

SMART DIGITAL MONITORING SYSTEMS FOR OCCUPATIONAL SAFETY AND HEALTH: IMPLEMENTATION AT THE WORKPLACE

Introduction: Digital systems monitoring OSH at the workplace

Digital OSH monitoring systems use digital technology to gather and analyse data in order to identify, assess and monitor workplace risks. These systems aim to prevent and/or minimise harm, promote occupational safety and health (OSH),¹ improve workers' OSH and augment existing OSH procedures across various sectors. In low-risk OSH sectors (such as office work)², and more significantly in high-risk OSH sectors (such as industrial facilities, construction and mining),³ digital OSH monitoring systems can reduce and/or prevent a vast range of workplace risks that may arise. Workplace risks monitored by the OSH monitoring systems can be **physical** (extreme temperatures, noise, vibrations, radiation, lighting), **ergonomic** (repetitive movements, extreme postures), **chemical** (inflammables, toxics, emissions) and **psychosocial**⁴ (stress, anxiety, depression, low self-esteem), and **safety-related** (traffic-, work-, equipment-related).⁵

Digital OSH monitoring systems are often sensor-based and incorporate various new technologies, including artificial intelligence (AI), machine learning (ML), and Internet of things (IoT), as well as conventional wireless technologies (Bluetooth, RFID, Wi-Fi, infrared, or other camera technologies). These technologies are often present in stand-alone wearable devices (such as exoskeletons), clothing, and personal protective equipment (PPE), as well as in industrial equipment including vehicles and facilities like working spaces.

The new digital OSH monitoring systems can provide **on-the-job training** by alerting workers when executing a task in a dangerous manner. They can also **react to or prevent risks** by collecting and sharing data with OSH team leaders to help them identify risk sources. These data can be used to improve OSH procedures and (re)design the workplace accordingly.⁶

Workplace resources for new OSH monitoring systems

For the purpose of this policy brief, **workplace resources** encompass different types of products (audio, visual and written documents) and activities (both in-person and online) that are supplied by companies using the devices and product manufacturers to protect workers' safety at the workplace.⁷ Workplace resources can help inform companies on the safe and healthy use of new OSH monitoring systems and facilitate their

¹ EU-OSHA – European Agency for Safety and Health at Work, *Smart digital monitoring systems for occupational safety and health: uses and challenges*, 2023. Available at: <https://osha.europa.eu/en/publications/smart-digital-monitoring-systems-occupational-safety-and-health-uses-and-challenges>.

² For more information, see: OSHWiki, *Musculoskeletal disorders and prolonged static sitting*, 2020. Available at: https://oshwiki.eu/wiki/Musculoskeletal_disorders_and_prolonged_static_sitting

³ This information is based on the review of product manufacturers' websites and Ecorys interviews with stakeholders.

⁴ These examples refer to principal hazards in the ports sector but are also applicable in other sectors. The examples are taken from: International Labour Office. (2016). *Safety and health in ports* [revised edition]. https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/normativeinstrument/wcms_546257.pdf (p. 406).

⁵ Niu, S., Colosio, C., Carugno, M., & Adisesh, A. (Eds) (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. https://www.ilo.org/global/topics/safety-and-health-at-work/resources-library/publications/WCMS_836362

EU OSHA – European Agency for Safety and Health at Work, *Digitalisation of work*, n.d. Available at: <https://osha.europa.eu/en/themes/digitalisation-work>. OSHWiki, *Monitoring new and emerging risks*, 2017. Available at: https://oshwiki.eu/wiki/Monitoring_new_and_emerging_risks

⁶ EU-OSHA – European Agency for Safety and Health at Work, *Smart digital monitoring systems for occupational safety and health: uses and challenges*, 2023. Available at: <https://osha.europa.eu/en/publications/smart-digital-monitoring-systems-occupational-safety-and-health-uses-and-challenges>.

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. HCII 2022. Lecture Notes in Computer Science, Vol. 13320* (pp. 249-265). Springer. https://doi.org/10.1007/978-3-031-06018-2_18

integration in the workplace. A recent EU-OSHA publication⁸ assessed a range of workplace resources, including codes of practice, guidance documents (such as videos, posters, user manuals and leaflets), training materials, marketing materials and case studies.

Workplace resources can offer guidance and training to both workers and employers, resulting in numerous benefits. Specifically, workplace resources can support the integration of digital OSH monitoring systems by:

- describing the specific risk addressed by the digital OSH monitoring system and exposure limits in relation to workers' activities or tasks, equipment, work environment and patterns;⁹
- explaining the purpose of the digital OSH monitoring system and how it can be used to ensure OSH at the workplace;
- clarifying the use of data and addressing privacy concerns;
- defining responsibilities, rights and (legal) obligations for both workers and employers for OSH at the workplace, and identifying the persons within the organisation who workers can contact in case of problems with the digital OSH monitoring systems;
- delineating the limitations of digital OSH monitoring systems to manage workers' expectations, and level of trust, and avoid misuse that can have negative effects on workers' OSH;
- synthesising, simplifying and making information relatable to workers; and
- combining with other types of workplace resources, both online and print resources, following a multi-media strategy.

In general, workplace resources have the potential to empower both workers and employers, promote their wellbeing, and offset the negative impacts of work demands,¹⁰ thus preventing employee frustration and inefficiency in the workplace.

This report has examined workplace resources within organisations and those supplied by international organisations, such as the ILO, IMO and EU-OSHA. These resources offer broader guidance on how to improve OSH in the workplace, taking into account factors such as policy and legislation, and can help raise stakeholders' awareness of monitoring and managing OSH systems. International resources **provide a comprehensive overview** of various types of risks and OSH exposure limits in distinct sectors, technical and practical aspects of OSH monitoring systems, different steps in OSH monitoring, and good practices, challenges, and opportunities. However, they may not provide extensive information on digital OSH monitoring systems.

On the other hand, resources from companies, i.e. product manufacturers of the new systems and their clients using them, offer detailed information and guidance **on a specific digital OSH monitoring system** and its implementation at the workplace. These resources aim to enhance existing OSH procedures and prevent the occurrence of a specific type of risk by explaining the purpose of the new OSH monitoring system and how to use it to safeguard OSH at the workplace. However, resources from companies may also lack information on the key limitations of the systems, data privacy concerns and OSH exposure limits.

Cross-cutting dimensions to effectively implement digital OSH monitoring systems

Based on the analyses of the resources and interviews, we identified a set of cross-cutting dimensions. The successful introduction of digital OSH monitoring systems in the workplace cannot be achieved through workplace resources alone. While they are an important piece of the puzzle, companies need to address

⁸ EU-OSHA – European Agency for Safety and Health at Work, Smart digital monitoring systems for occupational safety and health: workplace resources for design, implementation and use, 2023. Available at: <https://osha.europa.eu/en/publications/smart-digital-monitoring-systems-occupational-safety-and-health-workplace-resources-design-implementation-and-use>

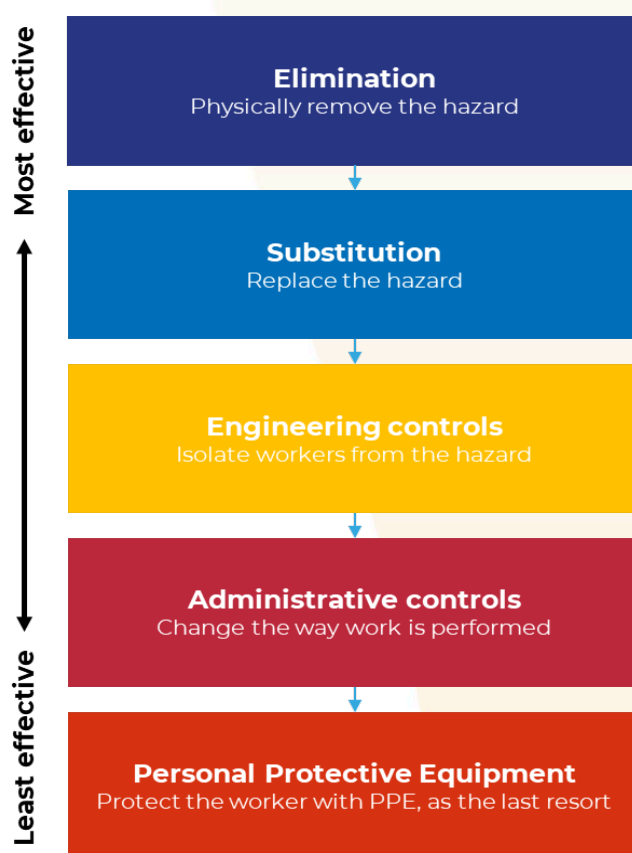
⁹ International Labour Office. (2016). *Safety and health in ports* [revised edition]. https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/normativeinstrument/wcms_546257.pdf (p. 406).

¹⁰ 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. HCII 2022. Lecture Notes in Computer Science, Vol. 13320* (pp. 249-265). Springer. https://doi.org/10.1007/978-3-031-06018-2_18

several other cross-cutting issues and general considerations related to the implementation of digital OSH monitoring systems, in addition to the gaps and needs of workplace resources.

It is important to recognise that digital OSH monitoring systems cannot replace existing OSH procedures but rather **enhance them**. Therefore, the integration of these systems in the workplace should be seen as a tool and not a solution towards improving OSH, and it should rely on a pre-existing OSH framework. Indeed, successful integration is more likely to be carried out effectively in with an existing OSH culture and robust OSH frameworks, where OSH professionals are present on site alongside workers, and where there is clear steering from the OSH leadership and communication channels with workers, and the OSH management system is based on the **hierarchy of controls** (Figure 1). At the same time, workers and employers should not excessively rely on the new digital OSH monitoring systems and should recognise their potential negative implications stemming from their limitations. Therefore, to ensure the effective integration of digital OSH monitoring systems and eliminate workplace risks, it is essential not to disregard existing OSH frameworks.¹¹

Figure 1: Hierarchy of controls¹²



In addition, it is important to recognise that on-the-job training can be extremely effective in minimising risks at the workplace. Training can be delivered through digital OSH monitoring systems that detect harmful behaviour in task performance and provide guidance on how improving OSH in the task execution. Training can also be delivered and through OSH professionals and product manufacturers on the ground. The new digital OSH monitoring systems can offer training tailored to the users' features as well as collecting data to aid OSH professionals in enhancing workplace health and safety by reducing risks. Thirdly, it is crucial to consider the **socio-cultural and work-contextual differences** (age, religion, culture, level of unionisation, among others)

¹¹ EU-OSHA – European Agency for Safety and Health at Work, *Smart digital monitoring systems for occupational safety and health: uses and challenges*, 2023. Available at: <https://osha.europa.eu/en/publications/smart-digital-monitoring-systems-occupational-safety-and-health-uses-and-challenges>.

¹² Adapted from: ILO. (2021). *Exposure to hazardous chemicals at work and resulting health impacts: A global review*. International Labour Organization. https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---lab_admin/documents/publication/wcms_811455.pdf (p. 69).

between and within different sectors and countries, which may determine varying degrees of compliance and resistance to new OSH systems.

What is perhaps the most effective way to implement the new OSH monitoring systems is to foster an open dialogue between OSH professionals and workers, placing workers at the centre of the process to understand the real needs of the workplace and directly involving them in the design and testing of new digital systems and/or workplace resources. Companies where OSH professionals are present on the ground alongside workers, and where workers can discuss any eventual concerns with the OSH leadership through an open channel of communication, are more likely to integrate new OSH monitoring systems effectively and enhance workplace OSH. Placing workers at the centre of the process through a bottom-up approach can also increase the effectiveness of implementation by enabling employees to test and optimise new systems and approve of changes to OSH procedures, as well as involving them in the design of workplace resources.


Moreover, involving workers in an open dialogue can shed light on the **real needs of workers and employers**, the key safety and health issues to address, and the measures available to address them. To design and implement workplace resources effectively, it is essential to consider and address the **real needs of workers**, and particularly, those of **vulnerable workers** (with mental or physical disabilities, old/young workers, migrant workers, pregnant women and so on). This can be achieved by strengthening the dialogue between employers and employees and ensuring continuous consultation with workers prior to changes in OSH procedures and the involvement of workers in the creation of new systems. Dialogue is also key to **inform workers about their rights and responsibilities** in connection with new digital OSH monitoring systems, including the **use of their data** and any **limitations**, which increases workers' acceptance of the new technology.

Last but not least, there is a need for better cooperation between private and public stakeholders and **between companies** to address risks, limits and common problems of digital OSH monitoring systems and **standardise workplace resource** to amplify their effectiveness. As discussed by the above-mentioned recent EU-OSHA report,¹³ for OSH monitoring systems to be integrated effectively, it is also necessary to foster initiatives for cross-company or cross-sectoral knowledge-exchange and peer-learning activities and to address knowledge gaps stemming from limited cross-company or cross-sectoral dialogues on new systems.

Recommendations

This policy brief puts forward three key recommendations for companies to effectively implement and integrate digital OSH monitoring systems in the workplace (Table 1). These recommendations are like complementary pieces of a puzzle.

Table 1: Summary of recommendations¹⁴

Puzzle pieces to integrate new OSH monitoring systems	
 <p>Understand real workplace needs</p>	<ul style="list-style-type: none"> ▪ Grasp the real needs of your workplace, such as the main safety issues and measures available to address them, through continuous consultation with workers. ▪ Manage expectations as to what is (un)achievable by new digital OSH monitoring systems. ▪ Tailor workplace resources and new OSH monitoring systems based on the needs of vulnerable workers. ▪ Appreciate socio-cultural or work-contextual specificities at the workplace to ensure acceptance.

¹³ EU-OSHA – European Agency for Safety and Health at Work, “digital monitoring systems and OSH – Workplace resources design, implementation and use. Available at: <https://osha.europa.eu/en/publications/smart-digital-monitoring-systems-occupational-safety-and-health-workplace-resources-design-implementation-and-use>.

¹⁴ Icons made by [Freepik](https://www.freepik.com) from [flaticon.com](https://www.flaticon.com)

Puzzle pieces to integrate new OSH monitoring systems



Place workers at the heart of the process

- Place workers at the centre of the process through a bottom-up approach to increase their acceptance to change and digital OSH monitoring systems.
- Involve workers in testing, implementing and optimising digital OSH monitoring systems.
- Involve them in the design of workplace resources to provide them with a sense of ownership of the process.



Foster dialogue and open communication

- Foster and maintain an open channel of communication between workers and OSH professionals to discuss any potential issues.
- Inform workers about their rights and responsibilities in connection with digital OSH monitoring systems (i.e. data, limitations) to increase their acceptance of the new technology.
- Cultivate shared learning with workers within and between companies and sectors through knowledge-exchange and peer-learning activities.

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