European Agency for Safety and Health at Work

Smart digital monitoring systems for occupational safety and health: workplace resources for design, implementation and use

Summary

European Agency for Safety and Health at Work

Authors: Kyrillos Spyridopoulos, Lucija Kilic, Mario Battaglini, Niklas Olausson, Pietro Regazzoni, Andrea Broughton, Dareen Toro (Ecorys)

Project management (EU-OSHA): Annick Starren, Ioannis Anyfantis, Emmanuelle Brun

This summary was commissioned by the European Agency for Safety and Health at Work (EU-OSHA). Its contents, including any opinions and/or conclusions expressed, are those of the authors alone and do not necessarily reflect the views of EU-OSHA.

Table of contents

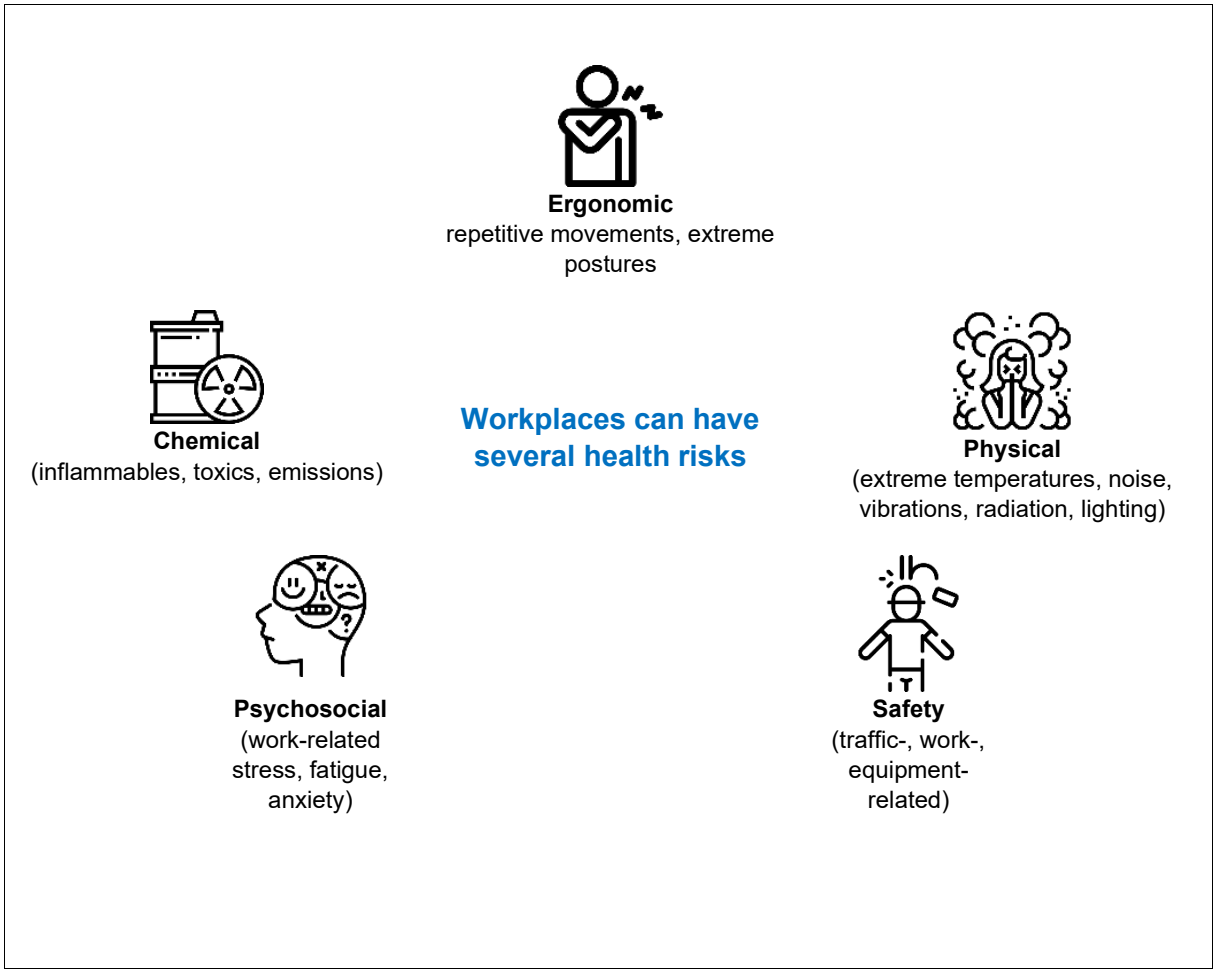
List of figures and tables

1 Introduction

Risks at the workplace can have negative impacts on and consequences for workers' wellbeing[1] and the wider economy at large.[2] New OSH monitoring systems (e.g. sensor-based systems) use digital technologies to monitor workplace risks by collecting and analysing data to identify and assess risks, prevent and/or minimise harm, and promote occupational safety and health.[3]

This summary report presents the results of EU-OSHA's report assessing available workplace resources and how companies can use them to effectively integrate new OSH monitoring systems at the workplace. It provides a brief overview and assessment of workplace-level resources relevant to the design, implementation and use of new OSH monitoring systems at different workplaces.

Figure 1. Examples of workplace risks[4]



[1] ILO. (2022). Diagnostic and exposure criteria for occupational diseases – Guidance notes for diagnosis and prevention of the diseases in the ILO List of Occupational Diseases (revised 2010). International Labour Organization. Available at: https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---lab_admin/documents/publication/wcms_836362.pdf

[2] EU-OSHA – European Agency for Safety and Health at Work, *The value of occupational safety and health and the societal costs of work-related injuries and diseases*, 2019. Available at: https://osha.europa.eu/en/publications/value-occupational-safety-and-health-and-societal-costs-work-related-injuries-and

[3] EU-OSHA – European Agency for Safety and Health at Work, Types, purposes, and uses of digital OSH monitoring systems: An assessment of risks, challenges and opportunities. (To be published November 2022).

[4] Figure based on information from: ILO (2016). Code of practice on safety and health in ports (revised edition) International Labour Office, Geneva., p. 406. Retrieved 23/05/2022 from: https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/normativeinstrument/wcms_546257.pdf . Chemical and physical icon made by Eucalyp from flaticon.com. Ergonomic, psychosocial and safety icon made by Freepik from flaticon.com.

2 Overview of methodology

The methodology consisted of both a literature review and stakeholder interviews. Among the 92 workplace resources identified, 55 workplace resources qualified for the analysis.[5] Resources were retrieved from a wide range of **manufacturing companies (i.e. companies that produce the OSH monitoring systems as well as companies using them)** and from **international (sectoral) resources** available through the International Labour Organisation (ILO) database and from social partners, encompassing a large variety of new OSH monitoring systems.

First, a comparative analysis of workplace resources for the group of companies and international sources/social partners has been executed, and secondly a critical assessment.

In parallel, 11 interviews were conducted with key informants (i.e. product manufacturers, companies, trade unions, health and safety authorities, certification bodies). The findings emerging from both exercises were compared and triangulated to provide a comprehensive overview of existing practices of integrating new OSH monitoring systems and to fill in potential gaps.[6]

For the purpose of this summary report, workplace resources include any type of product and activity that companies use at the workplace to enable workers to successfully accomplish their tasks and goals while enhancing their safety and health.[7] These products can be of different types or formats, including audio, visual or written documents, while activities can be delivered both in person or online. Most of the resources reviewed referred to new OSH monitoring systems that use a variety of sensor-based systems and technologies. Table 1 presents an overview of the workplace resources reviewed and their types, sectors and the technologies they refer to.

Table 1. Summary of workplace resources reviewed

Workplace Resource source	No of sources	Codes of practice	Guidance documents[8]	Training Material	Other[9]	Sectors	Technologies
Product manufacturers of OSH monitoring systems	31		10	2	19	Mostly cross-sectoral: industrial facilities (warehousing, manufacturing, etc.), construction, mining, oil & gas, healthcare, agriculture	AI, ML, IoT, wireless (Bluetooth, RFID) sensor and camera-based technologies in wearables/equipment
Companies using OSH monitoring systems	5		2		3	Construction, engineering	Sensor-based technologies, wireless (Bluetooth, RFID)
International resources (sectoral)	8	6	1	1		Shipping, mining, chemicals, textiles, agriculture, clothing, leather and footwear	Sensor and camera-based technologies
International resources (general)	11	3	5	2	1	Mostly cross-sectoral: industrial facilities (manufacturing), construction, mining, oil & gas, automotive, chemical, agriculture	AI, wearables, IoT, cloud, wireless Bluetooth
Social partner	1			1		Shipping	Sensor and camera-based technologies

[5] The analysis was based on a comparative grid formulated by the research team through an internal brainstorming exercise based on the findings of research work of a sister project from EU-OSHA on OSH monitoring systems, initial interview and literature review findings, and EU-OSHA's feedback.

[6] A detailed account of this analysis (including the comparative analysis of the workplace resources identified, as well as including the list of resources reviewed and key informants consulted) is available at the main report: EU-OSHA (2022). Workplace-level resources supporting the design, implementation and use of new (smart) OSH monitoring systems

[7] Based on information in: Rick, V. B., Rasche, P., Mertens, A., & Nitsch, V. (2022). Workplace health promotion: mHealth as a preventive mediator between psychosocial workplace characteristics and well-being at work. In V. G. Duffy (Ed.), *Digital human modeling and applications in health, safety, ergonomics and risk management. Health, operations management, and design* (pp. 249-265). Springer. https://doi.org/10.1007/978-3-031-06018-2_18

[8] Guidance documents can include user/implementation manuals, posters, videos and other materials.

[9] Other documents include case studies, marketing materials and reports.

Codes of practice aim to provide practical guidance for those who have obligations, responsibilities, duties and rights regarding safety and health in a given sector. The codes of practice reviewed primarily mentioned new OSH monitoring systems such as camera monitoring systems or other sensor-based systems used to prevent workplace risks (e.g. by improving traffic safety).[10]

Guidance documents such as **videos, posters, user manuals** and short **leaflets**, among others, provide instructions on how to use a new OSH monitoring system. Usually brief and concise, these types of resources tend to be developed by product manufacturers but can also be provided by companies to their workers independently or in collaboration with the product manufacturer. In turn, a set of publications from the ILO offer comprehensive guidance that is universally applicable or related to specific sectors and can support product manufacturers and companies to design their workplace resources.

Similarly, **training materials** aim to provide practical training on the use of the new OSH monitoring systems. Finally, **marketing materials**, **reports** and, more often, **case studies** were frequently included in documents to explain the implementation and results of the product manufacturers' solutions for clients across different industries.

Companies using new OSH monitoring systems that participated in the study also make use of a wide range of channels to inform workers about their implementation.[11] Among these, companies run in situ or remote trainings/visits in conjunction with product manufacturers, which allows for open dialogue between manufacturers, OSH managers and employees to assess a new system's implementation. Moreover, **direct technology testing by workers/operators** is viewed as fundamental by companies to facilitate the acceptance of a new system.

3 Comparative analysis and critical assessment of workplace resources

3.1 Comparative analysis of workplace resources

The comparative analysis of workplace resources was divided in two parts: A first part analysing workplace resources from international sources and social partners and a second part analysing resources from product manufacturers of OSH monitoring systems and companies using them.

This distinction was made as the two types of workplace resources are different in terms of their scope and thus merited a separate analysis. In particular, workplace resources from international resources are more particular to general safety and health provisions, both within specific sectors but also across sectors. In turn, workplace resources from product manufacturers are companies are explicitly referring to new OSH monitoring systems and are more relevant for their design and implementation.

The comparative analysis is available at the main report[12]. In turn, this report focuses on the critical assessment of these two types of workplace resources, which is presented at the section below.

3.2 Critical assessment of workplace resources

International (sectoral) resources seem to be the most useful in supporting workplaces to structure their own detailed, equitable and participatory approach to OSH monitoring by raising the awareness of stakeholders on monitoring and management, as well as the hierarchy of controls, the residual role of PPE and the need for it to be user-centred, and the regularity of risk assessments, among others. These sources provide guidance on how to improve OSH in the workplace, paying attention to risk factors, context and worker participation. **Although international resources are comprehensive, they do not include**

[10] Company-level policies, resources that are developed in-house and outline workplace health and safety procedures, were not identified by the research team due to its limited access to companies and their internal or confidential nature. Also based on feedback from Ecorys stakeholder interviews.
[11] According to stakeholder consultation (interviews) conducted as part of the study, 2022.
[12] EU-OSHA (2022). Workplace-level resources supporting the design, implementation and use of new (smart) OSH monitoring systems

much information on new OSH monitoring systems and cannot replace manufacturers' and companies' resources.

The latter resources narrowly focus on a particular new OSH monitoring system and its application at the workplace. When addressing workers, these are shorter (e.g. videos, posters), simple and relevant for implementation, while longer and more elaborate when targeting technical staff and OSH professionals (e.g. information on data management or software administration).[13]

Information on acceptable OSH thresholds in relation to different risks is mostly provided by international resources rather than product manufacturer/company resources.

In the case of resources produced by product manufacturers and companies, the limitations of new OSH monitoring systems are not included. A plausible explanation is that these resources are typically succinct (e.g., short 1-5 minute videos, posters, leaflets) and thus might not be the appropriate template to list a detailed account of the limitations, which are usually covered in toolbox talks or through prior consultation. Indeed, companies interviewed for this study reported to test new OSH monitoring systems with their workers before introducing them to their workplaces.[14]

Similarly, **resources from product manufacturers/companies lack information surrounding the use of data**, with the exception of resources developed by product manufacturers targeting company technical departments, which may include documentation on data issues. This could be explained by the fact that such information may be addressed before a new OSH monitoring system is introduced. Consulting workers ahead of a change in safety procedures in the companies interviewed was reported as a good practice that can improve workers' acceptance of the new OSH monitoring system; in the case of some countries,[15] strong legal frameworks legally oblige employers to negotiate with workers before introducing a new system.

In conclusion, **the limited number of workplace resources that are relevant to new OSH monitoring systems are mostly available from product manufacturers and companies**. There are other means beyond the above-mentioned resources that companies use to implement new OSH monitoring systems, as discussed in section 3: **involving workers in the testing, selection and optimisation of the new OSH monitoring system, in situ or remote trainings, as well as regular meetings with the OSH management professionals/team leaders**. Additionally, new systems can provide **on-the-job, real-time feedback** when workers are engaging in an unsafe behaviour through tangible indications.

There are two prerequisites for the effective integration of new OSH monitoring systems in the workplace: **workers' buy-in** and the **broader OSH framework of the company**. Firstly, bottom-up approaches may be more impactful as prior consultation with workers is proven to lead to the more effective implementation of a new system; for instance, designating workers as ambassadors and testers of a new technology has been reported to increase the acceptance of the system. Secondly, as new systems do not replace existing frameworks but rather amplify them, a strong safety culture is more likely to see the effective implementation of new OSH monitoring systems, meaning that new systems should not neglect existing OSH procedures.[16]

4 Gaps and needs in workplace resources developed in relation to new OSH monitoring systems

The review highlighted existing gaps and needs in relation to the above resources and to the effective implementation of new OSH monitoring systems, a summary of which is shown in Table 4. Despite the knowledge cultivated by companies on the new OSH monitoring systems' implementation, the **lack of knowledge sharing** between companies remains a challenge. A viable solution would be to create an online or in situ knowledge exchange forum for companies, which would enable OSH team leaders across companies to discuss common issues and exchange knowledge within a specific sector, thus positively contributing to the effective integration of new systems at the workplace. Additionally, it is necessary to

[13] For example, Reactec. (2022). *Software administration guide*. Available at: https://documents.reactecanalyticsplatform.com/Documents/SoftwareAdministrationGuide
[14] Ecorys interviews with stakeholders.
[15] Based on Ecorys interviews with stakeholders. Examples include Germany and Italy.
[16] EU-OSHA – European Agency for Safety and Health at Work, Types, purposes, and uses of digital OSH monitoring systems: An assessment of risks, challenges and opportunities, 2022.

consider the **needs of vulnerable workers** (with mental or physical disabilities, old/young workers, migrant workers, pregnant women and so on) in the implementation of new OSH monitoring systems.

Similarly, it is also necessary to ensure all workers with different digital competence can **access** workplace resources and find them relatable. The inability to **access** modern workplace resources among certain workers (e.g. older workers) could lead to low self-esteem and resistance to the introduction of more advanced technologies.

Moreover, **informing** workers about their **rights** in relation to new OSH monitoring systems and the use of their **data**, and engaging them during the selection and implementation phases, leads to positive experiences with technology.[17] **Workplace resources for new OSH monitoring systems may thus benefit from two-way communication and interactive elements to ensure the effective dissemination of workplace resources and increase workers' sense of participation and trust in the technology.** Given the **fast pace of technological advancements**, it is also necessary to strengthen cooperation between private and public stakeholders at EU, national and company levels, as well as opening a dialogue on the limits, risks and common issues in relation to new OSH monitoring systems.

Table 2. Summary of gaps and needs[18]

Summary of gaps and needs		
 Knowledge exchange	Gaps	Cross-company or cross-sectoral dialogues on new OSH monitoring systems is limited-company or cross-sectoral dialogues on new OSH monitoring systems is limited
	Needs	Sectoral initiatives for knowledge sharing/peer-learning activities between companies can help bridge knowledge gaps
 Addressing vulnerable workers	Gaps	Provisions for vulnerable workers are often given less attention
	Needs	The design of new OSH monitoring systems should give more attention to vulnerable workers
 Taking into account the real needs of workers	Gaps	Gaps might exist when corporate clients do not consult with workers beforehand and try to push solutions in a top-down fashion
	Needs	There is a need to take into account the reality of the workplaces and the workers. Continuous and further consultation is essential for any changes in OSH procedures is essential
 Providing information on responsibilities, data and limitations	Gaps	Workers may not be aware of their rights, responsibilities and other important issues in relation to new OSH monitoring systems
	Needs	Resources should appropriately address information gaps around new OSH monitoring systems in relation to data (e.g. interpretation, privacy, transparency, cybersecurity), rights, responsibilities and limitations in a way that is accessible and relatable to workers
 Pace of technology and standardisation issues	Gaps	The pace of technology makes difficult to develop up-to-date workplace resources
	Needs	There is a need to strengthen dialogue between private and public parties to better understand the implications of technologies. In addition, there is a need develop common standards in order to develop shared resources across the EU

[17] Jacobs, J. V., Hettinger, L. J., Huang, Y.-H., Jeffries, S., Lesch, M. F., Simmons, L. A., Verma, S. K., & Willetts, J. L. (2019). Employee acceptance of wearable technology in the workplace. *Applied Ergonomics, 78*, 148-156.

[18] Icons, from top to bottom, made from Nualnoi Kinkaeo, Freepik, Eucalyp, Smashicons and Dreamstale from https://www.flaticon.com/

5 Conclusions: How can workplace resources ensure the safe and healthy use of OSH monitoring systems?

The review highlighted **several issues going beyond workplace resources and key factors in determining the effective integration of new systems**:

- Firstly, new OSH monitoring systems are part of the solution to health and safety at work, but not the solution itself. Well-established OSH frameworks are characterised by the presence of OSH professionals on site alongside workers and clear steering from the OSH leadership through company-level policies, a well-defined OSH management system,[19] direct communication with workers, and a combination of accessible and relatable resources; the more established safety culture is in a company, the more likely it is that new systems will be integrated successfully, preventing workplace resources from being disregarded.
- Involving workers in the selection, testing and implementation of new OSH monitoring systems represents another key factor by tailoring of communication within resources and activities to each stakeholder to guarantee that the OSH monitoring systems are implemented coherently, which can be achieved by improving workplace resources through consultation with workers.
- Finally, fostering knowledge exchange should not only be done within companies and sectors through, for instance, regular team meetings among workers and between workers and OSH professionals/team leaders, but also across companies and sectors through knowledge-sharing activities. Workplace resources are critical to ensure the safe and healthy use of new OSH monitoring systems and have the potential to empower workers and companies while increasing their wellbeing and counteracting the negative aspects of work demands,[20] which, in turn, prevent employee frustration, inefficiency and loss of profit.

[19] For example, see the Norwegian Federation of Industries' OSH management e-tool. For more information, see: https://everdier.no/

[20] Rick, V. B., Rasche, P., Mertens, A., & Nitsch, V. (2022). Workplace health promotion: mHealth as a preventive mediator between psychosocial workplace characteristics and well-being at work. In V. G. Duffy (Ed.), *Digital human modeling and applications in health, safety, ergonomics and risk management. Health, operations management, and design* (pp. 249-265). Springer. https://doi.org/10.1007/978-3-031-06018-2_18

The European Agency for Safety and Health at Work (EU-OSHA) contributes to making Europe a safer, healthier and more productive place to work. The Agency researches, develops, and distributes reliable, balanced, and impartial safety and health information and organises pan-European awareness raising campaigns. Set up by the European Union in 1996 and based in Bilbao, Spain, the Agency brings together representatives from the European Commission, Member State governments, employers' and workers' organisations, as well as leading experts in each of the EU-27 Member States and beyond.

European Agency for Safety and Health at Work

Santiago de Compostela 12, 5th floor
48003 - Bilbao, Spain
Tel. +34 944358400
Fax +34 944358401
E-mail: information@osha.europa.eu
http://osha.europa.eu

Publications Office of the European Union