

Digitalisation and workers wellbeing: The impact of digital technologies on work-related psychosocial risks

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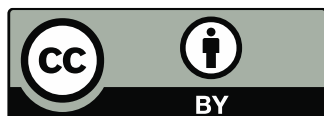
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Digitalisation and workers wellbeing: The impact of digital technologies on work-related psychosocial risks

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Abstract

This paper examines the psychosocial risks associated with the digital transformation of work, focusing on the automation of tasks, digitalisation of work processes, and the platformisation of work. It highlights that while automation and digitalisation can offer ergonomic and occupational safety and health benefits, they may also diminish worker autonomy and increase mental health risks. The adoption of digital technologies can improve communication and engagement but may lead to intensified workloads and can incentivise an 'always-on' culture. Platform work, with its precarious employment conditions, can also exacerbate occupational safety and health risks. The paper also argues that the spread of platform-like worker monitoring and algorithmic management to traditional workplaces can exacerbate certain psychosocial risks. The paper confirms that addressing these challenges requires a comprehensive approach that includes worker consultation, integration of OSH considerations from the design phase, and a holistic risk assessment that considers both technological and organisational contexts.

Keywords: digitalisation, psychosocial risks, occupational safety and health

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This paper synthesises evidence from recent JRC and EU-OSHA publications on the changing nature of work and skills. For more information on both institutions' research projects:

https://joint-research-centre.ec.europa.eu/scientific-activities-z/employment_en

<https://osha.europa.eu/en/publications>

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Executive summary

The digital revolution significantly alters the nature of work, bringing about important changes in work organisation and working conditions. While digitalisation leads to benefits and opportunities

for both workers and employers, it often comes hand-in-hand with working conditions that can exacerbate psychosocial risks for workers. The JRC and EU-OSHA have been analysing these impacts for the last few years. This paper synthesises the main available evidence produced by both JRC and EU-OSHA, putting a specific focus on occupational safety and health (OSH) risks. The paper is structured along three main vectors of change through which digitalisation of work can have an impact on psychosocial risks: the automation of tasks, the digitalisation of work processes, which enables telework and hybrid work as new modes of work, and the 'platformisation' of work, which entails the extension of features of platform work such as digital worker monitoring and algorithmic management to conventional workplaces. All of these vectors of change affect workers and can pose risks to their mental health, while also leading in some cases to benefits and opportunities.

Main findings

Recent research on the impact of **task automation** through digital technologies indicates a mixed effect on workers' safety and health. While automation often leads to ergonomic improvements and reduced physical effort, it can however also result in decreased worker autonomy, de-skilling, work intensification and increased stress, and therefore may put workers' mental health at risk.

As far as **digitalisation of work processes** is concerned, the evidence that we present seems to suggest that – under certain circumstances – it may lead to a significant decrease in OSH risks and improvements in physical work conditions, as well as enhanced communication, social interaction and employee engagement. Digitalisation of work processes is often perceived as an opportunity by both employers and workers, offering the potential for increased flexibility, autonomy and optimised workloads. Digitalisation can also provide tools for health monitoring to prevent stress and mental health issues. However, as the evidence presented in this paper also shows, digitalisation can also present various OSH challenges, such as increased work intensity, a blurring of work-life boundaries, and potential for the development of an 'always-on' culture that can contribute to stress and anxiety. The involvement of workers or their representatives in the decision-making process of technology introduction appears limited, although early worker involvement can lead to less resistance to the changes and a safer and more successful integration of new systems.

Digitalisation has facilitated the surge of **telework** since the Covid-19 pandemic. Prolonged exposure to telework can result in an increased workload, extended work availability and longer working hours, difficulties 'switching off' and disconnecting, and in some cases, increased worker monitoring and surveillance. At the same time, the reorganisation of workspaces often implied by hybrid work arrangements can also be detrimental to workers' safety and health, for example by isolating individual hybrid workers. This can also undermine on-site work activities, impose forced telework for some team members and impact team cohesion and collaboration.

The surge in recent years of **digital labour platforms** has been another channel through which the digital revolution has had a significant impact on work. While platform workers remain a limited share of the working age population in Europe, their working conditions have been in the spotlight due to their precariousness, resulting in an increasing regulation of this new form of work. Indeed, recent evidence shows that several features of digital platform work result in additional specific OSH risks. Platform work's isolated nature, with a dispersed workforce and high turnover in often inadequate work environments, contributes to a range of OSH issues, including sleep problems, exhaustion, stress, depression, burnout, loneliness and overall job and personal life dissatisfaction. The isolation hinders worker organisation, social dialogue, collective bargaining and the development of OSH management systems. It also challenges the promotion of training and access to OSH services and initiatives. Furthermore, despite its flexibility, platform work can be stressful, monotonous, and subject to constant monitoring, often extending into nights and weekends, potentially conflicting with personal life. As a result of this platform workers are more likely to be exposed to increased psychosocial risk factors compared to other workers, with more frequent

reports of increased workload, speed or pace of work determined by digital technology, reduced autonomy, heightened surveillance, and solitary work.

Last but not least, the **platformisation of work** can extend these risks to conventional workplaces. For example, AI-based worker management (AIWM) systems increase the exposure of workers to psychosocial risk factors, such as higher work intensity, reduced work autonomy, high cognitive overload and isolation, and can exacerbate work-related stress. Recent research shows that the conditions exist for these technologies to deteriorate job quality and increase psychosocial risks in Europe, since they embed a strong intrinsic potential for work intensification. Furthermore, all the technologies analysed have a strong potential for being used for intrusive worker monitoring and surveillance.

Overall, the implications of the use of digital technologies in terms of psychosocial risk factors differ significantly across the different vectors of change that we have analysed. Recent evidence points in the direction of some positive effects in the case of automation and digitalisation of work, coupled with potential risks in terms of mental health. Platform work is linked with features that represent a relevant risk in terms of stress and mental health, also because OSH provisions in most EU countries only apply to workers classified as employees. Additionally, the extension to traditional workplaces of AI-based or algorithmic management and digital monitoring of workers poses a significant risk of deterioration of job quality, leading also to a number of psychosocial risks.

Conclusion: The evidence synthesised in this paper confirms the importance of ensuring good OSH prevention to mitigate the potentially negative impacts of digital technologies on workers. This can be achieved by adopting an inclusive human-in-command approach, establishing proper accountability and transparency safeguards when introducing new technologies, ensuring proper consultation of workers and integrating OSH considerations from the outset when designing and developing new technologies in the workplace. Last but not least, good OSH prevention also requires adopting a holistic approach to evaluating risks related to the technologies. This implies taking into account not only the immediate risks stemming from the use of the digital technology itself, but also broader organisational and contextual factors that may amplify or contribute to mitigating these risks.

1 Introduction

The digital revolution is having a pervasive effect on the world of work that generates opportunities for job creation and can lead to more efficient work processes, increased productivity and better working conditions. However, it can also entail significant psychosocial risks factors for workers that can result in stress and mental health issues. Psychosocial risk factors are “those aspects of work design and the organisation and management of work, and their social and environmental context, which may have the potential to cause psychological or physical harm” (Cox and Griffiths, 1995, quoted in EU-OSHA, 2024). There is evidence that these risks are real and tangible in the EU: recent data from the EU-OSHA OSH Pulse 2022 survey shows that a significant share of workers in the EU-27 report that the use of digital technologies determines the speed or pace of their work (52%), results in increased workload (33%), reduces autonomy at work (19%), increases surveillance of workers (37%) or results in solitary work (43.5% of workers). These are all relevant psychosocial risk factors for workers.

Against this background, the impact of digitalisation on occupational safety and health (OSH) is an important source of concern, and researchers are devoting increasing attention to this topic. However, the way new technologies affect work, working conditions and employment is complex and fluid, and varies over time as digitalisation of work increases and evolves. Over the last few years both the Joint Research Centre (JRC) and the European Agency for Safety and Health at Work (EU-OSHA) have collected an extensive body of scientific evidence on the implications of digitalisation in terms of workers’ psychosocial risks and mental health issues, and also on the management practices of such risks and issues at workplace level. This body of evidence has been the result of ambitious research programmes on the changing nature of work. The core research question over these years has been to understand the different ways through which digital technologies are affecting the world of work, with a strong focus on work organisation, working conditions and job quality, including OSH. The JRC research agenda has systematically looked into the potential deterioration of working conditions and job quality as a possible negative outcome of the digital revolution in the world of work, and this has led to significant evidence pointing towards an increase in psychosocial risks. EU-OSHA, on the other hand, has systematically investigated the implications of the digital transformation for OSH in terms of risks and challenges, but also in terms of opportunities for OSH improvement.

Following Fernández-Macías (2017), in this paper we analyse the impact of digital technologies on work and employment along three main vectors of change:

- the automation of work looks at the replacement of human labour by machines and software performing specific tasks;
- the digitalisation of processes focuses on the increasing use of digital tools at work, translating parts of the physical production process into digital information and vice-versa;
- and the platformisation of work analyses how digital monitoring and algorithmic management practices, which used to be typical of digital labour platforms, extend into conventional workplaces.

The paper examines how these vectors of change and their implications have consequences for psychosocial risk factors influencing workers’ mental health. Section 2 develops the vectors of change and implications for work presented in the introduction into a simple conceptual framework to analyse psychosocial risk factors through the lens of the digital revolution. Section 3 puts the focus on automation of tasks. Section 4 then analyses the digitalisation of work processes, while Section 5 focuses on telework and hybrid work arrangements. Section 6 discusses the implications of digital labour platforms in terms of working conditions, including OSH, and Section 7 delves into the platformisation of work. We conclude by discussing the main findings and drawing some policy insights.

2 Analysing psychosocial risk factors through the lens of the digital revolution

Findings from JRC and EU-OSHA research highlight that the digital revolution comes with a range of opportunities for both employers (e.g. increased efficiency) and workers (e.g. reduced physical risks, less repetitive tasks, development of new skills), including opportunities to improve occupational safety and health (OSH) (see Box 1 in section 4). Nevertheless, the changing nature of work resulting from the digital revolution translates also into risks for workers' safety and health. In this paper, while we acknowledge the opportunities and potential benefits for workers stemming from digitalisation, our focus is on the risks that the digital revolution entails for them.

The vectors of change outlined in the introduction can potentially have four different and closely interrelated types of implications:

- direct changes in tasks and occupations;

direct changes in the physical, psychological and environmental requirements and conditions of work;

indirect changes in working conditions, which are mediated by social and institutional factors;

and indirect changes in industrial relations which, in turn, can influence all the other aspects.

Each of these types of changes, in turn, can entail both physical or psychosocial risks for the worker. Our focus is on the psychosocial risks, often overlooked in relation with the use of digital technologies at work. As showed in Table 1, psychosocial risks related to digitalisation can arise from poor work design, organisation and management, as well as a deteriorated social context of work, and they may result in negative psychological, physical and social outcomes such as work-related stress, burnout or depression. There are many ways through which these risks can materialise: excessive workloads; conflicting demands and lack of role clarity; lack of involvement in making decisions that affect the worker and lack of influence over the way the job is done; poorly managed organisational change, job insecurity; ineffective communication, lack of support from management or colleagues; psychological and sexual harassment or third-party violence¹.

There is plenty of scientific evidence indicating that the digitalisation of work can have relevant physical and psychological effects on workers. For example, by standardising job content and reducing worker autonomy (Wood, 2021) digital technologies can turn work into a fragmented and meaningless experience, leading to increased stress, anxiety or depression. Platform work in particular has been shown to be linked with a lack of autonomy which is, in turn, also associated with diminished job quality and increased psychological harm (Kellogg et al. 2020; Lee et al., 2015). This lack of autonomy has also been observed in conventional workplaces, for example in the logistics sector, a highly platformised sector in which high levels of digital monitoring and algorithmic management have been reported (Wood, 2021; Delfanti, 2019). Similarly, digital technologies can lead to social isolation, work-life balance issues or job insecurity, which can in turn also generate stress. This can happen when workers are deprived of organisational support (Bérestégui 2021). In the specific case of platform workers, the remote and decentralised nature of their work is particularly likely to lead to social and professional isolation (Wang, Li and Coutts 2022, Bérestégui 2021). Existing evidence also seems to suggest that the pervasive use of digital technologies at work can lead to work intensification. This in turn is clearly linked with stress and anxiety (Cooper and Roden 1985, Kushnir and Melamed 1991, Narayanan, Menon and Spector 1999, cited by Urzi Brancati et. al. 2022) which may ultimately result also in lower worker performance (Westman and Eden 1992). Todolí-Signes (2021) also shows this effect linked to algorithmic control requiring workers to adapt the pace of their work.

¹ <https://oshwiki.osha.europa.eu/en/themes/psychosocial-risks-and-workers-health>

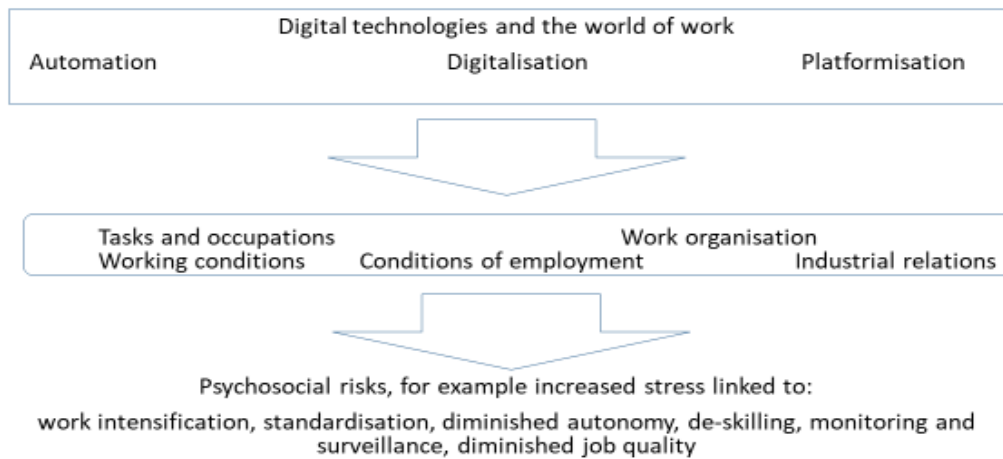
Table 1. A taxonomy of psychosocial risk factors linked to digitalisation of the workplace and related mental health outcomes

Psychosocial Risk Factor	Description and related mental health outcome
Fear of job loss/job insecurity/financial insecurity.	Job and income insecurity are major work-related stressors and have been associated with poor mental health, burnout, depression, anxiety and physical health issues such as fatigue and pain
Long or irregular working hours. Time Pressure	Prolonged working hours can lead to fatigue, which is a significant OSH hazard. Increases stress levels and can lead to rushed decisions and mistakes, compromising safety and health.
Excessive Workload	Leads to chronic stress, burnout, and physical health problems due to sustained high levels of effort.
Monotonous Work (Work Underload)	Can cause mental disengagement, reducing vigilance and increasing the risk of accidents.
Cognitive overload	Occurs when the amount of information-processing required exceeds the cognitive capacity of the individual; this may lead to decreased performance, increased stress, and potential errors.
Poor Communication or Cooperation within the Organization	Creates confusion, misunderstandings, and conflicts, affecting mental well-being and productivity.
Lack of Involvement in Making Decisions that Affect the Worker	Reduces job satisfaction, increases stress, and can lead to decreased motivation and engagement.
Lack of Autonomy and lack of control over one's work	Lack of autonomy or lack of influence over how the job is done, an important source of stress that negatively affect mental health especially when coupled with high demand/time pressure/excessive workload.
Third-party violence (threats, abuse, assaults from members of the public): having to Deal with difficult customers, patients, pupils, etc. Includes cyberviolence.	Exposes workers to emotional strain and potential conflict, increasing stress levels. Exposure to abuse can directly affect mental and physical health, leading to stress, anxiety, and long-term psychological harm.
Poor Social Relationships within the workplace including Harassment, Bullying and Sexual Harassment	Can lead to isolation, decreased job satisfaction, and mental health issues like depression and anxiety.
Conflicting Demands and Lack of Role Clarity	Cause stress and uncertainty, making it difficult for employees to prioritize tasks and manage their workload effectively.
Lack of Support from Management or Colleagues	Leaves employees feeling undervalued and isolated, which can exacerbate stress and negatively affect mental health.
Sense of Unfairness/Discrimination	Undermines trust in the organization and can lead to disengagement, stress, and mental health issues.
Lack of adequate skills/ lack of Training	Leads to a lack of confidence and competence in performing job tasks, increasing stress and the risk of errors.
Lack of Trust	Lack of trust erodes the foundation of positive workplace relationships, leading to increased skepticism, reduced cooperation among employees, and higher stress levels. This ultimately affects overall organizational effectiveness and employee well-being. Trust issues can also concern lack of trust in the technology, which may lead to over-reliance on it on one side, and underutilisation on the other.
Change of job roles	Change of job roles can be seen as a psychosocial risk as it may involve new skills that workers have not yet acquired and lack of adequate training; in addition, when the new role is perceived as less skilled or prestigious it can lead to feelings of undervaluation or an identity crisis.
Exposure to Physical Hazards at Work	Working in the presence of physical hazards is a psychosocial risk factor. While stressful work an exacerbate the risk of musculoskeletal injuries, or working at a fast pace can lead to a higher risk of accidents and injuries.

Source: EU-OSHA (2024b)

Figure 1 summarises the pathways of potential impacts of digital technologies on psychosocial risks, anchored in the scientific literature on the topic. In a nutshell, automation, digitalisation and platformisation of work tend to standardise work, reduce worker autonomy, limit social interaction, intensify work and lead to enhanced monitoring and control. All these features can, in turn, lead to stress, anxiety and more generally different forms of physical or psychological harm for workers.

Figure 1. Possible pathways of impact of digital technologies on psychosocial risks



Source: own elaboration

A recent review of EU-OSHA’s literature on this area (EU-OSHA, 2024b) also shows how the way that different types of digital technologies used at work are associated with different psychosocial risks (see table 2).

Table 2. Psychosocial risk factors associated with specific types of digital technologies

	AI for Worker Management (AIWM)	Platform Work	Smart Digital Systems	Advanced Robotics and AI	Remote Working Technologies
Lack of Trust	✓	✓	✓	✓	
Cognitive Overload	✓	✓		✓	
Fear of Job Loss/Job Insecurity	✓	✓		✓	
Poor Communication and Poor Social Relationships	✓		✓		✓
Sense of Unfairness	✓	✓	✓		
Time pressure	✓	✓	✓		
Lack of autonomy	✓	✓			✓
Poor work-life balance	✓	✓			✓
Deskilling/Need for Upskilling	✓			✓	
Workload Increase			✓		✓
Lack of Training	✓		✓		
Professional isolation		✓			✓
Changes in Job Content				✓	

Source: EU-OSHA (2024b)

3 Automation of cognitive and physical tasks

Key insights

- The **impact** of automation technologies in terms of psychosocial risks **differs significantly across technologies and domains**.
- On the one hand, an **improvement in terms of safety and health** can be observed in some technologies as a result of (i) **reduced physical efforts and improved ergonomics** when physical tasks are automated, and (ii) **reduced cognitive workload** when cognitive tasks are automated.
- On the other hand, in some other cases the introduction of new automation technologies can lead to stress and mental health problems linked to **diminished autonomy** in the workplace, **lack of control** and an **intensification of work**.
- **When workers are consulted** before and during the early stages of the introduction of these technologies and there is adequate provision of information and clarity regarding the scope of the automation, **psychosocial risks can be minimised**.

The automation of labour has been a key focus of research on the impact of technological change on employment since the Industrial Revolution. Automation of work tasks refers to the replacement of human labour input by digitally-enabled machine input for some types of tasks within production and distribution processes (Fernández Macías, 2017). Recent JRC research on the impact of robotisation in manufacturing in Europe has shown that robots have had a small but positive effect on job creation, and at the same time have contributed to important productivity gains and resilience in the sectors where they have been introduced (Klenert et al. 2022, Antón et al. 2022, Jungmittag and Pesole 2019). However, this does not exclude potential changes in the nature of work, with an impact on working conditions. Indeed, in the scientific literature a number of psychosocial risk factors are reported in connection with the use of digital technologies in the workplace, including lack of autonomy, increased surveillance, loss of trust and fear of job loss.

Both the JRC and EU-OSHA have conducted in recent years research in the area of task automation through digital technologies, including artificial intelligence (AI). These studies show that **the impact of automation technologies on working conditions differs significantly across technologies, with negative OSH implications in some cases but tangible benefits in others**. Overall, these technologies often – but not always – have positive impacts in terms of improved ergonomics and reduced physical effort, but the diminished worker autonomy, de-skilling and intensification of work they often imply can increase stress and mental health risks.

EU-OSHA research in this area has looked at automation not only of physical, but also of cognitive tasks, through the use of advanced robotics and AI-based systems. The technologies analysed included, among others, systems for physical handling and quality control, product inspection, trenching via an automated excavator, image analysis of hazardous substances, video feed analysis and gas vessel inspection (EU-OSHA, 2023). Additional evidence collected through a number of case studies allowed the identification of specific steps for successful implementation, drivers and barriers for adoption of these technologies, and most importantly the implications for OSH. For example, the integration of sophisticated robotic systems could lead to ergonomic issues where humans and robots share spaces not originally designed for human use. This might force humans to work in awkward or uncomfortable positions and could heighten the likelihood of accidents and collisions, and experience stress related to a fear of possible accidents occurring, especially when the introduction of the technology has not been accompanied by training.

Additionally, the introduction of such systems may give **rise to various psychosocial risk factors**, such as cognitive overload, job insecurity or fear of job loss, heightened workload, issues of lack of trust towards the new technologies, diminished worker autonomy, data protection and privacy issues, the transformation of job roles, and increased social isolation of workers. From a strictly organisational standpoint, the implementation of advanced robotics and AI in the workplace can have implications in terms of communication and cybersecurity. It can also imply a need for upskilling and reskilling of workers (EU-OSHA, 2022a; EU-OSHA, 2022b; EU-OSHA, 2022c).

Recent JRC case studies on automation in services also revealed that different technologies can have very different impacts. Some of the technologies analysed (in particular, automated guided vehicles in large warehouses in the logistics sector) were seen to improve ergonomics by reducing physical effort and allowing workers to concentrate on core activities. Similarly, as identified in one of the EU-OSHA case studies, a manure cleaning robot shifted a previously highly physical job towards a supervisory role by automating several tasks on the farm, coupled with upskilling. Overall, in most cases the JRC case studies showed improvements in working conditions, but sometimes increased physical or cognitive workload and fatigue. The cases did not reveal an increase in working rhythms although the technologies analysed did limit the degree of worker autonomy to determine the pace of their work (Cirillo et. al. 2022). Finally, remote health monitoring devices used in health care increased workloads and required some upskilling, particularly for nurses. It is apparent from the JRC and EU-OSHA case studies that the different effects of digitalisation and psychosocial risk factors are closely interrelated and strongly influence each other. For example, the fear of job loss seems to be connected to the level of understanding workers have of the technology, trust in the system and the level of experience.

Another set of JRC case studies conducted together with the ILO on automation in manufacturing, covering the automotive and the garment sectors, revealed that the adoption of automation technologies has reduced heavy and repetitive tasks and improved health and safety for workers directly concerned by automation. However, similarly to some of the technologies analysed in the automation in services study, at least in the automotive sector, better OSH only concerns the physical dimension – ergonomics - while mental health risks emerged in some cases due to increased work intensity. Another common finding is the reduction of workers' autonomy, as they are now subject to increased standardisation of tasks together with an ongoing process of de-skilling of operators (Fana et. al. 2024). De-skilling can be linked to lower specialised skills requirements for certain production jobs (e.g., workers in cutting in the apparel and footwear industry), as well as to the deployment of digital technologies which concentrate intellectual tasks at the top and middle management level. As shown in EU-OSHA case studies, some companies acknowledge that in the process of automating their workflow specific skills become redundant and workers are no longer trained in them.

Importantly, a common feature of all the JRC/ILO cases was that trade unions play a very limited role when decisions were made to introduce a new technology. However, this lack of worker involvement was not seen in the EU-OSHA case studies. According to the EU-OSHA findings, the timing when workers are actively involved in the implementation process is heavily dependent on company size and whether the system is purchased from a third-party supplier or self-produced. Also, it was found that companies with early worker involvement reported less resistance in their workforce towards automation.

The EU-OSHA case studies also demonstrated that often the motivation for introducing an automation is OSH improvement, and in these cases provision of information to workers and worker participation allow acceptance of the new technology and its effective introduction into the workplace. In any case, most challenges for OSH can either be managed as they arise or even be prevented in the first place. Early OSH management during implementation, early worker involvement, human-centred task design and clear communication are effective tools to address most issues.

4 Digitalisation of work

Key insights

- Digitalisation of the workplace may lead to data-driven management and affect work organisation and job quality, including occupational safety and health. Case studies show nevertheless a generally **positive impact on job quality thanks to a decrease in manual and routine tasks**.
- On the other hand, this is coupled with **increased work intensity and very limited involvement of workers in decision-making processes** linked to the introduction of technologies.
- Like in the case of automation, the involvement of workers in all the phases of technological change can help prevent these risks.
- Digitalisation can also promote an **“always-on” culture that can lead to anxiety and stress**, and opens up the possibility for intrusive worker monitoring and surveillance.

The use of sensors and rendering devices to translate parts of the physical production process into digital information (strings of bits), and vice versa (Fernández Macías, 2017) is one of the most visible aspects of digitalisation of work and workplaces. By changing business models and work organisation, digitalisation can reduce costs and improved resource utilisation, leading to increased revenues, but it may also affect job quality, with potentially relevant implications in terms of psychosocial risks.

A joint study conducted by JRC, Eurofound and EU-OSHA (Urzi Brancati, Curtarelli and Riso 2022) describes how the **digitalisation of the workplace** may lead to data-driven management and affect work organisation and job quality, including OSH. Digital technologies enabling data-driven management at the establishment level can improve performance, provision of training and worker autonomy, while leading to greater job complexity. Two case studies conducted in Spain² in 2021 on **digital technologies at work** (Grande, Vallejo-Peña, A. and Urzi Brancati, C. 2021) also revealed **mostly positive impacts** on job quality. This was achieved in particular through a decrease in manual and routine tasks in all the establishments analysed, coupled with a significant upskilling process linked to the new tasks and work processes implemented through the new technologies. It is also important to note that in these cases one of the most relevant effects of the introduction of new digital technologies was the **significant reduction of OSH risks and the improvement in the physical conditions of the workstations** (posture-related, ergonomic, vibration, noise, temperature, etc.). Furthermore, an improvement in communication and social interaction was observed in both cases, with a positive effect on the level of employee engagement in the workplace.

EU-OSHA research (EU-OSHA 2019; EU-OSHA 2022; EU-OSHA 2023) corroborates these findings. According to these studies digital technologies are seen as an opportunity by both employers and workers, as they can provide higher flexibility and worker autonomy across various areas. When used in the workplace to support work organisation, they can support the rationalisation of workflows, balancing individual workloads and optimising performance at both individual and company level (EU-OSHA 2019; EU-OSHA 2022). Digitalisation also offers opportunities for direct health support and monitoring of workers. Digital counselling is expected to support workers' well-

² The focus of the case studies was on two technologies: 3D printing and Internet of things (IoT). The case studies were carried out in Spain: TTI-Algeciras (stowage and logistic port container terminal) and Airbus (manufacture of aerospace and defense equipment).

being, while smart digital tools may help monitoring parameters related to stress and mental health, preventing negative health outcomes and therefore also support the OSH management function (EU-OSHA 2022; EU-OSHA 2023).

Conversely, the digitalisation of the workplace also comes with a range of risks and challenges for OSH. In spite of the mostly positive situation described by Grande et. al. 2021, some OSH risks were also identified, in particular in relation to the **potential increase in work intensity, and also a blurring of working and non-working time.** While some of the changes induced by the new digital technologies may have allowed for more flexibility and better work-life balance for workers, some other changes may lead to increased time pressure and longer hours (Grande et. al. 2021). Similarly to the case studies on automation, in the two case studies conducted in Spain mentioned above a very limited degree of involvement of workers was reported in the process of introduction of the new technologies, thereby limiting their degree of influence in the process. Other risks observed are related to the **'always-on culture'** (that is, the impossibility to disconnect) or the anticipatory surveillance fear that can result in anxiety and stress. Alerts, warnings, reminders sent from the digital devices in use in the workplace can be stressful as they give a sense of constant oversight (EU-OSHA 2022; EU-OSHA 2023). All in all, all these factors can also result in a lack of worker trust in the technologies used in some of these systems, such as AI (EU-OSHA 2022; EU-OSHA 2023).

Box 1. Smart digital tools for OSH risk prevention

A specific group of smart digital tools has been developed with the objective of preventing OSH risks or react to them. Their use, benefits and potential challenges to employers and employees are discussed in EU-OSHA (2023). For example, in terms of preventing risks, new digital technologies embedded in stand-alone equipment (e.g., exoskeletons), in personal protective equipment (PPE), in wearables and sensors, in industrial facilities, etc., are able to nudge and even provide personalised feedback to workers' on how to manage their workplace's risks. In addition, they are able to provide aggregate data to OSH managers that can help them identify where risks occur, and act on them. In terms of reacting to risks, digital OSH monitoring systems can help track e.g. a lone-worker who is at risk, through man-down functions, and possibly reduce the time of rescue operations. The smart tools manage worker exposure to OSH risks by providing comprehensive and accurate data unavailable via traditional OSH monitoring methods. This way they can identify and measure data in a more systematic and overall improved way (compared to traditional methods), and identify and assess risks that may have been otherwise overlooked.

In addition to helping reduce worker exposure to risks, they may also minimise the harmful consequences of accidents and improve their investigation and reporting. Smart digital systems can also be employed to remove workers from performing the most hazardous tasks – for instance, using a drone to perform maintenance checks. However, new smart OSH tools may have adverse effects, and occasionally have a negative net impact on the worker. For example, exoskeletons may modify the redistribution of effort and can result in the emergence of new biomechanical constraints and risk factors for musculoskeletal disorders (MSDs). Sensor's accuracy is also important, this is particularly the case in working environments that may limit sensor accuracy because of, for example, fire, dust, heat, and presence of steel. In addition, smart digital tools allow for extensive collection of data on worker vital signs, performance or behaviour, which may be used for monitoring and surveillance purposes (and therefore to inform decisions about the worker, including dismissal). This is clearly outside of the originally intended use of these tools, which can actually be a source of concern and stress for the worker when there is awareness of this united use of the tools.

Source: own elaboration

As pointed out in EU-OSHA (2023) **worker consultation and participation** in all stages of the implementation of digital technologies – from the design stage to the introduction in the workplace or in the work processes – **is a key factor for preventing the psychosocial risks stemming from the use of the digital technologies**, and mitigating their impacts. To guarantee that digital technologies are implemented in the workplace coherently following OSH prevention principles, findings from the fieldwork highlight the importance of obtaining the support of many different

stakeholders, including works council, trade unions, worker safety representatives, ergonomists, operation managers, innovation managers, site managers, and production planners.

5 Telework and hybrid work

Key insights

- When digital technologies are used to work away from the employer's premises, such as in the case of voluntary telework, workers are more likely to report **increased motivation and job satisfaction**.
- **Telework** can negatively affect job quality through **isolation and work-life balance difficulties**.
- **Hybrid work arrangements** usually imply a reorganisation of workspaces that can also be detrimental to workers' OSH. This **can undermine on-site work activities**, and **impose forced telework** for certain team members.
- When not appropriately managed, the staggered presence of individuals at the office can lead to **prolonged feelings of isolation for individual** hybrid workers, also **impacting team cohesion** and collaborative efforts.

Digitalisation also enables remote work and telework, which surged massively in 2020 because of the Covid-19 pandemic and remains a very relevant mode of work with lots of potential benefits and opportunities, but also a significant impact on job quality and psychosocial risks factors. A qualitative study on telework conducted during the pandemic by the JRC (and continued by EU-OSHA at a later stage) showed a broadly positive picture for workers, but also pointed towards several challenges and negative implications for job quality, that could lead to an increase in psychosocial risk factors and an increased level of stress (Fana, M., et al. 2020).

The study showed that **workers were generally positive about teleworking**. In many cases working from home increased satisfaction and productivity, and allowed better reconciliation of work-family obligations. In contrast, other workers felt teleworking, and the ensuing communication through digital platforms, made it more difficult for them to receive meaningful feedback and exchange ideas with co-workers and supervisors. At times, for workers with children in school age, the negative impact was aggravated by school closures and the general lockdown. Yet, and despite the many challenges of adapting to the sudden, obligatory and high intensity telework, most of the respondents agreed that teleworking had upsides, and that they would be willing to continue to work remotely in the future, at least occasionally (Fana et. al., 2020).

On the negative side, many workers reported that the fact that they had less immediate access to colleagues could mean greater difficulties in team-working, mentoring or on-the-job learning, a limited level of support, and lower levels of informal co-operation. All these factors were identified as potential risks to career progression and job security. Further to this, a significant number of workers, particularly those with family responsibilities, reported a notable difficulty in separating working and non-working life, which could lead to stress and mental health issues.

At the end of 2021 EU-OSHA published a report presenting the findings of a study involving fieldwork with workers and employers (EU-OSHA, 2021). The study showed that almost two years into the pandemic **the impact of prolonged teleworking was leading to increasingly negative effects on workers' health and wellbeing**. While the findings were in line with the ones identified by the JRC study, especially with regard to the work-life conflicts of women teleworkers, they displayed additional evidence in particular in the area of psychosocial risk factors and mental health. More specifically, even if the interviewees were still appreciative of telework and

the range of related opportunities, the experience of prolonged working from home had resulted in an increased workload, extended availability time and longer working hours, difficulties in 'switching off' and disconnecting, and in some cases, increased monitoring and surveillance. Social isolation, including the lack of support from colleagues and managers, was reported as a common issue among teleworkers, and was frequently associated with increased stress and anxiety.

Stress was the most common reported outcome of (prolonged) exposure to such psychosocial risk factors, and also specifically in association with the use of the technologies ('technostress'). The increase in virtual meetings and other forms of digitally mediated communication, resulted in an impact on workers' mental health. The information or cognitive overload (namely, the need to manage multiple information channels leading to fatigue and loss of control over the information flow) was frequently mentioned by the interviewed workers as another outcome.

The employers responded to the new needs of teleworkers in some cases by providing ergonomic equipment and financial support, but also by collecting their views through surveys and launching initiatives to mitigate the psychosocial risks. **The general trend was to put in place mechanisms to increase communication to monitor performance, checking workers' well-being and preventing isolation.** Many employers maintained their usual meetings online or established additional regular meetings, and encouraged line managers to keep regular contact with employees. Other communication channels (chats) were also adopted to allow direct contact with co-workers and supervisors. However, only a limited number of the interviewed employers reported having considered telework and related risks in a more general comprehensive OSH strategy, or included home-based workplaces in their risk assessments (RA). When present, the works council also played an important role in monitoring well-being and channeling workers' requests.

With the aim of supporting workers and employers to implement safe and healthy telework practices, EU-OSHA carried out additional studies to identify examples of existing practices of risk prevention in the area of telework including those involving workers or workers' organisations (EU-OSHA 2021a). EU-OSHA also developed practical tools for workers (EU-OSHA, 2020; EU-OSHA, 2021b) and for employers (EU-OSHA, 2021b), including an online interactive risk assessment tool. In order to support policymakers, EU-OSHA carried out reviews of legislation and regulation on telework in all the EU-27 member states, which found significant differences in the national legislative frameworks that could explain why telework is more common in some countries than in others (EU-OSHA, 2021c; EU-OSHA, 2023b).

The post-pandemic world of work has seen the emergence of **'hybrid work' models**, with related negative impacts on workers in terms of work-life balance and stress as discussed in a EU-OSHA study (EU-OSHA, 2023c). Findings show that, besides sharing most OSH risks with telework, hybrid work also has some specific risks. For instance, the development of this working model often results in a reduction in office space at employers' premises, with increased adoption of flex-office and hot-desking arrangements. In these flexible models the workstations are no longer assigned to specific workers, who typically need to reserve a desk to work during specific periods at the office. The smaller office spaces mean that organisations cannot accommodate all workers simultaneously. The staggered presence of individuals at the office can lead to prolonged feelings of isolation for individual hybrid workers, which also impacts on team cohesion and collaborative efforts (EU-OSHA, 2023c).

6 Digital labour platforms

Key insights

- **Digital labour platforms** have surged in recent years. While platform work is flexible and offers job opportunities, it is also **associated with long working hours, work-life balance difficulties and stress**.
- The **employment status of platform workers is often unclear**, and this can lead to discrimination and diminished job quality and entitlements, including coverage by OSH regulations. Recent regulatory steps in the EU and some Member States aim to address this issue.
- The OSH risks that platform workers face are very similar to those associated with the same tasks performed outside the platform economy. However, there are additional **platform work-specific risk factors** and health outcomes, including income insecurity, sleeping problems, exhaustion, stress, depression, burnout, loneliness, and an overall dissatisfaction with one's job and personal life.
- **Algorithms** used by platforms to allocate tasks, monitor and evaluate workers' performance and behaviour can **undermine workers' autonomy, job control and flexibility, and result in heavier workload and exhaustion, and in negative impacts (such as anxiety and stress) on health and wellbeing of platform workers**. They also pose a **major risk in terms of worker privacy**.
- Platform workers are a **dispersed workforce** that faces social isolation and specific challenges to get organised and engage in industrial relations.

Digital labour platforms have been studied since their emergence by both the JRC and EU-OSHA in order to understand their characteristics and implications in terms of working conditions and OSH. Digital platform work can be defined as “all paid labour provided through, on or mediated by an online platform” (EU-OSHA, 2021:5). A digital labour platform can be defined as “an online facility or marketplace operating on digital technologies (including the use of mobile apps) that are owned and/or operated by an undertaking, facilitating the matching between the demand for and supply of labour provided by a platform worker” (EU-OSHA, 2021:5). In particular the JRC COLLEEM surveys (Pesole, et al. 2018) (Urzi Brancati, Pesole and Fernández-Macías 2020) have contributed to a better understanding of the prevalence of platform work in the EU and the socio-economic characteristics of platform workers. According to COLLEEM, the typical platform worker tends to be younger, better educated, and more likely to live in a larger household with dependent children.

Working through digital labour platforms can provide opportunities to those who face discrimination in traditional labour markets as worker's gender, age, education, ethnicity, or sexual orientation are usually concealed to clients. EU-OSHA research (EU-OSHA, 2023a) shows also that **platform work allows a high degree of flexibility and autonomy that many may find desirable**. In addition, digital platform work can **lower the barriers to employment** entry and re-entry, and can therefore increase labour market participation for all. Additionally, this type of work allows people to develop skills and gain experience, which in the longer term can potentially lead to jobs with better working conditions.

However, **these benefits can come at a cost in terms of OSH impacts**. Regarding OSH risks, one of the initial research efforts by EU-OSHA (EU-OSHA, 2022e) was mapping types of platform work to build a taxonomy to identify more correctly the OSH risks associated with this form of work, which encompasses several economic sectors and types of jobs. One initial distinction is between on-location and online platform work. Even if in both cases the tasks are allocated online (through

an app or via the web) to the workers, in online platform work they are provided entirely online, while in on-location platform work they are provided in a physical location. The related OSH risks are understandably different in the two types of platform work. Considering as well other dimensions of the work provision, such as the level of skills needed to carry out the work or the level of control exercised by the platform on the worker, it is possible to identify four main categories of platform work and the related OSH implications. For each of these types of platform work, EU-OSHA has carried out an exemplificative case study as reported in table 3.

Table 2. Types of digital platform work by dimension of labour provision (format, skills needed, level of control)

Dimensions	Type of digital platform work			
	Type 1	Type 2	Type 3	Type 4
Format of labour provision	On-location	On-location	Online	Online
Skills level required to execute the tasks	Lower-skilled	Higher-skilled	Lower-skilled	Higher-skilled
Level of control exercised by the digital labour platform	High level of control	Moderate level of control	High level of control	Low level of control
Example	Parcel delivery	Handiwork	Online content review	Remote programming

Source: EU-OSHA, 2022e

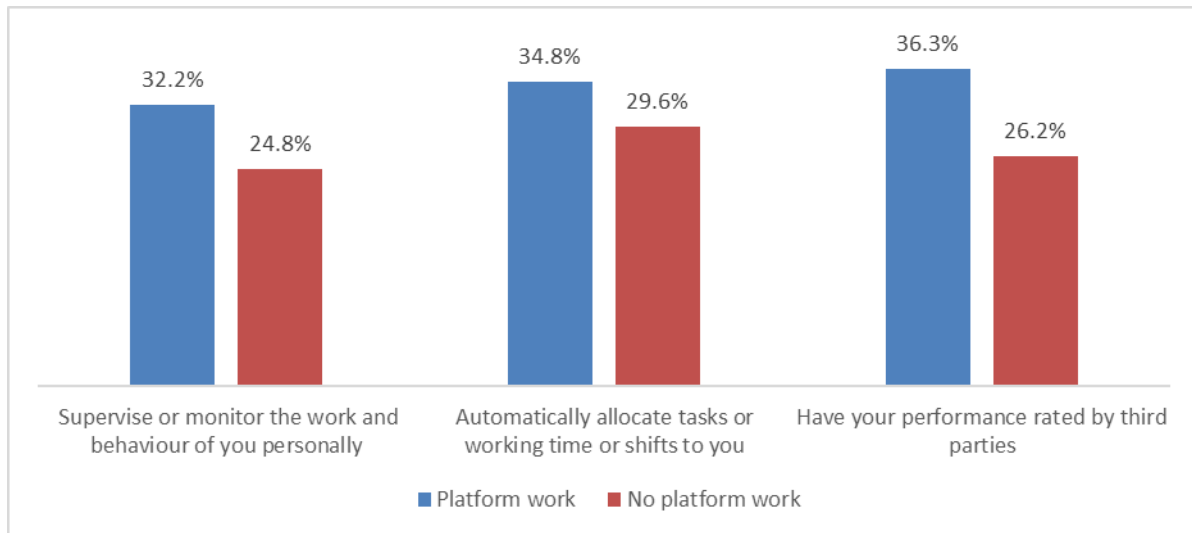
According to these case studies, **the OSH risks that platform workers face are very similar to those associated with the same tasks performed outside the platform economy.** However, there are a number of features of digital platform work that result in **additional specific OSH risks**, and it is more common in occupations that are generally riskier, such as transport and delivery.

A major concern is the **ambiguous employment status**, which creates a serious problem regarding OSH prevention in platform work. The COLLEEM surveys have systematically linked platform work with an unclear employment status. Platform workers are in most cases hired as independent contractors, which means that they may not be covered by basic employment rights, including sick or holiday pay, minimum wage, pension rights. Indeed, digital labour platforms tend to classify workers as self-employed independent workers, which may not match their actual working conditions. Being self-employed makes platform workers responsible for their own OSH, as in most EU Member States OSH legislation applies only to employees. Also, these workers are normally not targeted by prevention, monitoring and enforcement services, are almost always excluded from social dialogue initiatives and are not covered by collective bargaining, which puts them in a vulnerable position.

Algorithmic management (AM) is another feature of platform work that can give rise to OSH risks. Platforms use algorithms to allocate tasks, monitor and evaluate workers' performance and behaviour. This can undermine workers' autonomy, job control and flexibility, and results in heavier workload, exhaustion, anxiety and stress, negatively impacting health and wellbeing of platform workers. The algorithms often ranks and provides rewards or penalties to workers based on their performance or behaviour, which can be emotionally demanding. The overall lack of transparency on the way the algorithm works can contribute to insecurity and stress, and is a barrier to worker

participation and consultation. Furthermore, this process requires massive **data collection**, which may pose a threat to workers' privacy. Data from the EU-OSHA OSH Pulse 2022 survey³ confirm a higher prevalence – among platform workers compared to other workers – of supervision or monitoring of worker performance, automated allocation of tasks or schedule and rating by third parties (e.g. customers) through digital technologies.

Figure 2. Reported psychosocial risk factors associated with the use of digital technologies in the workplace and type of work (platform work/non-platform work), EU-27, 2022 (% of workers)



Source: authors' elaboration based on EU-OSHA OSH Pulse 2022 data

Digital platform work is mostly carried out in isolation by an anonymous and dispersed workforce, with a high labour turnover, in ill-adapted workplaces, frequently with inadequate equipment and with blurred work-life boundaries. The evidence produced by EU-OSHA shows that this can have a range of OSH implications for platform workers including **sleeping problems, exhaustion, stress, depression, burnout, loneliness, and an overall dissatisfaction with one's job and personal life**. The **social isolation** of platform workers limits possibilities to organise, and consequently social dialogue, collective bargaining and participation in the development of an OSH management system. Digital platform work comes with **significant job and income insecurity**, as most platform workers have little or no control, or negotiation power, over how much they can work and earn per task. Job and income insecurity are recognised psychosocial risk factors related to work. Even though platform work is frequently **recognised as very flexible** by the workers themselves, for many of them it involves a certain degree of stress, it is often perceived as monotonous, and it is in most cases subject to constant monitoring by the platform. The COLLEEM surveys have revealed that platform work often involves longer schedules, and it is more likely to

³ The 'Flash Eurobarometer – OSH Pulse survey' was carried out in 2022. The survey was commissioned by EU-OSHA to get insights into a range of impacts the COVID-19 pandemic has had on workers' health and wellbeing and related workplace measures, also in combination with the increasing work-related use of digital technologies. A representative sample of 27,250 employed individuals aged 16 and over was interviewed over the phone in Spring 2022 in the European Union member states (EU-27) (25,683 respondents) and in two associated countries (Iceland - 562 respondents - and Norway - 1,005 respondents -). The survey covers all the economic sectors. More information on the survey, including sampling and weighting strategies, technical and analytical reports, and country fact-sheets can be retrieved from <https://osha.europa.eu/en/facts-and-figures/osh-pulse-occupational-safety-and-health-post-pandemic-workplaces>, while the full dataset can be downloaded from https://search.gesis.org/research_data/ZA8753?doi=10.4232/1.14192.

be done at night and during weekends, in periods where it may conflict with family and personal life. Findings from the OSH Pulse 2022 confirm that platform work is frequently associated with increased psychosocial risk factors: platform workers are more likely than other workers to report increased workload (39.8% versus 32.3%), digital determination of speed or pace of work (59.6% versus 51.8%), reduced autonomy at work (23.7% versus 19.2%), increased surveillance (41.3% versus 37.1%) and solitary work (54.1% versus 42.8%).

EU-OSHA has carried out also research to **identify examples of actions** to prevent the risks associated with digital platform work by public decision-makers, by digital labour platforms or platform associations, by social partners and – although to a much lesser extent – platform workers themselves. Among the most relevant policy-level initiatives studied by EU-OSHA, it is worth mentioning the so-called ‘Riders’ Law’ in Spain, which introduced a right to algorithmic transparency and the presumption of a dependent employment relationship. In addition; the Italian legislative framework and the Bologna charter of fundamental rights of digital labour introduced OSH protection conditions for platform work and inspired similar initiatives in the Lazio region and in Milan, as well as changes to the national legislation including the legislative decree 104/2022 known as ‘transparency decree’ which introduced the obligation for the employers to inform workers about the use of automated decision or monitoring systems. Finally the French legislative framework consisting of a set of laws, such as the El Khomri law on the fight against fraud and the Mobility Orientation Law (LOM), grants a range of rights and protection to platform workers, like the right to form and join a trade union, right to disconnect and insurance against work-related accidents (EU-OSHA 2022e). In 2024 an agreement has been reached at EU level on a new Directive on improving the working conditions in platform work.

As shown in EU-OSHA (2023e), **platforms can actively promote safe and healthy work**. Some platforms have introduced a number of initiatives to integrate OSH aspects into the functioning of their apps and technologies, including hotlines, helpdesks, automated support systems, OSH messaging, tips and advice through app-based notifications, corporate group forums and interpersonal safety measures (e.g., emergency assistance or panic buttons). Other examples include the provision of safety nets in the form of sickness, accident and compensation insurance, healthcare and disability insurance, maternity and paternity leave, as well as tailored OSH training and awareness resources.

7 The ‘platformisation’ of work: digital monitoring and algorithmic management

Key insights

- The platformisation of work, or extension of features of digital labour platforms such as algorithmic management and digital monitoring to traditional workplaces, has a **potential to deteriorate job quality**, although limited evidence is available in this regard.
- The AMPWork survey, conducted in Spain and Germany, shows initial evidence that platformisation of work can be **mildly associated with worsened working conditions**.
- Evidence from case studies shows a potential deterioration of job quality as a result of algorithmic management, coupled with a **potential for intrusive worker monitoring**.

New organisational models based on digital systems and tools to gather and process data to monitor workers’ performance and to determine their pace of work, such as AI-based or algorithmic worker management systems (AIWM), initially common features of platform work, are increasingly being adopted in traditional workplaces. The JRC has referred to this phenomenon as the

'platformisation' of work (Fernández-Macías et al., 2023), which encompasses the use of digital devices, digital monitoring and algorithmic management. In this context, these new organisational models involve continuous monitoring of workers' performance to gather large amounts of data to be used to coordinate labour input through the use of computer-programmed procedures. This activity, which can be powered by AI or not, may involve automated allocation of work shifts and tasks, developing and delivering of job-related instructions, and assigning rewards or penalties. These technologies can improve service delivery, foster efficiency gains and streamline work processes, but they also entail risks for workers' occupational safety and health.

7.1 Impacts in terms of psychosocial risks and workers' mental health

These new forms of worker management based on AI or algorithmic systems, by automating management functions have several implications for the organisations that adopt them and for the workers themselves. They result in **changes to work organisation**, including a centralisation of control, a blurring of organisational boundaries and a redefinition of tasks and roles. Also, they contribute to altering employment relations and encouraging outsourcing. Finally, they result in **information asymmetries** between employers and employees, which weaken the bargaining power and the involvement of workers in the production process.⁴ These effects, in turn, can affect working conditions and job quality, and also impacts worker's safety and health (Baiocco, et al. 2022) (Figure 3) and the increased exposure of workers to psychosocial risk factors, such as **increased work intensity, reduced work autonomy, high cognitive overload and isolation, and exacerbate work-related stress** (EU-OSHA, 2023f).

Figure 3. The implications of algorithmic management for job quality



Source: Baiocco et. al. (2022)

A joint JRC-EU-OSHA study, drawing on a representative survey of European establishments (ESENER 2019) confirms that digital technologies enabling new forms of worker management are associated with increased psychosocial risks, which in turn can result in work-related stress and other mental health issues (Urzi Brancati and Curtarelli 2021). The study displays that OSH measures, such as having an action plan to prevent work-related stress, help preventing psychosocial risks in the workplace, but do not mitigate the relationship between psychosocial risks and management technologies.

The **intensification of work** is one of the most frequently reported work-related psychosocial risk factors related to the use of AIWM systems (EU-OSHA, 2022d). AI-based and algorithmic

⁴ Such information asymmetries (e.g. employers holding more information than workers) also endanger the proper consultation and participation of workers or their representatives, which is a cornerstone for OSH prevention and a legal obligation on employers as per Directive 89/391/EEC (the OSH framework directive). See: <https://osha.europa.eu/en/legislation/directives/the-osh-framework-directive/1>

management can lead to work intensification and increased pressure by relying on data-driven, automated processes to coordinate work, compounded by an increased standardisation of work that can lead to job dissatisfaction (Berástegui, 2021), all of them psychosocial risk factors. According to (Wood 2021) “The limited learning at work and influence over tasks, work intensification and insecurity [...] is likely to increase workforce stress and anxiety and be harmful to wellbeing and health”.

Loss of job control and autonomy are other psychosocial risk factors commonly reported in relation to the use of AIWM systems in the workplace (EU-OSHA, 2022d). Some AIWM systems can control work content, pace and schedule through worker direction, and little is left to be decided by the worker, taking away from workers the possibility to develop different ways of working in order to meet production targets without having adverse effects on their health. The loss of job control and autonomy is frequently associated with high levels of stress, and also leads to lower productivity, poor performance and increased levels of sickness absence⁵.

To increase productivity, organisations may implement AIWM **systems that monitor workers and direct them to work more and faster**. There is ample scientific evidence linking worker monitoring, a key feature of platformised work, with increased levels of stress and anxiety (Ball, 2021). This is especially the case when workers are aware that they are constantly monitored and evaluated, as a result they do not take breaks when needed, and this may lead to stress and exhaustion (and in turn to incidents, accidents and musculoskeletal disorders) (EU-OSHA, 2022d). Monitoring may also lower employee morale and result in higher employee turnover (Ajunwa, Crawford and Schultz, 2017). It is worth to mention that the link between performance monitoring – carried out with or without the use of digital devices – and employee stress has been observed for decades (Aiello 1993, Aiello and Svec, 1993).

As a consequence of the increased performance pressure and work intensity generated by the use of AIWM, **workers feel lonely and isolated as they communicate and interact less with their peers** (EU-OSHA, 2022d). Poor social interactions with peers at work is another well-known psychosocial risk factor. In turn, due to the poor communication between workers and lack of social support, the working environment does not facilitate camaraderie and, as a result, no close work community is formed. This may lead to fierce competition among workers and thus endanger cooperation, team spirit and the working climate more generally. These problems can increase work-related stress as well as workplace bullying. Besides, feelings of loneliness and isolation can lead to depression and anxiety (EU-OSHA, 2019). It can even decrease people’s capacity for reasoning and decision-making. Finally, loss of support from managers/supervisors in cases where AIWM systems replace them may also lead to increased stress, anxiety and, in some cases, burnout in workers.

Performance pressure and work intensification may also be exacerbated by **customer satisfaction rating systems** integrated into the algorithmic management system (EU-OSHA, 2022d). AIWM can use customers’ rankings to penalise workers, ignoring possible biases in the opinions of customers, which can lead to stress, anxiety and the feeling of job insecurity in workers.

EU-OSHA (2022d) research shows also that AIWM systems are also reported to profoundly alter the industrial relations within an organisation. For instance, the heavily competitive culture that AIWM systems can create through, for example, gamification can prevent workers from teaming up and can lead to the deterioration of organising and negotiating power. Similarly, heavy worker monitoring that allows employers to collect sensitive data on workers further shifts some power from workers to employers. This power imbalance can trigger feelings of anxiety and vulnerability

⁵ According to Karasek’s job demands-control model, ‘high-strain’ jobs, where workers have high demands at work and at the same time very little control over what they do at work, which is the case when AIWM is used (EU-OSHA, 2022d), have the highest negative impact on mental health.

in workers. Usage of AIWM could also lead to workers resisting algorithmic management, which might lead to animosity and lack of trust between workers and employers, in turn leading to negative psychosocial effects (EU-OSHA, 2022d).

In addition, as AIWM takes over certain tasks previously performed by workers, this may lead to situations where workers' initiative, concentration and skills are not required and jobs may lose meaning (EU-OSHA, 2018). A study of an Italian Amazon warehouse reveals that algorithmic direction dispossesses workers of essential and required knowledge for performing their work tasks. Such de-skilling of workers may result in decreased job satisfaction and increased work-related stress (EU-OSHA, 2022a).

Finally, but importantly, AIWM systems can also result in worker discrimination, as intrusive monitoring can involve collecting private and sensitive data, which can in turn be used to make automated or semi-automated decisions about the worker. This can result in favouring certain workers and discriminating against others, for example, at the stages of hiring or appraising/promoting workers (Fernández-Martínez & Fernández, 2020; EU-OSHA, 2018), especially when AIWM systems incorporate bias when designed. Discrimination is recognised as an important work-related psychosocial risk factor, and it is related to mental health issues (EU-OSHA, 2022a).

Recent case studies conducted by the JRC in collaboration with the ILO on algorithmic management in the logistics and healthcare sectors (Rani, U., Pesole, A. and Gonzalez Vazquez, I. 2024) **do not reveal a major deterioration of job quality in the European countries analysed** (Italy and France), **but do show that the conditions are in place for this deterioration to materialise in the future, with potentially negative impacts on mental health.** Case studies conducted in Italy and France on the introduction of these tools generally show them to have a mild impact, with benefits in terms of work coordination and improvements in the business models without pervasive negative consequences regarding job quality or visible negative implications regarding monitoring and surveillance of workers. In the case studies conducted in India and South Africa the situation was much more negative.

7.2 Evidence from EU-OSHA OSH pulse survey and the JRC AMPWork survey

Evidence from the OSH Pulse 2022 survey data confirms the **existence of psychosocial risk factors associated with the use of digital technologies in the workplace.** More in particular, 52.3% of EU-27 workers report that the use of the digital technologies determines the speed or pace of their work, while about 43% of workers report that the use of digital technologies in the workplace increases working alone, and 37% with increased surveillance, all recognised risk factors for mental health. Workers also report that the use of digital technologies results in increased workload (around 33%), or reduced autonomy at work (around 20%), which in combination with a reduced autonomy are crucial sources of work-related stress.

When focusing specifically on uses of the digital technologies related to worker management functions (namely to supervise or monitor the work and behaviour of the worker or to automatically allocate tasks or working time or shifts), the OSH Pulse data indicate that workers subject to digitally-enabled worker management are consistently more likely to report psychosocial risks in all the areas mentioned above, although the main concerns of workers are mainly related to the digital technologies determining the speed or pace of work or allowing an increase in surveillance at work. Also, digitally-enabled worker management is more frequently associated with the reporting of mental health-related issues such as stress, depression or anxiety, and overall fatigue.

The 2023 JRC AMPWORK survey measured the prevalence of algorithmic management in conventional workplaces, based on a statistically representative sample of the working age population in two EU Member States (Germany and Spain) (Fernández-Macías, E., et al. 2023). The survey found that the proportion of workers using digital tools and subject to digital monitoring and algorithmic management ranges between 10% and 20%. Algorithmic management is more

prevalent among clerks and operators in high-technology industries, knowledge-intensive services, and public administration, and is higher for those working outside of their employer's premises, such as at home, in a vehicle, or in public spaces. The automated allocation of work — or the assignment of shifts or working time via a digital device — is the most common form of algorithmic management, concerning 10% and 20% of German and Spanish workers sampled. A smaller share of workers are also allocated work activities, or have their pace of work determined by a digital device. 4% of German workers and 11% of Spanish workers follow automated instructions or directions at work. The survey found that automated direction is more common for those working in a vehicle (for example drivers and deliverers). Workers who are subject to automated direction are more likely to have monotonous work and tend to have less time flexibility and autonomy. Automated evaluation is more common for those working from home, and less likely when working in employers' premises. Overall, it appears that algorithmic management is mildly linked to poor work quality (Fernández Macías et al 2023).

8 Discussion and conclusions

Digital technologies are transforming the world of work, enabling the creation of new forms of work (e.g. platform work, new forms of outsourcing), new modes of work (e.g. telework) and new forms of worker management and monitoring (e.g. digital monitoring and algorithmic management). While the digital revolution has not had a massive effect so far on the destruction of jobs, the empirical evidence shows that it does have major implications in terms of the nature and organisation of work, and also implications for OSH, including in terms of psychosocial risk factors and mental health issues. Previously, computerisation impacted the nature of work mostly by changing tasks and roles within organisations. Recently, the accelerated pace of the digital revolution - due to the widespread work-related use of digital devices, the introduction of complex digital systems based on AI, the massive collection of worker data, and the increasingly generalised use of these data to feed the technologies - significantly impacts on tasks and occupations, affects work organisation, and increases worker exposure to psychosocial risk factors. More generally, the digital revolution is impacting on job quality and working conditions, and on industrial relations, while regulation in the area is not always fit to respond or is too slow to catch up with the new challenges posed by the digital transformation of the world of work.

In this report we have summarised available evidence from a wide range of recent JRC and EU-OSHA studies on this matter. Digital technologies create in the workplace the conditions for a new work organisation that can contribute to deteriorating job quality, increase exposure to psychosocial risk factors leading to more stress at work. At the same time, digital technologies can also improve ergonomics, reduce physical tasks and foster autonomy, and they can also be used to design specific tools to protect and foster occupational health and safety. The overall impacts depend on how the technologies are designed and implemented. However, the implications of the use of digital technologies regarding psychosocial risk factors differ significantly across the different vectors of change that we have analysed. Recent evidence points in the direction of some positive effects in the case of automation and digitalisation of work. As far as automation is concerned the evidence presented shows improvements in OSH from reduced physical effort and improved ergonomics. However, these improvements come together with mental health risks related to reduced worker autonomy. Similarly, the digitalisation of work appears to have led to some improvement in job quality thanks to the use of smart digital tools for OSH improvement and overall a reduction of physical and repetitive tasks, but this has also led to work intensification in some cases, and comes with data protection and privacy issues when it involves collecting and using worker's data. A common feature in both spheres is the limited degree of involvement of workers and their representatives in the design, development and implementation of the technologies, which can result in organisational changes that are ill-adapted to workers and do not take into consideration their characteristics and needs at work. At the same time, digitalisation enables telework and hybrid work arrangement which, on the one hand, can increase flexibility and improve work-life balance while, on the other, can negatively affect job quality through isolation.

Digital labour platforms are linked with features such as long working hours and unclear employment status that represent a relevant risk in terms of stress and mental health. The unclear employment status – if workers are not classed as employees – means that OSH provisions may not apply to them, which is the case in most EU countries. Conversely, the extension to traditional workplaces of AI-based or algorithmic forms of management, together with an increasing digital monitoring of workers poses a significant risk of deterioration in job quality and increased exposure to work hazards, especially psychosocial risk factors. Although available evidence is inconclusive concerning deterioration of job quality and working conditions in Europe, the intrinsic potential that worker management technologies have, for example, to intensify work, reduce worker autonomy or collect data for monitoring purposes and for intrusive worker surveillance requires attention to prevent the risks of deterioration of job quality and working conditions, including stress and worker mental health from exposure to psychosocial risk factors.

These phenomena create new challenges in several domains, including job quality, psychosocial risks, privacy, equality and fairness at work. The existing regulatory and institutional frameworks, which were designed for pre-digital forms of work, often cannot cope with these challenges. Further research to better understand the implications of these trends in particular in terms of exposure to psychosocial risk factors and workers' mental health is therefore essential in a future that most likely will see further regulatory action. Besides the provisions already defined or that could be potentially defined in the legislation, a number of factors based on principles that are key to OSH prevention are important to consider to prevent risks and to mitigate the impacts of digital technologies on workers:

- Firstly, adopting an inclusive *human-in-command approach* is key. AI and digital technologies should support, and not replace, human control and decisions. The design, development and use of digital systems in the workplace should aim to support workers and preserve their job control and autonomy.
- Secondly, it is imperative to establish accountability and ensure proper access to all relevant parties to information concerning the technologies employed and the data gathered from workers. Specifically, workers should be consulted and duly informed regarding the nature of data collected within their work environment and pertaining to themselves. They should be made aware of the purposes for which this data is gathered and who possesses access to it. The necessity of gathering worker data must be weighed against their right to privacy and their health and safety, adhering to the principle of minimising the collection of worker data.
- Thirdly, and related to the previous point, it is important to ensure *proper consultation and participation of workers and their representatives* in the development, implementation and use of technologies in the workplace. This entails ensuring transparency regarding how digital systems work, along with a clear understanding of their advantages and disadvantages. Equally crucial is bolstering digital literacy among both workers and employers through the promotion of qualifications and skills development for digital applications. This would equip them with a deeper understanding of digital systems, as well as the related OSH risks and opportunities, serving as a prerequisite for effective social dialogue and OSH prevention and management.
- Fourthly, OSH considerations must be integrated from the outset during the design and development phase. The 'prevention through design' approach should encompass not only the design of digital technologies in isolation but also the entire workflow where these technologies are implemented. Collaboration between programmers, designers, developers of digital technologies, OSH experts, employers, and workers and their representatives should commence from a project's inception. If digital technologies are not purposefully designed to enhance OSH, they are unlikely to fulfil this function effectively. Furthermore, there is a necessity to delineate the responsibilities and liabilities of developers and employers concerning the design, development, and utilisation of digital technologies in the workplace, including their potential OSH risks. This is particularly pertinent concerning the degree of autonomy exhibited by AI-based systems in decision-making processes.

- Finally and importantly, a holistic approach to evaluating risks related to the technologies is indispensable for comprehensive risk management. This involves taking into account not only the immediate risks stemming from the use of the digital technology itself but also the broader organisational and contextual factors that may amplify (or contribute to mitigating) these risks.

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