditions and workers' rights were affected positively or negatively, or remained unaffected, by digitalisation depended upon the type, nature and function of specific systems, as well as the implementation process and the interplay between technology and contextual factors such as position within a subcontracting chain, existence and engagement of union and occupational safety and health (OSH) representatives, practices for systematic OSH management, and employment conditions. Our findings support earlier research showing how AM, depending on how it is deployed, can either enable or control workers. In our study, algorithmic instructions were found to serve as facilitating tools that enhanced workers' capabilities, but they could also deprive workers of their skills and autonomy if used pervasively. Similarly, digital monitoring could be perceived as legitimate or improving safety, but also infringing on individual integrity.

As for the response of workers to AM-related issues, there were notable differences between the three sectors. Warehouse workers testified of low levels of power of the local union club over the labour process and negative consequences, such as unsustainable workloads, arbitrary structures of discipline, and conflicts between the workers and management but also internally on the floor. In the transport sector, the primary response of the workers at the time of the study was resignation. This was associated mainly with the context of subcontracting, where AM systems were not owned nor controlled by the employer. Individual-level workarounds were primarily available for the more experienced and less vulnerable employees. Both union and safety representatives were active in raising AM-related concerns, with a focus on data privacy. In the retail sector, there was a lack of worker response when systems were perceived as enabling tools. In reaction to negative aspects, union and/or OSH representatives played a critical role by getting involved, raising concerns about specific features and practices, and advocating employers to take more active measures, for example, performing risk assessments. Workers with insecure employment contracts were more reluctant to act, fearing they would not be granted well-needed extra shifts or other benefits.

These results suggest that, although the trade unions in Sweden have a history of being favourable to new technology and have the same approach today, AM presents new challenges for safeguarding workers' rights and good-quality jobs. Firstly, AM practices support individualisation and potential isolation of workers, going against the idea of cohesion and solidarity between union members. Secondly, the implications of AM on deskilling can be detrimental to workers' professional identity and joy at work. In times when trade union membership levels are declining (albeit from a high level in Sweden), the risks for fragmentation, individualisation, deskilling

and decline in professional identity are problematic for a unified worker voice. Thirdly, in the context of automating the labour process, AM is threatening the very existence of many jobs, setting up a conflict between techno-positivism and the goal of high employment levels. Finally, by facilitating the extension of the reach of one employer and enabling third parties, such as customers, to control the labour process, digital technologies and AM challenge the existing regulatory frameworks of co-determination and OSH. These risks in the context of the Swedish model of labour relations, where unions are traditionally reticent to legislation, including EU law, do call for the strengthening of existing strategies to support local union organisations and workers. The Swedish unions are already active in fact-finding exercises to learn about AM practices and effects among their members, with the development of guidance materials to support local unions and members in the process. Importantly, however, the results from this study illustrate that more structural measures may be needed, and though AM is still in the initial phase, in terms of its potential hold over the labour process, it is expanding rapidly, and therefore, action to ensure its balanced application is needed now.

1 INTRODUCTION

1 INTRODUCTION

This study was commissioned by the Foundation for European Progressive Studies and contributes to a Nordic report on the same topic that combines studies from Sweden, Finland and Norway.

The Swedish labour market is characterised by the Swedish model of industrial relations, with its strong and autonomous social partners that have the power to regulate a range of work and employment-related matters through sectoral collective agreements. Due to the high dependence on these time-bound agreements, workers' and employers' organisations maintain a continuous close dialogue, and the labour market conflict level is comparatively low.

At the company level, the local trade union representatives have the right to be involved in major organisational decisions via the Co-determination Act (SFS, 1976:580). Adding to the collective agreements and the Co-determination Act, the Swedish occupational safety and health (OSH) legislation mandates employers' activities in systematic OSH management, and nearly all workplaces have the right to one or more health and safety representatives elected by the employees (SFS, 1977:1160).

This study focuses on the ramifications of digital technologies and algorithmic management (AM), examining how technology affects working conditions and the prospects for workplace co-determination and democracy. We specifically look at the effects of AM on work and workers' rights in non-platform work; workers' response to AM-related issues; and the implications of these results for trade unions, solidarity and policy.

Three non-platform sectors were selected for inclusion in this study: transport; warehousing; and retail – all of which are sectors where AM is known to be relatively prevalent. We interviewed 16 employees in various companies from these three sectors and five full-time trade union employees from the Swedish Trade Union Federation (LO), Swedish Commercial Employees' Union (*CEU, Handelsanställdas förbund*) and Swedish Transport Workers' Union (TWU, *Transportarbetareförbundet*). All but one of the interviewed workers were also active as trade union representatives for CEU or TWU.

The study is structured as follows: Section 2 provides the background, explaining AM and introducing the Swedish labour market model; Section 3 describes the methodological approach; Section 4 presents results from the interviews in the three sectors, union responses at the central level and a comparison of the findings from the different sectors; Section 5 provides a discussion about the implications of our findings for the unions and the national policy context; and Section 6 presents our conclusions.

2 BACKGROUND

2 BACKGROUND

2.1 Algorithmic management (AM)

When we speak of AM, it should be viewed in the light of 20th-century scientific management, as a contemporary form of digital Taylorism. In Frederick W. Taylor's *Principles for Scientific Management* (Taylor et al., 1911) the fundamentals of modern management were said to rest on systematic observation, measurement and analysis of the labour process. For this to become possible, a radical division of labour had to decompose the work process into smaller, specialised tasks. When the contribution of the individual worker became possible to measure, the construction of an individualised incentive system became the logical next step. Piece-rate pay, bonuses and other forms of rewards tied to performance were suitable options to enhance productivity. Finally, decomposition and individualisation allowed for a more far-reaching regime of discipline, ensuring adherence to established methods and standards.

Ethnologist Moritz Altenried (2019, 2020) uses the term AM to describe how a variety of combinations of software and hardware enable the measurement, standardisation, fragmentation and monitoring of labour to take on a new form Along the same lines, labour process theorists, industrial sociologists and critical management scholars have analysed how sociotechnical innovations have been crucial for the rationalisation of work organisation and management practices. At its core, AM can be defined as digital technology assuming managerial functions traditionally performed by human managers and supervisors (Lee et al., 2015). Such functions include, but are not limited to, hiring and firing workers; planning and scheduling of tasks and shifts; monitoring and surveillance; instructing and directing; and evaluating, rewarding and punishing employees (Baiocco et al., 2022; Kellogg et al., 2020). What distinguishes AM from technical management regimes in earlier periods of industrial capitalism is that decisions can be enacted semi-autonomously without much human interference (Alizadeh et al., 2023), reducing or removing the human interaction between worker and manager from the equation. Furthermore, the scope and scale of managerial control can be augmented, as control mechanisms become more comprehensive, instantaneous, interactive and opaque (Kellogg et al., 2020). However, while the literature on AM is full of case studies mapping the controlling aspects of algorithms used for work organisation, there are other conceivable applications of digital systems at work. Noponen et al. (2023) elaborate a typology recognising that algorithmic systems can be deployed in a controlling or enabling manner – either reducing workers' autonomy by extending managerial discipline or enhancing workers' capacities by providing them open-ended information rather than orders, serving as tools that workers control, and supporting them in their work practices.

Delfanti and Frey (2021) refer to the most extensive algorithmic control of work as humanly extended automation, where humans and machines have become symbiotically coexistent in an environment where every movement is monitored and measured to enhance work productivity. They understand it as a form of "artificial intelligence", in that it does not seem to be about replacing workers through full automation, but rather constructing the human as an extension of the machine integrating human labour more seamlessly into the digital workflow as a form of sensors, necessary to supply the algorithm with data and to constitute its extended arm in physical space (ibid).

In this study, we follow Rani et al. (2024) in their report for the ILO and the European Commission by adopting a broad definition of AM that includes any form of digital technology systems impacting the governance and organisation of work because

of their implications for working conditions, worker rights and co-determination. Moreover, we adhere to De Stefano and Doellgast's (2023) contention that institutional and regulatory contexts matter for the adoption and outcomes of digital technologies for management purposes.

2.2 The Swedish context

In Sweden, like in other Nordic countries, the social partners – trade unions and employers' organisations – enjoy significant autonomy in governing the labour market. What is commonly referred to as "the Swedish model" is based on limited state intervention, allowing working conditions, working time, employment-related insurance schemes, wage formation and more to be negotiated by unions and employers and regulated in collective bargaining agreements(Anxo, 2021; Kjellberg, 2023; Medlingsinstitutet, 2023). The sectoral-level social partners can deviate significantly from state legislation. An essential condition for the functionality and legitimacy of this model is the high affiliation level to both trade unions and employers' organisations (Kjellberg, 2023).

Work environment standards are regulated by law and enforced by the Work Environment Authority (*Arbetsmiljöverket*), unless replaced by provisions at the sectoral level in collective agreements. Employees are represented by health and safety representatives, elected by workers and commonly (but not exclusively) appointed by trade unions at workplaces. The role of safety representatives includes monitoring the work environment for all employees at a workplace, demanding improvement measures from the employer where necessary, and participating in planning processes where changes can impact the work environment (including risk assessments). They have the legal right to receive work environment training and to notify the Work Environment Authority if the law is violated and the employer does not make the necessary corrections. In this study, both company-level union representatives and safety representatives are included among the interviewees.

A distinguishing feature of the Swedish model is that trade unions, compared to countries like the UK and France, have traditionally had a positive attitude towards technological development (De Vylder, 1996). In 1920, the central blue-collar union federation LO (*Landsorganisationen*) stated that "Trade unions should promote the planned development of industry, its structural rationalisation into larger units, the financial reorganisation, and the substitution of old machinery and methods by new plants and innovations" (quoted in (De Vylder, 1996). This techno-progressive position from unions was compatible with employers' interest in modernising production and facilitated harmonisation and cooperation, while mitigating labour-capital confrontation. By international comparison, the Swedish labour market is characterised by low strike and conflict levels.

Although the Swedish political economy has undergone significant changes, like other Western economies, it still stands out in comparatively high unionisation and collective agreement coverage. Roughly 70% of Swedish employees are union members (LO, 2024). However, this figure hides a relative decline among blue-collar union members, with the share of white-collar union members (75% in 2023) now surpassing the blue-collar union membership (59% in 2023) (Larsson, 2023). Due to the extension of collective agreement coverage at the workplace level, regardless of union membership, more than 90% of employees in the total labour market are covered by collective agreements.

Due to the institutionalisation of the Swedish model in the context of nearly a century of pragmatic and comparatively peaceful industrial relations, the political parties in Sweden and the social partners are generally sceptical towards the introduction of new labour market legislation. The consensus around state non-interference extends to the EU level, where Swedish parliamentarians from left to right recurringly refer to the importance of maintaining national sovereignty regarding labour issues (Söderberg, 2024). At the time of writing this policy study in summer 2024, it is uncertain how the Swedish model will be affected after GDPR has been implemented by all EU member states, including

Sweden, along with the Artificial Intelligence (AI) Act and Platform Work Directive approved by the European Parliament. Despite initial reluctance, once the EU legislation is in place, the social partners have been actively engaged in influencing the national adoption of relevant legal acts, careful to preserve their autonomy and discretion in the face of supranational regulation.

During the many rounds of negotiations of the Platform Work Directive within the European Parliament and in the following trialogue, the Swedish Social Democratic Party consistently, with explicit reference to LO's interests, voted against the "presumption of employment" within the directive (this core feature was an attempt to legally reclassify falsely self-employed workers), being the only members of the S&D Group to oppose it. The argument was that the employment status within the platform economy could, and should, be resolved by social partners in the context of the Swedish model, not through EU legislation.

In the context of this study, it is relevant to note that the transport, warehousing and retail workers in Sweden are organised mainly in two unions: the TWU and the CEU. Both unions are affiliated to the national blue-collar union federation LO. The TWU has a slightly higher affiliation level, standing at 57% compared to 51% for the CEU (Larsson, 2023). Collective bargaining coverage is also somewhat higher in the former than the latter. TWU represents drivers and warehouse workers in terminals, while the CEU organises retail workers and warehouse workers in e-commerce and retail (Handelsanställdas förbund, n.d.) Therefore, warehouse workers could be covered by either union, depending on the context and type of company they work at.

3 METHODS

3 METHODS

The focus of this study on the transport, retail and warehousing sectors was based on ongoing debates in this area at the union level in Sweden, as well as research confirming the relatively high prevalence of AM in these branches (Gent, 2018; Wood, 2021). Three researchers from the Unit of Occupational Medicine, Karolinska Institutet (KI), and one from the department of Economic History, Stockholm University, conducted 21 interviews and the ensuing analysis in March-May 2024. Ethical approval for the research carried out by KI was obtained from the Swedish Ethical Review Authority (2024-00805-02). In Section 4, each informant has been given an alias to maintain anonymity.

Retail and transport sector studies draw on 12 semi-structured interviews with 13 persons: three full-time trade union employees and ten workers who were also trade union representatives (see Table 1). The interviews were recorded and transcribed verbatim. The workers who were interviewed were selected and recruited via contacts provided by the CEU and the TWU. This selection was guided by the goal to include workers from organisations that

differed in size and type and ensure an even gender balance. The interviews with union employees were added to provide a more in-depth picture of the views of the trade unions at the central level. The interviews ranged in length between 50 and 100 minutes. Three interviews took place on-site and the rest were conducted online via Microsoft Teams. The transcripts were coded and analysed using the Atlas.ti software. An abductive approach was applied, based on the overall research questions of the project, relating to workers' experience of AM practices and their reactions, as well as the effects of AM on workplace democracy and workers' rights.

The warehousing study draws on eight semi-structured interviews, six with workers and union representatives at five companies and two with central union negotiators and strategists from the CEU. The interview process made it immediately apparent that each warehouse's technological structure largely defined its particular social relations. The empirical material was, for this reason, coded to capture not just the effect of AM in general, but also the specific type of technology in place.

Table 1. Overview of the interviewees

	Women	Men	Workers and union reps	Workers (not union reps)
Passenger transport	2	1	3	
Freight transport		2	2	
Retail	3	2	5	
Warehousing	2	4	5	1
LO employees	1		1	
CEU employees	1	2	3	
TWU employees	1			
Total	**10**	**11**	**20**	**1**

4 RESULTS

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4.1 AM in the transport sector

This section is based on five interviews with employees from the transport sector – three working in passenger transport (PT1, PT2 and PT3 in the text) and two in freight transport (FT1 and FT2). The passenger transport interviewees were employed in different Swedish regions, with their employers offering different travel services and ranging in size and ownership from locally owned taxi enterprises (PT1, PT3) to a branch of a multinational mobility company (PT2). However, the current study focuses strictly on employee experiences within one specific area of activities that differs significantly from the "traditional" taxi service. Our interviewees were thus employed in providing so-called "service travel" to local regions and municipalities in the form of pre-booked taxi rides, such as school transport or transport for passengers with special needs. The sector is characterised by high price competition in the context of public procurement, putting pressure on fair working conditions. The freight transport interviewees were employed in companies offering dangerous goods transportation to mainly one large customer in the chemical industry and long-haul commercial goods transportation. Here, the term "customers" refers to either the municipalities or the chemical company buying in the transportation service, while the individuals travelling are referred to as "passengers".

4.1.1 Digital technology and AM

According to the interviewees, the main functions of the digital technologies at their workplaces were route optimisation, performance monitoring, and incentivising a "good standard of driving" and safety, all of which relied on the monitoring of vehicles and individual workers.

- **Traffic planning systems** incorporating both ride scheduling and route planning functions combined automation and human input. For scheduling, human traffic planners employed by the customer (municipality) fed order data to the system, which then automatically selected the best available car for the assignment. System-driver interfaces differed, using either mobile-based apps or SMS or vehicle-based hardware. Critically, these systems belonged to and were managed by the municipalities and not the drivers' employers.

- **Global positioning systems (GPS)**. Scheduling and route planning relied, in all cases, on some form of GPS-based location monitoring by both the employer and the customer. For scheduling, older systems used digitalised maps with distance-based zoning that did not account for road geography or traffic conditions. In contrast, more modern systems had integrated GPS that considered real-time traffic situations. Drivers themselves occasionally relied on GPS for additional manual route planning when needed.

- **Eco-driving** systems were either already implemented or in the implementation phase in both modes of transport, with a described purpose of incentivising good driving practices for improved economic, environmental and safety performance. The system's modern technical features allowed convenient "user-friendly" tracing and collection of data on the vehicle and driver actions (e.g., fuel consumption, speed, braking, taking curves, but also standing still). In the case of PT1, it also had an integrated feature that allowed remote disabling of drive mode to restrict the car from being used for private purposes – a practice that was previously "quietly" accepted. In contrast to the traffic planning systems, data from the

eco-driving system was accessible only to the employer.

- The most technologically advanced and invasive system described was a **driver monitoring system** used in freight transport. At the time of the study, this system belonged to and was implemented at the requirement of the customer of FT1's employer: a chemical company. Using in-car cameras and AI to track driver behaviour and facial expressions, the system issued alerts when registering signs of tiredness. While the remote transfer of data from this system was disabled due to privacy considerations, the data was stored and accessible later to customers and managers at the transport company.

4.1.2 Effects of AM on work and workers' rights

An overarching theme emerging from the interviews was the restricted ability of workers, and sometimes managers, to participate in decisions regarding if and how AM tools were to be implemented and used. Decisions regarding technology tended to be top-down, taken by higher-level management, customer organisations or elsewhere. At the same time, worker representatives and sometimes middle-level managers were described as "out of the loop": "We are not able to be involved, the union is not able to be involved as this is seen as a thing for the officials at the municipality to take care of…" (PT1).

This problem concerned data critical for work organisation, negatively affecting workers' access to information on how the system functioned and their ability to voice feedback. Besides notifying late arrivals, the drivers were told not to contact the customer directly but to report any problems to their own direct manager. However, the interviewees described how the managers seemed to lack opportunities or incentives to take up problems with the customer: "It is a bit like… one does not bite the hand that feeds one. So, the drivers often experience that these things do not get anywhere. It does not matter if you report because it does not reach anyone" (PT1).

In this fragmented practice of AM, subcontracting thus added a layer of economic pressure. Customer control over digital systems, which played a crucial role in managing the drivers' work, was raised as a concern by all interviewees in passenger transport. Exemplifying customer control over digital systems relative to the employer is the situation in passenger transport where the employer could see the location of a vehicle, but it was the customer who controlled where and when it was headed next. Illustrating the workers' concern over their data rights, the drivers in freight transport were concerned with how their data was used by customers who had only limited information about them and the circumstances of their work:

> "[…] you squint because the sun is shining and the system registers that you have fallen asleep. And if it happens that another car comes and you crash, how is the client going to use this information? Will they trust the driver's words that the sun was shining, and I was blinded, or will it be like – you fell asleep, you are fired…" (FT1)

In addition, sub-contracting constituted an obstacle for safety representatives in safeguarding employee rights, for example, in accessing information in the context of the risk assessment process or demanding improvements. In contrast, where the transport company itself fully governed a digital system, our interviewee described how both co-determination and risk assessment processes were duly planned for (PT1).

Interviewees from both passenger (PT1) and freight transport (FT1) described how information on vehicle speed, real-time location, travelled route, and so forth was accessible to both their own managers

and the customers. None of the interviewees were formally informed of their rights concerning data, with interviewees describing confusion about the rules governing this field and workplace practices not only for themselves but also for their managers. For example, for FT1, the full extent of data collected through the driver monitoring system was understood only after the safety representative and a manager logged into the customer-owned system together. Illustrating concerns over excessive customer access to data and the employer's passivity: "This is important. They are not our employer. The employer must find out why they want this information" (PT2).

The patterns described above for worker rights are reflected in how the interviewees described the impact of AM tools and practices on their working conditions. The main themes that emerged included decreasing autonomy, increasing work intensity and changing nature of the jobs, and opportunities for improvement. Intensification is exemplified by ride scheduling, where the time allowance for pick-up, ride and drop-off were determined by the customer and guided by economic considerations:

"It is the time and the money. We cost x krona per minute, so that if the system can remove a minute here or there... It is not the system but the person using the system, actually. They would of course rather plan for one minute too little than one minute extra. And that has a big impact on us drivers of course, as it will be stress and pressure for us." (PT1)

Another critical aspect was that customers did not purchase labour in terms of human working hours but technology in terms of vehicle hours. Digital ride planning systems facilitated the streamlining of work processes and created distance from managerial responsibilities, as their parameters were not designed to consider human needs, such as eating, drinking or taking a bathroom break:

"When you need to take a toilet break, you are expected to call the customer's traffic planning to say that you need to take a break. And then the answer can be that you need to wait until the next ride. Adults needing to ask permission to go to the toilet – that is a big discussion among us." (PT1)

Relying on a phone call to request a bathroom break, clearly inconvenient for drivers, illustrates how the functional priorities of the system design lack employee perspective. Taking an unauthorised break recorded by the GPS meant a potential call from the manager or a customer representative – something all interviewees had experienced. The stress of being under continual surveillance was described: "You have it constantly at the back of your head that even if you are out on the road and drive and they are not there, they do see what you are doing" (FT1).

According to the informants, adopting AM practices had changed the nature of the jobs in both modes of transport. Managing different digital systems when transferring the goods was described by FT1 to have contributed to increased mental load. Reliance on digital predetermined schedules had intensified work but also hurt customer contact – an aspect of the job described as rewarding otherwise (PT1).

Implementing a system such as eco-driving allowed a new level of individual measurement of driving performance. Interviewees described two contrasting uses of this option at different workplaces. One employer used it for individual feedback as a learning

opportunity, considered among drivers favourably for skill development (PT1). Another (FT1) presented individual performance data publicly for the whole workgroup, thus providing social recognition to the best performers, but also followed up the weakest performers with individual-level reprimands.

The requirement to follow a pre-set route differed for the interviewees. FT2 worked with a system that automatically assigned a mandatory drop-off time, while the driver knew from experience that the customer facility would be closed. PT1 described it as demeaning to one's professional competence, but at the same time also helpful to disengage from work and thus reducing stress. One could thus blame the system for being late. A "nightmare system" with minimal overview and autonomy in passenger transport was described:

> "You are only getting the passenger addresses first. And when you have picked up all the passengers, then you will get the information about their destination. By then, you may have already passed the address where the first customer wanted to go." (PT2)

Poor scheduling function in old systems was another source of frustration. Rather than over-reliance on technology, it was the lack of sufficient technological development that was seen as a problem:

> "So, we are working in a system that does not understand that there is water, and it says it takes 12 minutes to drive to X, but it is actually completely dependent on when the ferry comes. But the system cannot figure it out." (PT1)

For PT2, system overload during the morning rush hour resulted in delays for the rest of the day. As emphasised by PT1 and PT3, the combination of tight scheduling, system inefficiencies and malfunctions put pressure on the psychosocial work environment, for example, through increased conflict risk or concern over the wellbeing of vulnerable passengers. For PT3, stress due to the tight schedule was associated with more safety incidents and vehicle damage.

There were thus several areas where technological advances were seen as an opportunity for improvement. Better GPS integration could, for example, contribute to more accurate scheduling and route planning (PT2), eco-driving could support skill development and overall cost savings (PT1, FT1), and upgrades in traffic planning systems' interfaces could facilitate better oversight of scheduled rides (PT2). Using more advanced technological solutions in combination with stricter state enforcement was named by both PT1 and PT3 as important to fight abuse of working time regulations. The current systems were described as follows: "It is actually called 'rest time book', but in the taxi industry we call it 'story book' instead, as you can write whatever you want in it" (PT3).

4.1.3 The response of workers

Two types of responses to the AM practices emerged from the interviews. One was resistance or attempts to impact some of the practices. The other was resignation to things "as is". All passenger transport interviewees described that active attempts to solve problems, ask for information and change systems came mainly from the local unions or safety representatives. The drivers themselves were described as relatively passive after previous unsuccessful attempts to be involved: "We must just live with it now and take what comes" (PT2).

At the individual level, all interviewees in passenger transport described how the more experienced drivers were sometimes able to use workarounds, such as taking advantage of contextual knowledge about the route or destinations of passengers. Another example was to "build in" break opportunities in the system. FT1 described how the drivers disconnected a monitoring system that was both intrusive and distracting. However, the complex and hidden nature of digital systems made workarounds increasingly difficult, with further barriers of insecurity for those new to the job or vulnerable to job loss.

Local union clubs attempted to strengthen the drivers' work community and stay in touch through physical meetings, texts and calls. However, the interviewees described how, in addition to the scattered nature of the job, supporting the formation of the community was challenging due to differences within the workforce, for example, in age or family circumstances.

4.2 AM in the retail sector

This section is based on six interviews, four of which were with retail workers who are also union and/or safety representatives. Two worked for a food wholesale company (Retail1 and 2), and the others in a supermarket (Retail3) or a furniture department store (Retail4). The fifth interviewee (OSHrep1) was employed full time by the CEU as a regional health and safety representative but had previously worked in different retail businesses. The sixth interviewee (Unionrep1) was employed by the TWU but had previous experience with the CEU.

4.2.1 Digital technology and AM

The technological systems described by the interviewees consisted mainly of AM solutions rather than automation technologies like robotics, even if such systems, to a limited extent, also existed in the sector. As mentioned by all interviewees, the primary reason for introducing digital technologies was streamlining distribution and services and increasing efficiency. The main digital systems identified in the retail sector identified were as follows:

1. **Automated order and inventory management systems** (mentioned by all interviewees) that track incoming and outgoing products, enabling almost instant and optimised ordering of goods and facilitating inventory of commodity stocks. Examples include sensor-equipped "smart shelves" and algorithms that alert managers or workers through wearables or handheld devices, recommending order volumes (Retail1, 2; OSHrep1). These systems are often connected to cash registers. The purpose is to streamline ordering processes, reduce time spent on fulfilment, and prevent shortages and stockouts.

2. **Picking systems, handheld devices and wearables** such as software-connected pads, phones, scanners, computers, watches and bracelets (all interviewees), which simultaneously allow for monitoring and collection of data on workers and work processes (e.g., pick-rate productivity, location, number of incoming customers) and transfer of instructions, recommendations and feedback to workers. They support e-commerce by instantly conveying customer orders to workers and instructing them on the most efficient order to pick items. They also automate, augment and inform decision-making related to business operations (e.g., replenishment of goods) and employees in terms of data-driven performance

assessment, individually or at the group level (OSHrep1, Unionrep 1).

3. **Planning and scheduling systems** enabling streamlining of staffing and planning of shifts by leveraging data and algorithms (all interviewees). These systems contribute to the slimming of organisations, achieved by aggregating data and algorithmically predicting "optimal" staffing needs, considering parameters such as consumption patterns, seasonal changes, campaigns, opening hours, deliveries, and fluctuations in incoming customers and sales volumes.

4. **Self-checkouts** that outsource the scanning and payment operations to customers, reducing the need for cash register staff (Retail3, 4).

5. **Software-connected cameras** monitoring workplaces and workers, collecting data available for managers, sometimes in real time via connected smartphones (Retail1, 2; Unionrep1).

4.2.2 Effects of AM on work and workers' rights

The use of digital technologies had complex and varying effects on working conditions and workers' rights in the retail sector. Differences could largely be attributed to the ways in which technologies were used, their sophistication, organisational and regulatory structures, as well as worker representatives' resistance.

Retail4 said that co-determination rights and risk assessments worked well in their company. In some cases, union representatives were informed, but not safety representatives (Retail1 and 2). In others, workers or their representatives were not adequately informed or involved, risk assessments were not made, and employers indulged in illegal data practices by using digital systems in violation of privacy regulations (OSHrep1, Unionrep1). Thus, in some companies, the implementation and use of digital technologies abused workers' rights to

co-determination and privacy, whereas in others, routines were followed "by the book".

All interviewees saw positive effects and the potential of algorithmic technologies. Auto-ordering and inventory management systems reduced the cognitive strain associated with keeping track of orders and stock with pen and paper, thus freeing up time for more rewarding and varied tasks (Retail1, 2, 3). Algorithmic instructions conveyed through wearables could reduce physical strain by recommending the most efficient way to pick orders (OSHrep1, Retail4), and self-checkouts could alleviate the physically and emotionally demanding workload of managing the cash register, creating a more equal relationship between workers and customers (Retail3). When picking systems were programmed to account for variation in the weight and height of items allocated algorithmically to workers, the physical work environment could be improved, especially if line managers had the discretion to adapt the workload to employees' different needs (Retail4).

However, when systems malfunctioned or workers were not adequately trained in how they operated, it could cause alienation and deskilling. Retail3 described how auto-ordering systems made the skills previously needed for orders and fulfilments in the supermarket redundant, but that this created frustration, as the system did not function optimally, with workers having to make up for malfunctioning without a proper understanding of why the problems arose and few means to correct the mishaps. Nevertheless, the interviewee experienced the system as overall enabling in a context characterised by a high workload and pace:

> "[...] the fact that it actually generates an order proposal, and even in the situations where it does not work, it is still less time-consuming to correct that than it has been to go and order manually all the time [...] After all, it is still facilitating a working day in a sector that is under extreme pressure in terms of time." (Retail3)

Worker autonomy, though, could be reduced, as digital technologies algorithmically monitored and instructed workers remotely and in real time. As expressed at the interview:

> "[...] when you are being managed to move as little as possible, to be able to help as many people as possible [...] in some way you experience it as if your professional role is being questioned, as if I can't make that judgment myself on how to give this customer service in the best way..." (OSH rep1)

The extent to which algorithmic instructions directed workers – providing guidance and recommendations or controlling their behaviour – affected whether systems were experienced positively or negatively. Retail1, 2, and 4 thought task allocation was of help, whereas Retail3 felt frustration over having limited discretion to correct algorithmic mistakes manually.

Regarding digital monitoring and evaluation technologies, such as cameras, wearables and handheld devices, the effects on rights and working conditions depended on the intrusiveness of surveillance and data collection, and the quality of the social contract between workers and managers. Retail4 stated that their employer collaborated closely with worker representatives, and that the company considered adherence to regulations and collective agreements important. Thus, while data was collected individually through handheld computers, utilising that data for individual assessments or reprisals was not allowed, nor allegedly occurring in practice. Indeed, Retail4 stated that if managerial misuse of data were to occur, worker representatives could sanction the employer and restrict their data access.

Retail1 and 2 similarly stated that they were monitored by digital cameras and that data was collected through handheld scanners, but that the information gathered was not used for disciplining or controlling workers. If this were to happen, it would constitute a legal breach by the managers. The perceived rationale for digital monitoring was increasing employee safety and preventing stealth and threats from customers. "[...] it's not like they're allowed to go in and be like [...] 'Yeah, now the two of you stood by the cash register and did nothing for 10 minutes. You must get out and move'." (Retail1).

> "They shouldn't use that information to seek you out and say that 'now you have to run faster'. On the other hand [...] they calculate averages [...] but we never go on an individual level. But they can get out a lot of data." (Retail4)

OSHrep1 and Unionrep1, however, stated that digital monitoring ushered in a tendency towards individualised performance appraisal. Some workers might be spurred by individual evaluation, especially those who could work fast, performing well at tasks prioritised by the algorithmic system and benefitting economically from data-supported piece-rate compensation, could experience it positively (OSHrep1, Unionrep1). However, they emphasised that individualised evaluation and discipline had negative implications for working conditions, for example, by generating work intensification and stress.

Unfair, atomistic performance evaluation was another risk, since, in the course of datafication, "some tasks get more valued than others" (OSHrep1). Tasks and skills not quantified digitally were neglected, even though they were necessary for a smooth work process. Digital systems expanded managers' prerogatives, since they could configure systems according to their preferences, prioritising some tasks (such as increasing sales) and degrading others (e.g., cleaning in the aisles, putting on alarm tags, filing shelves or helping customers) (OSHrep1, Unionrep1).

Adding to this was the erosion of social cohesion and organisational trust. The fact that workers were evaluated individually instead of collectively pitted them against each other, causing "internal competition" in the workplace (OSHrep1). Fear of being rated lower than peers or sanctioned incited higher work efforts, but it also paved the way for conflicts between co-workers, arising from the unwillingness to perform unmeasured albeit necessary tasks. Unionrep1 feared this increased competition between co-workers undermined solidarity, and by extension, union organising, because work intensification left less time for interactions between colleagues and because incentives for working as a group and supporting each other decreased. Constant surveillance could cause a sense of mistrust from management (Unionrep1).

Other significant effects on working conditions and workers' rights were related to planning and

scheduling systems. Such systems enabled companies to tailor their staffing based on a variety of data, such as fluctuations in sales, incoming customers and deliveries (OSHrep1). This often resulted in reduced staffing and hours. A consequence of this was work intensification and lower income, as the number of scheduled hours was aimed at aligning with data-driven predictions of organisational needs. OSHrep1 described how such algorithmic estimations often resulted in sub-optimal, overly streamlined business models, leaving little to no time for employees to carry out all tasks.

Some also pointed out that digitalisation of planning and scheduling shifted power from lower-level managers and workers to higher-level management. This centralisation of planning functions diminished the likelihood of workers' right to make requests and have their preferences considered when planning schedules, since decisions based on data analytics focused on profitability and were made centrally without considering local or individual circumstances. A potential effect was thus that workers' influence was restricted, not only with regards to how they worked, but also in terms of when and how much they worked. Furthermore, on-site lower-level managers were believed to be negatively affected by the restructuring of planning. As one interviewee explained:

> "Officially, they say that it should facilitate the managers' work so that the managers can be more out on the floor, with more time for coaching. But I think in practice the managers feel overlooked. After all, they are removing a task that might not be super fun [...] but if you've done a good job, you don't spend so much time on the schedule afterwards. Plus, it is the manager who will have to take the discussions with those who are not satisfied." (OSHrep1)
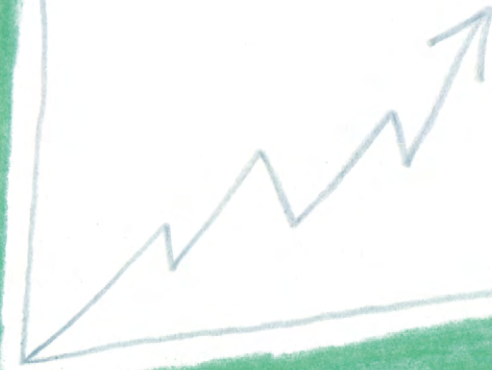
Again, the impacts varied across contexts and types of workers. Full-time employees and those covered by collective agreements fared better than temporary agency workers, part-time employees and those employed on an hourly basis, who constitute a large portion of the retail workforce in the Swedish context. Interviewees with full-time contracts said that digitalised scheduling enabled them to better keep track of their working times and access schedules, and that systems worked well. Scheduling systems could also secure healthy and reasonable working times, since regulations on rest periods were sometimes programmed into the systems and automatically alerted workers and managers when they were exceeded.

More precarious retail workers, meanwhile, given the data-driven scheduling flexibility in staffing levels and schedules, were increasingly required to "chase hours" to make ends meet (Retail1, 2; OSHrep1). Additionally, it decreased their prospects of getting a full-time contract and increased the risk of full-time workers being laid-off or getting fewer contracted hours in the wake of restructuring. Job insecurity combined with stress arising from irregular and unpredictable schedules were thus other adverse effects of the digitalisation of planning.

4.2.3 The response of workers

Mirroring the varying effects of digital systems on working conditions and rights, the workers' responses were diverse. Since many aspects were experienced positively, they did not raise digitalisation as a concern with managers (Retail1, 2). Regarding negative effects, however, several employees acted in their role as OSH or union representatives to restrict the use of intrusive data practices. They put pressure on employers to negotiate implementation, assess risks or improve the systems (Retail4, OSHrep1). "Sometimes we've stopped projects and said that we must do the risk analysis first..." (Retail4).

Co-determination rights, the right to be informed and receive training in how to use digital systems, and the employers' obligation to assess work

environment risks before implementation were often disregarded, according to all interviewees. However, when they alerted or pressured employers to follow regulations, employers often complied. OSHrep1 said that unions often prevented individual data collection by invoking GDPR and privacy rights.

However, since many workers in the retail sector were employed on a part-time or hourly basis, and probably increasingly so due to the streamlining enabled by digital planning and scheduling systems, they did not dare to make demands for improvements in fear of getting on bad terms with their employers. Such insecure employment arrangements implied skewed power relations between workers and employers that inhibited resistance to worsening working conditions caused by digital planning. OSHrep1 illustrated the resignation stemming from such power imbalances:

> "It's not at all unusual that you have a five-hour contract, but constantly working 20-25 hours on average, or more. When I say 'you know what, let's try to talk to the employer to try to raise this' [...] They don't dare, because you make yourself troublesome, and you know that if you're on good terms with the employer then you will get these extra shifts."

4.3 AM in the warehousing sector

This section is based on six interviews with warehouse workers, of which five were also trade union representatives, and two interviews with negotiators and strategists at the national level of the CEU. The six workers were employed in warehouses of five different companies, coded as WH1 to WH5 (Table 2).

Warehouse one (WH1) represents dark stores affiliated with a well-known food courier platform: a fusion of a grocery store and a warehouse, accessible solely through the platform and with goods delivered by gig workers. The two workers interviewed worked at several sites, which they described as functionally identical. WH4 served an identical purpose – delivering groceries to homes – albeit under the umbrella of a major Swedish grocery chain. WH2 represented an outsourced warehouse supplying an international e-commerce fashion corporation. Finally, WH3 and WH5 were wholesalers supplying commodities to hotels and restaurants.

Within the warehouses of this case study, the primary labour process revolved around the process of "picking". Incoming orders generated lists of items to be gathered from various warehouse locations and assembled into customer deliveries. Traditionally, this process had been predominantly analogue and manual – workers received picking lists specifying item quantities and shelf locations. The order in which the work was planned and performed was something that used to follow from experience, a situated knowledge of which sequence minimised both distance and thus time, and which also ensured that heavy items were placed at the bottom to make the order physically possible to ship. In the modern picking warehouse, however, this work process is digitalised and to various degrees sequenced algorithmically.

Table 2. Overview of AM systems in the warehousing study.

Code	Type of warehouse	Type of work process	Classification
WH1	Dark store connected to digital labour platform	Manual picking, sequence suggested in smartphone application	Algorithm guided
WH2	Warehouse for online clothing retailer	Manual picking, sequence determined by algorithm. Automated sorting	Algorithm controlled
WH3	Hotel and restaurant wholesaler	Pick-by-voice system. Sequence determined by algorithm	Algorithm controlled
WH4	Grocery home delivery warehouse	Stationary picking in semi-automatised process. Manual picking for peripheral types of items	Machine extended/ controlled
WH5	Medical equipment wholesaler	Stationary picking in semi-automatised process. Manual picking for peripheral types of items	Machine extended/ controlled

4.3.1 Digital technology and AM

Despite technological advancements, there have been obstacles to fully automating a picking warehouse. While some companies have attempted to standardise packaging processes, the complexity involved usually prohibited the complete elimination of manual labour. Instead, the solution has shifted towards AM of manual tasks – a facilitative technology aimed at enhancing productivity rather than replacing workers.

The modes of AM observed within the warehouse sample can be categorised into three distinct types. They differ in scope, determining the level of autonomy retained by individual workers and the degree of intrusion of AM into the actual workflow. In Table 2, we classified them as (1) algorithm-guided; (2) algorithm-controlled; and (3) machine-complementary work. The purpose of these categories is to highlight the relationship between worker and the machine, and they are based on the discussions of algorithmic power over work in Delfanti and Frey (2021) and Noponen et al. (2023).

> (1) Algorithm-guided work represents a fairly small departure from the pre-digitalised workflow, allowing workers to retain autonomy over the labour process.

In the sample of warehouses included in this study, the primary tools of this form of AM were mobile applications or similar electronic devices, presenting workers with an ordered list of tasks that calculated the most efficient sequence for picking items. Each was scanned at collection, feeding the algorithm with data and verifying the accuracy of picks. Individuals were, however, allowed to deviate from the sequencing if they deemed alternative routes more efficient.

This process represented the primary and dominant form of work in only one of the surveyed warehouses – the dark stores affiliated with the gig platform (WH1). Given the platform economy's pivotal role in pioneering algorithmic work monitoring, it was expected to serve as a benchmark for other warehouses, a site where algorithmic control was

most pervasive. The dark stores, however, emerged as the least technologically advanced within the sample. At the other sites surveyed, this method was peripheral, if at all present, and supplemented a more sophisticated and far-reaching technological infrastructure.

> (2) Algorithm-controlled work represents a fragmented process, where direction is given on an item-to-item basis, removing the possibility for the individual worker to structure their work autonomously. This usually requires GPS tracking of workers for the algorithm to calculate paths, which also becomes a possible tool for worker surveillance.

At WH2, a manual picking process was combined with a fully automated sorting mechanism that enabled an individual worker to pick more than 50 orders simultaneously. The batch was then fed into a machine that divided the orders and made it possible to ship to individual customers. The algorithm decomposed an individual order between several workers, minimising the physical distance it was necessary for each of them to cover. To autonomously plan such a process in one's head is impossible, and the algorithmic sequencing thus had to be followed step by step.

The "pick-by-voice" architecture of WH3 represented another example of algorithm-controlled work. As with WH2, workers received instructions on one item at a time without an overarching task list. Using voice commands, workers could confirm each pick and await further instructions from the system through their headsets. Its GPS data was also utilised by management to supervise individuals.

> (3) Machine-complementary work, finally, marks the highest level of automation possible before human involvement ceases. In the examples of semi-automated picking represented in this sample of warehouses, workers were stationary and received boxes continuously delivered by robots and/or systems of conveyor belts. The role of the worker becomes to perform the tasks not technically possible (or profitable) to automate.

This technical setup was the dominant architecture of WH4 and WH5 and necessitated an advanced facility design beyond mere software and digital tools. In both workplaces, workers stood on platforms roughly two square meters in size. A screen displayed the contents of the next box to be delivered, along with the quantity and the destination box on the opposite side of the platform. Goods were transported back and forth from their respective positions within the facility, and the workers moved items from one box to another without physically moving. This architecture is sometimes called "pick-by-light" due to the display-mediated work instructions.

4.3.2 Effects of AM on work and workers' rights

Out of the different forms of technology in place in the warehouses studied, not all carried significant repercussions for the working environment or the possibility for workers to pursue their rights. Within the context of dark stores (WH1), where the technology served guiding purposes, neither of the two workers interviewed perceived themselves as algorithmically managed and had a hard time expressing opinions about the digital aspects of the work process. It was a workplace where the social relations with the boss dominated, and picking assisted by handheld devices appeared to be a non-issue. This was also the case at WH2, where algorithmic sequencing was enforced. As the total picking process was decomposed to an extent that any alternative to algorithmic control was implausible, and there appeared to be no surveillance of movement by management, the interviewees perceived the system as generally helpful and benign.

In WH3, however, the technology took more invasive forms. The work process was algorithmically controlled by a pick-by-voice system, and the effects on the environment were directly measurable, especially the consequences for workers' psychological wellbeing. The "pick-by-voice" system fragmented the work process and removed the freedom to perform one's labour autonomously.

However, the perceived problem went beyond the loss of autonomy and involved a widespread sense of surveillance and a phycological toll following a task-by-task governance by voice. As the system relied on GPS to enable the algorithm to calculate optimal routes, new opportunities arose for supervisors to monitor work in real time and question taking breaks more directly.

> "Members come to us [the union] and say that they feel monitored by the boss. Management may have said something like 'What were you doing at this moment, because I could see that you did not move?' and they want to schedule a meeting, or whatever." (WH3)

At WH3, an individual could not know for certain whether or not the management actually observed one's movements at any given time; the workers just knew from experience that they could. Employees understood this primarily as a breach of their rights, as it violated the rules negotiated with the union when the system was put in place – rules that restricted this type of real-time performance monitoring.

The combination of surveillance and the permanently present voice delivering orders from headphones led to increasing stress. The union representative recounted how they dreamt about the "voice of the algorithm" and started to communicate with their children using the wordings of the audio commands of the software. Although the warehouse had alternative forms of picking in place, such as using screens instead of the pick-by-voice systems, access to these was restricted to those who had undergone rehabilitation after being diagnosed with exhaustion. Ironically, in these cases, the psychological toll of algorithmic control had become a necessary step for individuals to achieve better working conditions.

If the pick-by-voice technology had consequences that were mainly psychological, the *machine-complementary* stationary picking that characterised Warehouses 4 and 5 had additional physical ramifications. As one unionised worker at WH4 explained:

"If we pick as quickly as the company wants us to, it means intervals of four to six seconds between the robots arriving at your station. [...] This type of system might prevent certain types of injuries that previously occurred [with manual picking], but it makes the job much more monotonous. For the company, this is obviously good, because it's 5-6 times faster. However, a few years into the future, those who work will have repetitive strain injuries."

The parts of the work process that the machines cannot perform are very specific. Therefore, the physical aspect of the work becomes concentrated into a small number of movements repeated for long periods. This far-reaching automation and fragmentation had led to increasing work intensification in both WH4 and WH5, manifesting itself in task-specific performance goals. These goals, however, and the extent to which management enforced them, differed greatly between the two sites using this technology.

"Everyone is extremely worn out when they get home. You don't have the energy to do anything. You eat, and you collapse; your body is completely exhausted. This is due to both the extremely high pace and the constant monitoring because you're logged into a screen. I am a union representative and safety officer, so no one targets me, but many colleagues feel constantly chased. [...] Still it usually takes several hours after a shift before I can breathe normally. It was tough when my shifts ended at midnight, that it then took two to three hours before my body could relax." (WH4)

The situation at Warehouse 4 was characterised by a dysfunctional relationship between the union and the employer and a lack of functional co-determination. A typical shift usually included four hours of picking. Still, it could be longer and was followed by four hours of restocking, a task that "involved exactly the same muscle groups, thus preventing rest" (WH4). At one point in time, the situation at WH5 had been at least as taxing on the workers: "A few years ago, there was no rotation within a shift. You stood at the semi-automated picking station for eight hours, you folded boxes for eight hours, or you spent eight hours decanting." (WH5).

Over time, however, the union representation at Warehouse 5 was able to convince the employer to introduce shift rotations with a cap at 2.5 hours per shift for stationary picking combined with forklift restocking or managing outbound deliveries, thus minimising repetitive strain over the working day.

4.3.3 The response of workers

The various forms of algorithmic control implemented in work processes resulted in diverse outcomes concerning workers' perceptions of their roles and their relationships with management, technology and each other. In the dark store environment (WH1) and within related sections of warehouses where the algorithmic sequencing of work served guiding purposes (WH3, WH4), the presence of algorithmic process control was not widely perceived as problematic. Workers did not see themselves as being directly managed by algorithms; instead, they viewed algorithms as tools that were either benign or, at worst, mildly bothersome. Grievances among workers in the dark stores of platform companies were primarily directed towards their human supervisors or bureaucratic inefficiencies rather than towards algorithmic control. Issues such as irregular wage payments and absent HR support overshadowed concerns about algorithmic influence, although workers expressed awareness that couriers faced a different reality when picking up orders (WH1). The lack of antagonism involving AM was also the case at WH2, where work fragmentation was far-reaching and worker autonomy virtually non-existent. What these sites had in common was, however, productivity targets that were relatively easy to meet and an absence of significant repercussions when failing to do so. Despite tight algorithmic control, the structure imposed did not feel arbitrary or unjust (WH2).

The situation differed in WH5, where algorithm-controlled processes were combined with more extensive automation. Recent shifts towards algorithmically determined picking orders were met with scepticism from experienced workers, who expressed this loss of autonomy in much stronger terms. Here, it was also perceived as a loss of effectiveness, as something holding back productivity based on situated knowledge of the work process (WH5). Reflections on this system, however, were repeatedly framed in relation to the stationary "pick-by-light" that was perceived as much worse. As the algorithmically controlled but still manual work occurred in highly automated warehouses where most of the labour process relied on machine-complementary work, the manual picking, even if considered heavily dictated by algorithmic sequencing, was seen as a shift workers wished to be rotated into for relief.

This hierarchisation of forms of work within warehouses was a frequent occurrence, especially at sites where one task was perceived as especially mentally or physically taxing. At WH3, the pick-by-voice system was the subject of constant discussion, and complaints were raised, to cite the safety representative, "in the lunchroom, in workplace meetings, in the corridors, while working, after work, at After Works". The algorithmic voice was informally called Astro by the employees, and as they had begun to personify the voice, they started to grow resentment against it. In several cases, workers physically destroyed their headsets; one of the interviewees had done so themselves at one point: "Three times in one day it confirmed something I did not say. It was like the final straw, my limit was reached […], I screamed, took my headset and threw it [on] the floor" (WH3).

The system was so universally disliked that the fact that some workers had managed to "opt-out" by invoking health reasons had led to tensions within the collective. This was also the case regarding employees who had tasks that they could alternate, perceived as an injustice by those who were tasked to pick five days a week. According to the union representative, workers also advised each other on how to opt out most effectively, by invoking true or made-up reasons for why they could not use the pick-by-voice system during a specific shift (WH3).

The "pick-by-light" systems of Warehouses 4 and 5 were associated with similar lines of conflict. As the "picking" was just one of several components necessary to make the aggregate production process functional, some employees got what was perceived as much less demanding tasks. One interviewee pointed out, "My body has never been worn out to exhaustion by manual picking in the freezer where the work has yet to be semi-automated" (WH4). The difference between the worker-employer relationships between the two sites

and the dysfunctional co-determination at WH4 also amplified its relative discontent: "Even though we have fixed wages, and despite management being restricted from real-time performance evaluation, many workers feel as if they were employed on piece-wage due to how the supervisors behave" (WH4).

At this site, it was not uncommon for an individual to work up to six hours straight at a pick-by-light station, compared to WH5, where more successful co-determination had imposed a limit on this type of work. Union power thus dramatically helped mitigate the conflict in the context of these highly automated warehouses.

4.4 Intersectoral comparison

4.4.1 Digital technology and AM

The digital technologies and AM functions described in the interviews displayed intersectoral similarities and differences. In all cases, increasing efficiency and streamlining of the work process were common goals of AM practices. Warehousing is known as one of the sectors with most pervasive AM. While in many places, automation is slowly elbowing out human workers, this was not the case in our study. AM was used to enhance workers' productivity rather than to replace them. Similarly in the transport sector, AM tools aimed to optimise the driving process. Here, underlying drivers were high fuel prices, traffic safety and customer-demanded control over the work process. In retail, the reported reason for AM practices was streamlining distribution and services to increase overall efficiency. The modes of AM control diverged between the sectors, however, reflecting the differences in the labour process and the context of work.

In warehousing, instructions and monitoring took place via handheld devices, including mobile phone applications and scanners. Work was also instructed via pick-by-voice – audio instructions based on algorithms channelled via earphones – and pick-by-light – visual instructions to stationery workers in front of a conveyor belt. In transport, the

AM systems were either integrated into vehicles or implemented via mobile-based apps. There was a spectrum of technological advancement in the traffic planning systems (which had the most significant impact on the work process), with older systems relying on outdated information and human input in combination with partial automation. The main functions of the systems included scheduling, route planning and performance monitoring (of vehicles and increasingly of individual workers). Retail shared similarities with transport and warehousing in the use of planning and scheduling system and the wide variety of handheld devices and wearables. The primary function of these devices was to support work, but also to monitor the workers – as did software cameras. Some data-driven systems in retail affected the workers indirectly. One example is the use of automated order and inventory management systems, which streamlined the ordering processes via sensor-equipped smart shelves and cash registers rather than guiding human work directly. Another example was the increasing use of self-checkouts in shops.

4.4.2 Effects of AM on work and workers' rights

Four aspects of how AM affects work and workers stood out in the warehouse study. The first two relate to autonomy: (1) how AM limits the autonomy of workers in how they carry out their work; and (2) how the surveillance by managers limits the autonomy of workers. The third and fourth effects relate to worker health in the form of AM leading to (3) stress and (4) injuries related to physical strain. The psychological consequences were the most severe where the work was managed through pick-by-voice, which, beyond its fragmentation of the work process, was experienced as invasive, in terms of both surveillance and the impossibility to escape the voice directing one's every movement. The physical consequences were the most severe in semi-automated pick-by-light warehouses. It was, however, not as much a consequence of the type of *management* as of the automation itself. With labour being narrowly reduced to tasks impossible for the

machine to perform, work became increasingly repetitive, leading to injuries.

In the transport sector, three key themes emerged: (1) AM systems facilitated the partial transfer of managerial control to customers who had no managerial responsibility nor duty of care for the work environment and workers; (2) this had adverse effects on the ability of the workers and their representatives to influence the implementation and use of AM, particularly as AM technology was not considered an OSH issue; and (3) increasingly expansive and individualised surveillance by employers and customers intruded on workers' privacy in the context of poor awareness and information on data rights. These factors, in turn, were associated with reduced autonomy and work intensification due to the pressure to keep to schedules that were planned not by considering human labour and associated needs but through the purchase of machine hours. Consequently, the drivers reported both stress and an inability to fulfil their basic human needs, such as eating and taking breaks, leading to both stress and potential adverse outcomes for health and safety performance. The tight scheduling also affected job content, as inherently rewarding job elements such as providing care and good service to the passengers and the driving process itself were not prioritised. On the other hand, the drivers had an optimistic outlook on technological developments that had the potential to improve working conditions, particularly in the context of frustration over outdated technology and system malfunctions.

In the retail study, three aspects of how AM affects work stood out:

(1) While monitoring and surveillance were not perceived as intrusive or stressful for some, for others, they paved the way for individualised tracking and evaluation, which was seen as a risk for the psychosocial work environment and possibly employment security if workers did not reach set targets (though we did not find evidence of job displacement caused by AM).

(2) Algorithmic instructions were largely seen as positive and enabling, but some felt alienated and deskilled if they did not know how the systems worked, or perceived frustration and stress when they malfunctioned. Another effect was deskilling. The comprehensiveness of the systems and a worker's ability to override algorithmic instructions also affected these experiences.

(3) Digital planning and scheduling were experienced as positive by some full-time employees, as schedules became more easily accessible, while others feared that these systems could lead to downsizing, job insecurity and unpredictable schedules.

Two issues stood out in terms of workers' rights. Firstly, privacy and co-determination were respected only if the employer knew to negotiate with the unions, inform safety representatives and conduct risk assessments before roll-out. It also depended on the strength, knowledge and presence of worker representatives in the workplace. Secondly, monitoring and surveillance could be seen, in some examples, to be paving the way for individualised evaluation, which was seen as a risk for privacy rights as well as undermining solidarity and union strength.

4.4.3 The response of workers

Results from the warehouse study indicate a close association between the power of the local union club over the labour process, that is, the extent of co-determination, and the negative consequences of AM for workers. At sites where the union had real influence, management could not unilaterally design shift rotations and push the workers towards maximum specialisation in individual tasks. With proper co-determination, the possibility of using the technology as a means of worker surveillance was also drastically limited. The absence of such union power manifested itself in (unnecessarily) unsustainable workloads, arbitrary structures of discipline, and conflicts between the worker

collective and the management and internally on the floor.

In the transport sector, the main response of the workers at the time of the study was resignation. This was associated mainly with subcontracting, as the system that impacted working conditions most was not owned and controlled by the employer but was a condition for service provision by the customer. Attempts at feedback for system or AM practice change had not found a "receiver" at the customer nor a solution within the transport company. Individual-level workarounds were mainly available for employees with more experience and knowledge of the processes and systems, as well as those less vulnerable to job and wage insecurity. However, both union and safety representatives were active in raising AM-related concerns, focusing mainly on data privacy, reflecting the overall trend of increasing oversight and data collection. This further emphasises the critical role of worker representation in the context of AM.

In the retail study, there was no response from workers to systems perceived as enabling. However, in response to negative aspects, they acted in their roles as union and/or safety representatives to (1) be involved/consulted; (2) raise complaints on certain features and practices; and (3) force employers to negotiate and perform risk assessments if this had not been done properly. If workers had insecure employment contracts (e.g., part time and hourly based), they were more reluctant to make demands of their employers and call on representatives to improve their working conditions, since they feared they would not be granted well-needed extra shifts or other benefits.

4.5 The response from trade unions

This section is based on interviews with employees at federal (blue-collar unions) and sectoral trade union levels (transport and retail).

The approach of Swedish trade unions differs significantly from union strategies in other European countries, where it is more common to promote technology-specific regulations at the national and EU levels. Swedish unions have been hesitant towards EU regulations such as GDPR, the AI Act and the Platform Work Directive because of concerns that their bargaining capacity would be undermined or that decision-making power would be transferred from social partners to state authorities. However, Swedish unions have been active in lobbying and negotiating the design of the laws and involved in discussions with the government when transposing EU law into national legislation. One significant risk from the unions' perspective has been that EU regulations would complicate enforcement and compliance, since many laws already exist at the national level, making it more difficult for both unions and employers to know which rules are applicable.

According to the interviewees, the response from the Swedish trade unions to digitalisation, AM and AI has largely aligned with their traditional openness towards technological change, typical for the Swedish labour movement. They have been cautious about legislating against specific technologies and preferred leveraging the flexibility granted by collective bargaining and co-determination rights to draw attention to the outcomes of implementing these technologies. Nonetheless, the trade unions had a critical stance towards digital technologies' current use and effects for blue-collar professions, elaborating on strategies to address these.

The interviewee from the Swedish LO compared the approach of Swedish unions towards digitalisation with the positive attitude towards technological change and structural transformation in general over the past century. The approach to new technology was described as "neutral", in that LO does not consider specific types of technologies as necessarily being adverse. According to

the interviewee, Swedish unions and employer organisations have agreed to be open to new technologies to stay competitive, facilitate structural change and take advantage of the possibilities of technological development, thus not protecting "old", unproductive and possibly dangerous jobs. The existing national regulatory framework was seen as well-functioning and applicable to the challenges of digitalisation on working conditions and rights. The relevant tools included the law of co-determination, collective agreements, OSH legislation and various development agreements. These technology-neutral regulatory measures allowed unions to be part of the negotiation and implementation processes of digital technologies and AM practices, so that they could push for risk assessments and safeguard against negative reverberations.

LO unions were said to be reluctant for EU regulation and other supranational legislation to override national legislation and the Swedish model. However, once the EU acts were decided upon, the LO unions were reported to actively try to make the best of the situation. To prepare for the future, LO was said to appraise the existing tools' effectiveness and contemplate if additional strategies were needed. One reported challenge was low compliance with the co-determination law and employers implementing systems without the consultations foreseen in the regulation. The interviewee described practices of employers disrespecting legal requirements and collective bargaining agreements related to workers' data, also contradicting the GDPR, and said that both workers and sectoral unions often lacked the knowledge to counteract these practices. To improve this knowledge deficit, LO is actively mapping AM prevalence within the sectoral unions and is identifying associated risks. The union also tries to raise awareness and develop general-purpose tools, such as checklists for the sectoral unions. Additional challenges include declining membership, adversely affecting the unions' power resources.

According to the LO-affiliated transport and retail union interviewees, the unions are aware of various digital systems and AM tools deployed in logistics, transportation and retail, affecting workers' rights, work environment and working conditions. The

interviewee from the TWU stated that the union regarded AM primarily as a work environment issue, describing several core problems related to positioning systems such as GPS and route optimisation, advanced cameras, logging of workers' personal data, and real-time instructive systems. These technologies augment the direct control, surveillance, evaluation and sanctioning of workers, as well as causing work intensification and reducing autonomy. The interviewee also saw that effects of AM, such as individualisation, increased competition and deskilling, could have adverse effects on union strength and the capacity for collective resistance:

"[...] the number of members is going down [...] and I think that is partly because you don't have the same cohesion, not the same professional pride. Because [...] you were proud to know the entire warehouse and to be able to do the work based on your own knowledge. [...] if someone quit, it disappeared. Now, instead, all the knowledge is in the system, and you are very easy to replace, which also means a weakening of the union."

Among factors shaping the union response to AM, both TWU and LO informants pointed out how, across the industries, but particularly in the retail and warehouse work, employers tended to have a controlling and hierarchical management strategy concerning employees, reflected in how digital technologies were utilised. This manifested in the widespread misuse of digital management systems, with employers and managers resorting to dubious or outright illegal practices, for example, abusing workers' personal data for monitoring and surveillance of employees in real time. The TWU representative associated this with both

ignorance and poor managerial practices, while union members' poor knowledge of their legal rights was an obstacle to combatting this problem. With an air of self-criticism, the interviewee admitted "[...] it has not been a prioritised issue for the union either". In transportation, meanwhile, employers had more trust that workers would perform well without managerial top-down control. This difference was perceived as translating into a more critical stance and awareness of AM-related risks within the CBU compared to the TWU, even if the latter organised warehouse workers too.

Like the TWU interviewee, the interviewees from the CBU also described a complex picture regarding AM. While warehouse workers reported problematic surveillance, they also depended on technology and systems to do their work. Similarly, as cameras become more advanced in the retail sector with real-time and remote surveillance, risks to workers' privacy infringements emerge together with cameras serving as a security measure, improving occupational safety in situations of customer aggression and conflicts.

For AM in warehouses, CBU has a strategy in place. According to one interviewee, problems associated with AM extend beyond the strain on members' physical and mental health to the questions of power over technology. Put differently, it is about whether work should be subordinated to machines or if machines should be subordinated to work. The trade unions were active in addressing the numerous challenges associated with digitalisation and AM, acknowledging the rapidly increasing relevance of fast technological development and its accelerated implementation (LO, TWU). Unions conducted investigations and surveys in their respective sectors (TWU, CBU), as well as at an overall blue-collar level (LO), to increase knowledge of salient issues connected to digitalisation. In their survey reports, TWU and CBU have identified AM-related issues amongst their members and made corresponding policy recommendations. Amongst other things, TWU (2024) demands that employers guarantee transport workers' influence in all stages of technology implementation and take greater responsibility for skills development.

TWU also calls for a change in the Swedish implementation of the GDPR so that not only private individuals but also trade unions can lodge complaints with the Swedish Authority for Privacy Protection (*Integritetsskyddsmyndigheten*, IMY) (Transportarbetareförbundet, 2024). The CBU, for its part, calls for expanding the usage of the GDPR and co-determination rights involving workers, securing a healthy and safe work environment when introducing digital technologies, and investing in skills development and working conditions (Wrangborg & Söderberg Talebi, 2023). At the federal level, LO assembled several sectoral unions in a so-called "Amazon group" to discuss AM-related challenges. LO has also developed checklists for sectoral unions to adapt to their respective industries to assess risks associated with digitalisation and AM.

The obstacles to successfully address risks posed by digitalisation were thus largely tied to general problems facing the Swedish labour movement. These included declining membership levels and poor knowledge of workers' rights in relation to digitalisation, both at workplaces and within sectoral unions. According to an interviewee from TWU, workers in sub-sectors with a high degree of unionisation reported a higher level of influence over digital tools deployed in their workplaces, testifying to the importance of union strength for worker co-determination in digitalisation.

5 DISCUSSION

5 DISCUSSION

This study focuses on the workplace ramifications of digital technologies and AM in non-platform work, exploring how these technologies affect work, workers' rights, and the prospects for workplace co-determination and democracy. We looked at the response of workers and trade unions to issues related to AM and the implications of these results for labour organising, solidarity and policy.

5.1 Work and workers' rights in an AM context

The results of this study demonstrate that the effects of digital technologies and AM entailed both improvements and degradations of working conditions in the three studied sectors. This lends empirical credence to the conceptual framework of Noponen et al. (2023) in which AM could be deployed to either enable or control workers. Whether the effects of these technologies on working conditions and workers' rights were positive, negative, or neutral depended upon the type, nature, and function of the specific systems, as well as the interplay between technology and contextual factors, such as the planning and implementation process and the organisation and power of local unions. Besides economic constraints, other critical factors shaping the outcomes of technological change for workers were the existence, knowledge, and engagement of worker representatives; the routines for systematic OSH management; and employers' knowledge, opportunity, and willingness to comply with laws and regulations. The influence of these factors emphasises the importance of analysing AM as a thoroughly sociotechnical phenomenon taking into account pre-existing power structures and organisational characteristics (Jarrahi et al., 2021; Lippert et al., 2023).

Overall, current findings indicate that the use of algorithmic instructions could serve as enabling tools, reducing cognitive and physical strain and optimising work processes so that workers have time to carry out necessary and sometimes more rewarding tasks. We also found that automatic, real-time directions could deprive workers of their skills and autonomy if used pervasively, without the possibility of using one's own judgment or overriding algorithmic decisions in consultation with colleagues or managers. The opacity of algorithmic decision-making (Kellogg et al., 2020) was a source of frustration and stress, especially when systems malfunctioned or decisions seemed irrational.

Similarly, digital monitoring could be perceived as legitimate if it improved safety or reduced thefts and fuel consumption, but not if the purpose was to control workers; infringe on individual integrity or underpin data-driven, individual-based performance appraisal. Within the warehouse context, the surveillance regime in many cases resembled what Jamil (2020) refers to as the "algopticon" – the algorithmic adaptation of Jeremy Bentham's prison architecture, where the permanent possibility of being watched serves to internalise managerial discipline.

Regarding workers' rights, we found that AM practices often violated privacy rights, the right for co-determination, and the right to a healthy and safe work environment. Firstly, employers frequently ignored employee rights to be informed about technological changes and the obligation to involve worker representatives before introducing digital systems. This not only abused the right for co-determination but also adversely affected privacy and the work environment. Circumventing risk assessments and the opportunity to safeguard against abusive practices, AM tended to pursue efficiency and control objectives without considering worker interests. In some cases, such as in the context of subcontracting chains in transportation, the employer's responsibility to ensure a healthy and safe work environment fell through the cracks

not purely out of ignorance or ill will, but due to the fractured division of power over the organisation of work between employers and customers.

Reflecting the previously voiced caution that AM practices can exacerbate existing vulnerabilities (Baiocco et al., 2022), the quality of the employment contract emerged as one of the main determining factors for the impact of AM at the individual level. Full-time employees seemed to be less negatively affected by AM and digitalisation than part-time and hourly employees; those with in-depth knowledge of the work process had more opportunities to ignore or work around algorithmic restrictions. Whether or not workers felt they could confront employers and make demands via their union representatives seemed associated with the power entailed by stable and materially secure employment. However, in line with Wood (2021) we also found that the use of algorithmic scheduling systems plausibly increased the risk and prevalence of short-time shifts, lowered employment rates, and facilitated piece-meal pay for standard employees, thus undermining the capacity for resistance.

5.2 Implications for Swedish trade unions, solidarity and policy

In all three sectors, there were examples of resistance and social dialogue alleviating the risks AM posed to work and workers, as described above. Notably, the presence and strength of local union clubs and safety representatives constituted critical safeguards against abusive and illegal AM practices. In this light, the Swedish model – with robust co-determination rights; strong unions engaged in collective bargaining; and work environment regulations, in combination with worker representatives ensuring compliance – remains a promising industrial relations model for "negotiating the algorithm" (De Stefano, 2019).

Nevertheless, we also found that AM posed new challenges to union strength. These are crucial to consider since a weakening of union strength and social dialogue implies that existing and potential future regulations on the use of AM and AI risk becoming toothless. In the long run, the adverse effects of AM on workers are likely to become more significant. As De Stefano and Doellgast contend, "[l]egal protections guaranteeing worker privacy and discretion are blunt instruments without mechanisms that also strengthen worker voice in how these protections are implemented" (2023). We draw on power resource theory to distinguish between different sources of union strength (see, e.g., (Refslund & Arnholtz, 2022) and (Korpi, 2022) with a focus on structural power (the power of workers to withhold labour and disrupt production), associational power (the capacity to form collective organisations and mobilise members) and institutional power (regulations, laws, collective bargaining systems, democratic institutions etc.).

Datafication, routinisation of work processes, individual monitoring and performance evaluation were seen to elicit competition for rewards and compensation between co-workers. This fragmentation and individualisation risks eroding worker solidarity and obstructs opportunities for communication and relationship building. In addition, work intensification caused by AM seemed to limit time and energy for interactions between colleagues at the workplace, with AM systems also requiring that workers interact with technologies instead of each other to carry out the job. The implications of these changes to the work environment were not only perceived as harmful for workers' health and wellbeing, but individualisation and alienation were also seen as problematic because solidarity and collaboration at workplaces were pauperised, negatively affecting the readiness for collective organising. Subsequently, AM and digitalisation could aggravate pre-existing trends of declining membership levels, threatening the associational power of trade unions.

Related implications for trade unions are potential changes in professional roles and identity due to technological developments. Since the core of AM is the fragmentation of the labour process, and because managerial direction can be extended through digital technologies, there is a consequent risk of a decline in specialised skills and, thus, a shared professional identity. This acts against the unions' core principle of collective solidarity.

This, in turn, is likely to shift the power relations at workplaces to the benefit of the employer, adversely affecting local dynamics of co-determination.

A topic discussed to a greater extent in retail and warehousing than in transport was the fear of job displacement as workers get replaced by machines. According to the trade union interviewees, the fear of automation one day replacing most human warehousing workers already exists in the largest Swedish warehouses. We saw how retail workers were already facing reduced job openings and fewer and more irregular working hours due to algorithmic scheduling and the efficiency targets of algorithmic solutions. While one union representative expected the development of a new social segment of employees that would be tasked with managing the technology rather than carrying out manual tasks, this could, in their opinion, lead to skill polarisation and an increasing gap in working conditions, with deteriorating conditions for those still employed to perform physical labour. Automation naturally dilutes structural power for unions, since it replaces labour that thus cannot be withheld.

Regarding institutional power, Sweden has undergone a neo-liberal policy shift like most Western countries, stretching back to at least the 1980s (Pierre, 2015; Skyrman et al., 2023). For Swedish trade unions, reforms to the union membership and unemployment insurance system in 2007-2008 saw union density decline steeply, especially among blue-collar workers (Kjellberg, 2023). This has meant a decline in institutional and associational power.

Considering these mechanisms, we developed a model illustrating the risk of a negative feedback loop from AM to working conditions and employee rights, mediated by union strength (Figure 1). De-collectivisation and de-unionisation due to regulatory modifications and changes at the level of the political economy in Sweden effectively reduce employers' adherence to co-determination and risk assessment obligations during the implementation stages of AM and digital systems used in organising work. Because workers' interests are then easily dismissed when configuring digital systems, there is a negative effect on working conditions that, in turn, implies thinner social cohesion and further de-collectivisation as the labour processes are fragmented and individualised. There is also the deskilling of workers to a larger extent, making them replaceable. Ultimately, this further exacerbates the trend for declining union membership and the numbers of safety representatives. This decline in associational power, in combination with the loss of structural power implied by replaceability, reduces the opportunities for collective action.

Responding to these challenges, trade unions discussed relying on both traditional strategies of collective bargaining and negotiating with employers, as well as novel approaches to address digitalisation and AM. Firstly, unions used their institutional power, invoking their right for co-determination, proper risk assessment, work environment regulations and GDPR to protect privacy. Secondly, they aimed to raise awareness and knowledge by conducting research surveys and interviews in their respective sectors about the prevalence and risks of digital monitoring and AM. They also formulated policy demands for policymakers and employers and shared best practices. These actions could redress the problem of low awareness of workers' rights in relation to AM practices amongst both union members and employers. To maintain their associational power, unions also engaged in recruiting new members.

Considering the limited amount of empirical data and rather narrow focus in terms of sectors of the economy, it is not possible to draw general conclusions regarding trade union reactions to AM. Nor is it possible to make propositions or suggestions related to future actions, especially considering this study did not set out to analyse trade union actions in relation to EU or Swedish policies. However, we can conclude that the actions observed in this study mirror the traditionally tech-positive attitude of Swedish trade unions. This attitude seemed to reinforce the proactive approach of the unions to engage in bipartite social dialogue with the employer side, and actively engage in tripartite implementation at the national level of relevant EU legislation, such as the AI Act and Platform Work Directive.

Figure 1. Illustration of the negative feedback loop of union weakening and AM.

- Union weakening due to politico-economic and regulatory changes + effects of AM on solidarity and structural power.

- Reduced worker representative involvement during implementation stages of AM at company/workplace level.

Union strength

Union influen[ce]

Workplace relations

Workplace conditions

- Fragmentation of work, individualisation, intensification and competition eroding co-worker interaction, solidarity. Deskilling causing replaceability

- Worse outcomes of AM on working conditions and workers' rights (controlling rather than enabling workers).

5.3 Implications for Swedish and EU policy

The Swedish model of labour market relations is permeated by an underlying resistance to labour market legislation, as it risks curtailing the discretion of the social partners to use sector-wise collective agreements for solving and regulating sectoral concerns. For that reason, Swedish trade unions have questioned emerging EU policies. The importance of collective agreements to the Swedish model has led to social partners and the government (so far) adopting a restrictive position to EU policy in the labour market area. However, as described earlier, once a law has been decided (such as the Platform Work Directive), union officials take a pragmatic attitude to make the best of the situation.

So far, the Swedish model has been able to coexist with European policy affecting Swedish legislation. Whether that will hold in the future is difficult to say. However, if the challenges facing Swedish trade unions, as illustrated in the negative feedback loop of Figure 1, sufficiently weaken the effective functioning of the Swedish model, legislation may indeed become more common. A complementary threat to the Swedish model would be a change in direction in the EU towards a less flexible and acceptable approach related to the Swedish model.

To counteract the negative feedback loop depicted in Figure 1, results from this study point to actions from Swedish policymakers that would strengthen the power resources of unions and, therefore, reinforce the Swedish model. One of these actions

could be to provide institutional structures and support to social partners to encourage trade union membership. Another would be to support the coverage of health and safety representatives (at the regional and workplace levels) as well as collective agreements. An important measure would be to support workers' skills, as AM and technological changes in general change the labour market needs for competencies. At the policy level, it is essential to effectively enforce the application of existing legislation, including in OSH (including risk assessments of new technologies), as well as data and privacy, such as GDPR and the AI Act.

6 CONCLUSION

6 CONCLUSION

This study focused on the workplace ramifications of digital technologies and AM, and how technology affects the prospects for workplace co-determination and democracy. Based on interviews with workers and trade union employees in the transport, retail and warehousing industries, we found that the effects of digital technologies and AM entailed both improvements and degradations for work. The impacts on work and workers' rights depended on the type, nature and function of the specific systems, as well as the interplay between technology and contextual factors, such as the position within a subcontracting chain, the existence and engagement of union and safety representatives, practices for systematic OSH management, and employment conditions. Our findings support earlier research showing how AM can either enable or control workers, depending on how it is deployed. In our study, algorithmic instructions were found to serve as facilitating tools that enhanced workers' capabilities, but also deprived workers of their skills and autonomy if used pervasively. Similarly, digital monitoring could be perceived as legitimate and improve safety, but also as infringing on individual data rights. Control over the system and transparency emerged as critical factors shaping these perceived consequences.

The extent to which AM led to deteriorating working conditions was found to be linked to the level of co-determination, as well as knowledge of and influence over the digital systems in workplaces. In both warehousing and retail, we found that using AM technologies for worker surveillance was restricted in contexts where local trade unions were strong, and there was within-company influence over the adoption of managerial technologies, for example, through feedback or active worker involvement in work practices such as shift structures, task rotation, and safeguards against individual-level performance evaluation and discipline. Notably, the transport sector illustrated the risks related to the diffusion of managerial control that was facilitated

by algorithmic systems, with the employees being led in their work process by third parties with no responsibility for their work environment and health. Powerlessness and resignation were found as a response, mitigated somewhat by the legally mandated OSH structures and union involvement. In retail, this shift of power and influence over technological configurations manifested in the centralisation of planning and scheduling, resulting in increased flexibilisation and precariousness. In all cases, the extent of algorithmic control was seen to be associated with health risks in terms of physical and psychological strain.

These results illustrate how AM practices challenge the co-determination process in safeguarding workers' rights and good-quality jobs. Firstly, AM practices support individualisation and potential isolation of workers. Secondly, the implications of AM on deskilling can be detrimental to professional identity and job satisfaction. At times when trade union membership levels are declining, the risks of individualisation, fragmentation and a decline in professional identity are problematic for a unified worker voice. Thirdly, in specific contexts, AM threatens the very existence of jobs, setting up a conflict between techno-positivism and the goal of high employment levels. Finally, by extending the reach of one employer and enabling control of the workforce by third parties, such as customers, digital technologies and AM practices challenge the existing regulatory frameworks of co-determination as well as health and safety. These risks in the context of the Swedish model of labour relations, where unions are traditionally hesitant to legislation, call for a strengthening of existing strategies to support local union organisations and workers. Importantly, these results illustrate that, although AM is still in a starting phase in terms of its potential hold over the labour process, it is expanding rapidly and, therefore, action to ensure its balanced application is needed now.

ABOUT THE FEPS-NORDIC DIGITAL PROGRAMME: ALGORITHMS AT THE WORKPLACE

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FEPS, together with our Nordic partners, Tankesmedjan Tiden, Kalevi Sorsa Saatio, Tankesmien Agenda, CEVEA, Arbejderbevægelsens Erhvervsråd (ECLM), Friedrich-Ebert-Stiftung Nordics, Cooperation Committee of the Nordic Labour Movement (SAMAK), and with the support of Nordics Trade Unions, came together for a Digital Research Programme to investigate these developments and their effects.

Over a period of two years, we worked together on three different research strands: one on company case studies of algorithmic management, where workers' performance is tracked and rated; another on online platforms, employment terms and algorithms; and research that led to this policy study on workers' experience in algorithmic management from surveys. Below, you will find more information on two previous publications of the FEPS-Nordics Digital Programme.

"Algorithms by and for the workers Towards a fair, democratic, and humane digitalisation of the workplace"

*Bonn Juego, Tereza Østbø Kuldova, Gerard Rinse Oosterwijk, January 2024*
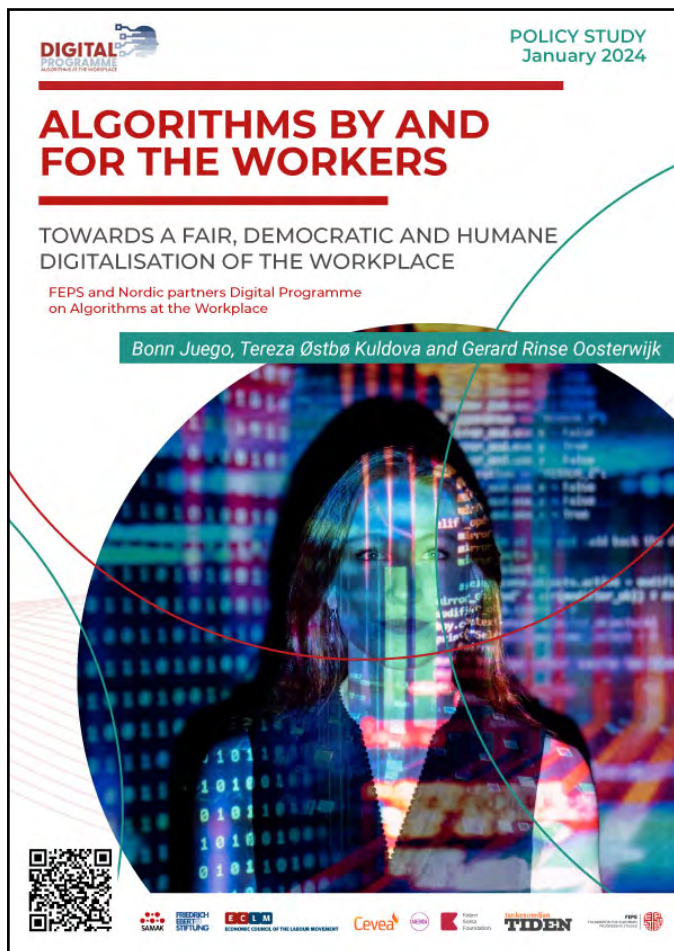
This policy study reflects on the complex interplay between technology and work, focusing on the impacts of algorithmic management (AM) techniques on workers' rights, dignity, and well-being. Drawing on preliminary findings from an ongoing study of FEPS in collaboration with Nordic-based partners, the policy study highlights the complexities and contradictions of AM and the limitations of current policies and institutions in dealing with the fast-paced digital transformation. It emphasises the importance of worker agency and participation in the innovation process.

It proposes the need to create socio-institutional frameworks to direct a pro-labour digital transition and institutionalise co-determination as a viable solution for workers to engage actively with incessant technical changes. It concludes with a forward-looking perspective, advocating for research methodologies and problem-solving approaches that cater to the needs of diverse working contexts. The purpose is to contribute to informed policymaking that ensures a fair, democratic, and humane work environment in the digital age.

Read it at https://feps-europe.eu/publication/algorithms-by-and-for-the-workers/

"Computer in command: Consequences of algorithmic management for workers"

Magnus Thorn Jensen, Gerard Rinse Oosterwijk & Asbjørn Sonne Nørgaard, June 2024
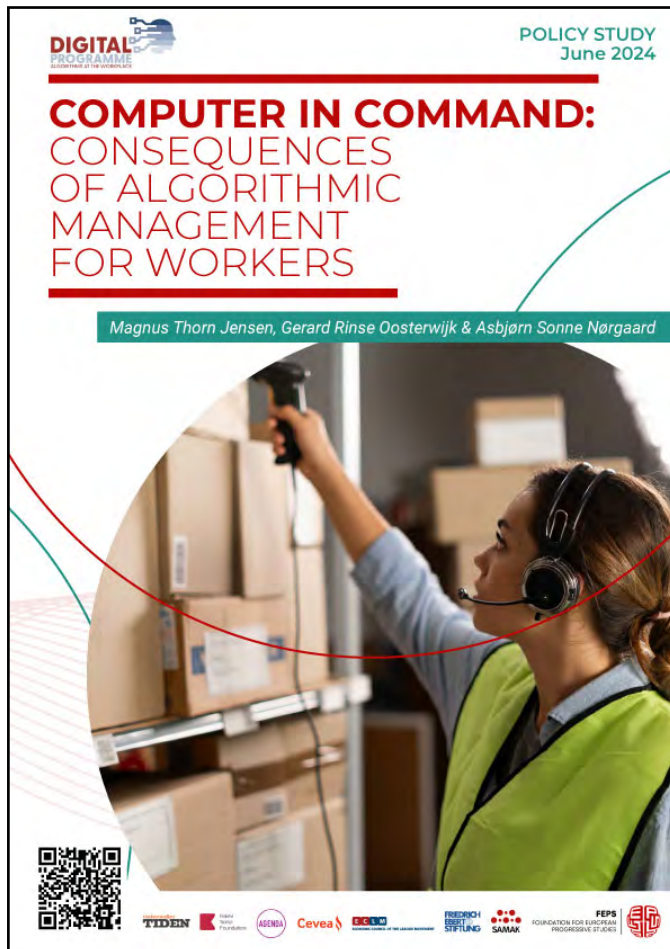
The integration of new technology in the workplace continues to spark intense debate. For years the debate has centered on the fear that robots and computers will displace human workers. Recently, the focus of the debate has shifted: rather than being replaced by computers, more and more employees find themselves managed by computers. Tasks that were once the domain of human managers are now performed by computer systems – a phenomenon known as 'algorithmic management'.

The study is based on a large survey conducted among union members in the warehousing and customer service/telemarketing sectors in Denmark, Sweden, Norway, and Finland.

This use of algorithmic management has several adverse consequences for employees. Workers exposed to algorithmic management experience less job autonomy, increased workloads, and heightened stress levels. Additionally, the study shows that algorithmic management is associated with less trust between employees and management, lower levels of job motivation and satisfaction, and a heightened fear of losing your job. Importantly, the study shows that these adverse consequences are not unavoidable altogether. High levels of employee influence in the workplace and transparency of company decisions significantly reduce the negative effects of algorithmic management. This is crucial insight for policymakers, unions, and others who want to ensure that the digitalization of work does not compromise job quality and workers' well-being.

Read it at https://feps-europe.eu/publication/computer-in-command/

Algoritmen som chef: Konsekvenser av algoritmiskt styrt arbete

Jenny Wrangborg och Magnus Thorn Jensen, Juni 2024

Som en del av FEPS och dess nordiska partners Digitala program om algoritmer i arbetslivet, syftar denna studie till att bidra med kunskap om vilka konsekvenser algoritmiskt styrt arbete får för anställda på Svenska lager. Algoritmisk styrning innebär att datorer eller algoritmer används för att utföra uppgifter och funktioner som traditionellt utförts av mänskliga chefer.

Som den första storskaliga kvantitativa analysen i sitt slag pekar resultaten i denna studie på att användningen av algoritmisk styrning i genomsnitt har flera negativa konsekvenser för de anställda. Ju mer arbetstagarna exponeras för algoritmisk styrning, desto mindre autonomi upplever de att de har i sitt arbete, desto mindre tillit känner de från och gentemot sin arbetsgivare, och desto större arbetsbelastning upplever de. Användningen påverkar också de anställdas välbefinnande på arbetet: När algoritmisk styrning används i stor utsträckning är de anställda mindre nöjda med sina arbeten och mindre motiverade, och de känner sig betydligt mer stressade och mer osäkra på om de kommer att få behålla sitt jobb.

Men studien visar också att några av dessa konsekvenser går att förhindra genom arbetstagarinflytande och transparens i företagsbeslut. Därför är det av största vikt att säkra att de fackliga organisationerna har tillräckliga verktyg för att försvara sina medlemmars intressen när det kommer till nya digitala system i arbetslivet. Både för att skydda de anställda mot ett dystopiskt arbetsliv där varje aspekt av arbetet kan övervakas och styrasoch för att se till att den svenska modellen, med sitt stora förtroende mellan arbetsmarknadens parter, står stark också på morgondagens digitala arbetsmarknad.

Read it at https://feps-europe.eu/publication/computer-in-command/

"Algorithmic Management in the workplace: Case studies on the impact of algorithmic technologies in seven sectors of the nordics"

Theo Cox and Gerard Rinse Oosterwijk, October 2024
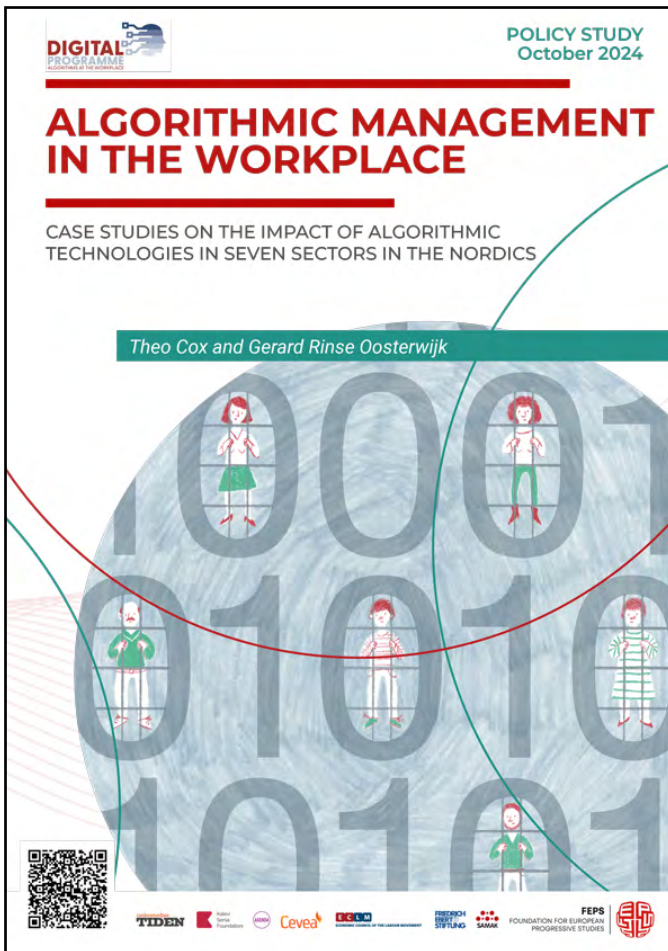
Algorithmic management, utilising algorithms and artificial intelligence to oversee and direct workers, is increasingly shaping the landscape of European workplaces. While narratives of technology-driven workplace transformation are alluring, the realities of increasingly automated and digitalised management present cause for concern. **This policy study explores these impacts with a focus on the unique labour environments of the Nordic countries—Finland, Sweden, and Norway—where long-standing traditions of labour organisation intersect with rapidly advancing technologies.**

Through detailed case studies across various sectors, including transport, retail, and finance, the report uncovers how these digital tools can exacerbate worker stress, diminish autonomy, and heighten job insecurity. However, it also identifies scenarios where meaningful worker participation and robust union involvement have mitigated these negative effects, showcasing the potential for more equitable outcomes.

The study highlights critical issues such as the **erosion of worker rights, the increasing imbalance of power between labour and capital, and the pervasive nature of workplace surveillance**. It provides targeted recommendations for EU policymakers, urging the implementation of stronger legal safeguards, greater transparency in algorithmic processes, and enhanced roles for trade unions in shaping the digital transformation.

Read it at https://feps-europe.eu/publication/algorithmic-management-in-traditional-workplaces/

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ABOUT SAMAK

The Cooperation Committee of the Nordic Labour Movement, better known by its abbreviation SAMAK, is an alliance of social democratic parties and labour councils in the Nordic countries.

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This report presents results from a study set in Sweden on the ramifications of digital technologies and algorithmic management (AM) and how technology affects the prospects for workplace co-determination and democracy. It specifically looks at the effects of AM on work and workers' rights in non-platform work, workers' response to AM-related issues, and the implications of these results for trade unions, solidarity, and policy.

The study is based on semi-structured interviews with informants in the retail, warehousing, and transport sectors in 2024 including five full-time trade union employees and 16 workers/trade union representatives.

The Swedish context is characterized by co-determination and occupational safety and health (OSH) legislation that supports workers' voice and comparatively high levels of collective agreement coverage and affiliation to workers' and employers' organisations. Although by tradition positive to new technology, Swedish unions have been hesitant to the introduction of EU laws regulating AM due to the preference to solve labour matters via collective agreements rather than legislation: the hallmark of the Swedish labour market model.