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ARTIFICIAL INTELLIGENCE AND OCCUPATIONAL HEALTH AND SAFETY

selected excerpts

*Tools, applications and recommendations
for companies*

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2.1 Two empirical phases

Phase 1: Provider interviews. Six organizations developing AI solutions for OHS were interviewed. They were chosen so as to span the main application areas (safety, health, ergonomics) and different levels of maturity. Each provider illustrated its solution in terms of functionality, expected benefits, type of preventive measure involved (individual or collective) and contexts of use, explaining how it contributes to risk management and how issues of privacy and acceptance are dealt with.

Phase 2: Focus group with OHS professionals. Eleven OHS professionals holding managerial roles (HSE managers) took part in a focus group set up with the support of Assolombarda. All of them work in high-risk sectors, namely energy, offshore/engineering, manufacturing, telecommunications, food manufacturing and airport infrastructure. Drawing on their own operational experience, participants tested the interview findings, sharpened and expanded them with further use cases, and helped calibrate the maturity assessments; the discussion also brought to light the governance conditions and regulatory constraints within which responsible development has to take place.

Combining these two viewpoints allowed the research to separate what the literature describes from what has actually been put into practice. This made it possible to pinpoint the concrete deployment conditions, regulatory constraints and organizational requirements that mark the shift from technology that is simply available to technology that delivers operational preventive value. The two perspectives played distinct roles: providers clarified the technical architecture, the degree of current technological availability and the underlying deployment logic, whereas professionals clarified the governance conditions, regulatory constraints and legitimacy requirements on which the real preventive value of those architectures ultimately depends.

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3. AI applications for OHS: the current landscape

Taken together, the research findings depict a heterogeneous picture, in which the level of development reached by AI solutions differs markedly from one OHS domain to another. Figure 1 condenses this picture into a consolidated operational framework that sets the applications already in operational use apart from those still under development.

	Safety Observable hazard precursors	Health Exposure and physiological risk	Ergonomics Biomechanical load and posture
INDIVIDUAL (worker-worn or assistive devices)	- CASE 3 Driver distraction and fatigue monitoring - Cabin-facing camera monitors attentiveness and fatigue states. Constrained by de-identification requirements on facial data. ○ UNDER DEVELOPMENT - F2 (FOCUS GROUP) Smart PPE: intelligent harness for work at height - Sensors detect metallic anchorage with virtual gate logic; alarm if perimeter crossed without attachment within 6 seconds. ○ UNDER DEVELOPMENT	- CASE 6 / F10 Wearables-based physiological monitoring - Vital parameters via chest straps. Experimental bounded fatigue study (F10). ○ UNDER DEVELOPMENT	- CASE 5 AI-driven exoskeletons - Embedded sensors modulate mechanical assistance dynamically across task phases, reducing biomechanical load at peak moments. ● DEPLOYED
COLLECTIVE (fixed infrastructure and system-level controls)	- CASES 1, 2, 5 / F1, F2 Camera-based compliance monitoring - Fixed-camera CV detecting PPE, restricted areas, suspended loads, man-down. Event frames retained max 24h. ● DEPLOYED - CASES 3, 6 Vehicle collision avoidance - Case 3: RGB stereocamera with graded speed limits and kinematic near-miss logging. Case 6: wide-angle 150/160° silhouette detection. ● DEPLOYED - CASE 5 AI safety management platform - Drag-and-drop workflow engine connecting detection to configurable control logic and standardised response pathways (i.e. IOGP). ● DEPLOYED	- CASE 5 IoT + CV exposure monitoring - Two-condition logic: IoT flags environmental threshold exceedance; CV confirms worker presence. Exposure event only when both conditions hold. ● DEPLOYED	- CASE 5 CV-driven ergonomic assessment - Keypoint detection reconstructs skeletal model; joint angles evaluated against ergonomic standards by task and workstation. ● DEPLOYED

Figure 1: Consolidated operational framework of AI applications for OHS

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4.3 Generative AI in risk management: opportunities and practical limits

The research also examined how generative AI can support OHS document management, from structured drafts of risk assessments to guidance on the implementation of preventive measures, the preparation of audit documentation and the formalization of corrective actions. On the technical side, these functions are no longer merely prospective: one of the interviewed providers already makes an operational tool available for them.

OHS professionals, however, converged on a markedly cautious stance. Their central concern is that generative AI produces outputs that look plausible but cannot be taken as verifiable. Incorrect content carries the same formal credibility as correct content, and a well-generated AI document tends to conceal precisely those contextual inconsistencies that would otherwise alert an experienced professional. Errors can be spotted only by someone with in-depth knowledge of the processes, the exposure scenarios and the applicable controls. Far from lessening the need for vertical expertise, these applications therefore make it even more critical.

Recommendation: for the time being, generative AI outputs should be regarded as drafts requiring expert validation and never as products to be used on their own. Future development should rest on structured collaboration between AI providers and OHS professionals, aimed at building tools tailored to the specific features of the OHS domain. Only in this way can such tools reach the robustness and precision of outputs demanded by a field in which mistakes have a direct bearing on worker protection.

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6. Guidelines and recommendations for companies

Building on the evidence collected, this section brings together the key recommendations for companies wishing to evaluate, introduce or expand the use of AI tools for OHS.

6.1 Where to invest: tools ready for deployment

The categories of applications listed below rest on operational deployments confirmed by the research, and companies can therefore consider their adoption with a reasonable degree of confidence:

- **CV-based compliance monitoring:** identification of PPE, restricted areas, suspended loads and man-down events, backed by multi-year deployments in manufacturing, logistics, offshore and airport settings.
- **AI anti-collision systems for industrial vehicles:** either stereo cameras applying speed limits that are graduated according to collision risk, or wide-angle silhouette detection combined with kinematic logging of near-misses.
- **Integrated safety management platforms:** configurable interfaces connect AI detections with predefined escalation pathways aligned with recognized standards, so that each deviation reaches the responsible role and aggregated KPIs are generated.
- **IoT + CV environmental exposure monitoring:** built on a dual-condition logic, whereby an event is flagged only when an environmental threshold is exceeded and the presence of a worker is confirmed at the same time.
- **CV-based ergonomic assessment and AI-driven exoskeletons,** aimed at lowering biomechanical load.

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6.2 How to integrate: exploiting the dual value mechanism

Real-time detection should not be the sole purpose of adoption. Right from the start, companies ought to plan how the structured data generated by monitoring will be fed into their PDCA processes:

- **Plan:** rely on deviation logs and on patterns of spatial concentration to keep the risk assessment up to date and to redirect prevention priorities.
- **Check:** assess over time whether the measures put in place actually lead to a measurable decrease in deviations.
- **Act:** draw on heatmaps, kinematic parameters and trends as the evidentiary basis for targeted physical changes, revised procedures and the redesign of spaces.

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6.3 Investing in professional skills

With AI monitoring, the information on which OHS practice relies moves away from sample-based observation and toward continuous and comprehensive data. Professional judgment, however, remains a human prerogative: if a system detects that someone has entered a zone, it is up to a supervisor to decide whether this is unauthorized access or an authorized activity that the monitoring profile did not anticipate. Unlocking the full preventive value of these solutions therefore requires the ability to read heatmaps and KPI trends, to understand how virtual restricted zones are defined, to tell detection patterns that signal a genuine concentration of risk from those caused by system degradation, and to be aware that AI systems are only as reliable as the data they are trained on and may consequently be affected by bias.

Recommendation: when technically sophisticated solutions are introduced without a parallel investment in the corresponding professional capacity, the resulting misalignment undermines the expected outcomes. Dedicated training on how to interpret AI data, and on how to configure and maintain the systems, must therefore be treated as an integral part of the overall investment.

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7. Future outlook and development directions

Looking ahead, the research pointed to a number of development directions that companies would be well advised to follow closely over the coming years.

Smart PPE. Individual devices complement collective systems in a structural way: they extend protection to settings that fixed infrastructures cannot reach and give SMEs a more accessible point of entry. Their further development calls for governance frameworks able to ensure that protection can be verified while preventing the devices from becoming tracking systems. Companies operating in contexts beyond the reach of fixed monitoring could, and indeed should, keep a close eye on how these solutions evolve.

Occupational health monitoring. Technological and regulatory constraints converge in keeping these applications at an experimental stage. Chronic occupational diseases nonetheless represent an epidemiologically significant burden, and while the current regulatory perimeter permits extensive spatial safety monitoring, it makes responsible physiological monitoring extremely hard to achieve. In the longer term, fully leveraging AI to improve OHS may call for a regulatory evolution that redraws this perimeter, without relaxing rigorous purpose limitation or the involvement of representatives.

Development of specialized generative AI tools. What professionals express is not opposition to the technology but a clear statement of the conditions under which it can be used responsibly. Development should therefore proceed through co-design between AI providers and OHS professionals; until that level of maturity is achieved, outputs ought to be considered proposals subject to expert validation.

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