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PREFACE

On behalf of the Scientific and Organizational Committee, it is my honor and great pleasure to present the Proceedings of the 4th EUROSA International Conference, held on 13-16 May 2026 in Vrnjačka Banja, Serbia.

The papers contained in this Proceedings represent current scientific and professional informations in the field of Engineering and Occupational Safety Management, Environmental Engineering and Management, Fire Protection Engineering and Management, Engineering and Management of Disaster and Emergency Protection, and Good use of practice in protection and represent a mix of scientific research and professional opinion, shared with us by participants from academia and industry professionals.

We sincerely thank all the conference participants for their contribution, ensuring the success of the conference. Special thanks to all the participants of the round tables and panel discussions, keynote speakers, chairmen of the sessions and of course the reviewers for their invaluable contribution.

Last but not least, I would like to express my sincere gratitude to all members of the Scientific and Organizing Committee, whose efforts and work led to the successful realization of the EUROSA 2026 conference.

Vrnjačka Banja, May 2026

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GLOBAL PERSPECTIVES ON ENVIRONMENTAL MANAGEMENT SYSTEMS: EVOLUTION AND PRACTICAL IMPLICATIONS OF ISO 14001:2026

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Abstract: Environmental protection is a constantly evolving process, influenced by technological progress, the introduction of new materials and substances, increasing resource consumption, and the generation of more complex waste streams, often with uncertain long-term behavior and limited recycling options. These developments create new challenges that require organizations to continuously adapt and integrate environmental considerations into their decision-making. ISO 14001 has evolved from a focus on regulatory compliance and pollution control to a more structured, risk-based approach, where organizations are expected not only to meet requirements, but to show measurable results. Developed through the participation of 176 countries, the standard represents a shared global approach to environmental management. This paper analyses the key changes introduced in the latest revision of ISO 14001, with a focus on leadership, risk-based thinking, and system integration in practice. It also examines how these changes influence environmental protection and occupational health and safety through more structured risk management. Particular attention is given to the strengthening of lifecycle thinking and supply chain control, the clearer distinction between normal, abnormal, and emergency conditions, and the enhancement of performance evaluation through objective-based auditing and structured management review. The findings highlight the convergence between environmental management and occupational health and safety, especially in the context of risk assessment and emergency preparedness. The paper contributes by interpreting ISO 14001 as both a reflection of global environmental priorities and a practical framework for integrated, evidence-based management.

Keywords: *ISO 14001:2026; environmental management systems; risk-based approach; lifecycle thinking.*

INTRODUCTION

Environmental management is no longer limited to regulatory compliance but can be understood as an integral part of everyday organizational decision-making, with studies showing that environmental management systems influence operational practices and performance (Sroufe, 2003). This transformation is caused and induced by increasing environmental risks, growing societal expectations, and the need to address challenges such as climate change, resource scarcity, and ecosystem degradation. ISO 14001 – Environmental Management Systems – Requirements with Guidance for Use can be considered the most widely applied international standard for environmental management. Besides being used as a technical standard, it is also the reflection of global environmental awareness and a tool for

translating that awareness into structured and measurable organizational practices. The transition to ISO 14001:2026, besides formal requirements, also represents a practical organizational challenge that requires timely planning, resource allocation, and coordination across departments and with certification bodies (ISO 14001, 2015). ISO 14001 has developed over time alongside changes in how environmental management is applied in practice. Early versions were mainly focused on regulatory compliance and pollution control, while later revisions introduced more structured approaches to risk identification, lifecycle thinking, and system integration (ISO, 2004; ISO, 2015; ISO, 2026). This development has also made the link between environmental protection and occupational health and safety more visible. Environmental risks, such as pollution events, resource failures, or emergency situations, often create direct risks for people. In practice, the same issue can affect both the environment and worker safety, which means these risks need to be managed together. For this reason, modern management systems increasingly use integrated, risk-based approaches that address both environmental and occupational aspects, forming what is commonly referred to as integrated management systems (Nunhes et al., 2017).

The ISO 14001 standard was developed by the International Organization for Standardization (ISO), specifically within Technical Committee ISO/TC 207, with the aim of establishing a globally applicable framework for environmental management systems (EMS). The first version, published in 1996, focused primarily on environmental compliance and pollution prevention (ISO, 1996). Over time, the standard evolved through revisions in 2004 and 2015, gradually introducing clearer requirements, improved alignment with other management system standards, and the concept of risk-based thinking. The 2015 revision marked a significant step through the introduction of the High-Level Structure (Annex SL), which aligned ISO 14001 with other management system standards, such as ISO 9001 - Quality Management Systems - Requirements and ISO 45001 - Occupational Health and Safety Management Systems - Requirements with Guidance for Use.

This development clearly shows which aspects the global community now considers essential, defining the areas where organizations claiming effective environmental management, and holding certification, must demonstrate concrete performance and accountability. In this sense, the standard serves as a formalized representation of global environmental thinking, translating complex sustainability challenges into structured and auditable organizational requirements. ISO 14001 can be observed as a framework through which global environmental priorities are translated into practical and verifiable organizational requirements.

Within this context, this paper aims to analyse the key developments introduced in the latest revision of ISO 14001 and to interpret them from both a global and practical perspective. Particular attention is given to the integration of environmental management with occupational health and safety, demonstrating how the standard supports a unified, risk-based approach to managing environmental and human-related risks in organizational practice.

MATERIALS AND METHODS

This study is based on a qualitative and comparative analysis of the ISO 14001 standard, focusing on the evolution of its structure and requirements through different revisions (2015 and 2026). A clause-by-clause interpretative approach was applied to identify key changes, with particular attention to risk-based thinking, lifecycle perspective, and system integration. The analysis considers not only formal differences in requirements, but also their practical implications for organizational implementation and their connection with occupational health and safety management systems.

RESULTS

The ISO 14001 standard is based on a structured framework consisting of ten clauses, organized in accordance with the Plan–Do–Check–Act (PDCA) cycle (Figure 1). Clauses 1 to 3 define the general elements of the standard, including its scope (Clause 1), normative references (Clause 2), and terms and definitions (Clause 3), providing the foundation for its interpretation and application. The core requirements are defined within Clauses 4 to 10, which correspond to the PDCA cycle. Clauses 4 (context of the organization), 5 (leadership), and 6 (planning) represent the "Plan" phase; Clause 7 (support) and Clause 8 (operation) correspond to the "Do" phase; Clause 9 (performance evaluation) represents the "Check" phase; and Clause 10 (improvement) corresponds to the "Act" phase (Figure 1).

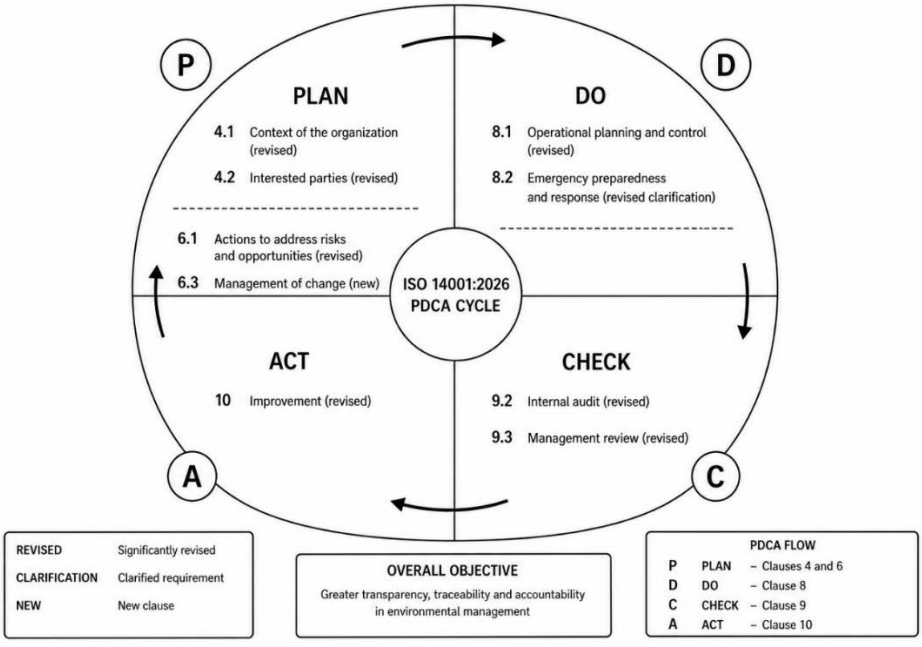

Figure 1. PDCA cycle of ISO 14001:2026 with key revised and new requirements across clauses.

In practice, organizational context (Clause 4) refers to understanding the conditions in which an organization operates and how they affect its decisions. In the revised ISO 14001, this now

clearly includes factors such as climate change, pollution, biodiversity, and resource availability. Organizations also need to identify relevant stakeholders and understand their expectations, since only defined expectations can become compliance obligations. The standard also places more emphasis on communication, moving from simple stakeholder identification toward more active and two-way engagement.

Leadership is increasingly recognized as a central element of environmental management, emphasizing that environmental issues should not be treated solely as a technical responsibility. Instead, top management is expected to integrate environmental considerations into everyday organizational decision-making (Clause 5). Compared to earlier versions, the focus is less on formal commitment and more on actual responsibility and results. In practice, this means ensuring that the system works, providing resources, and encouraging awareness across the organization. Even when tasks are delegated, responsibility remains with top management. Many environmental decisions, such as those related to emissions, resource use, or emergencies, also affect worker safety. For this reason, environmental and safety issues need to be managed together, rather than separately.

Planning within ISO 14001 is based on a structured approach to risk management, taking into account environmental aspects, legal obligations, and the broader organizational context (Clause 6). Although this approach was introduced in ISO 14001:2015, the 2026 revision indicates that relationship between risks, actions, and environmental objectives is more explicit and easier to follow (ISO, 2015; ISO, 2026). In practice, organizations are expected to clearly identify and document risks, explain their origin and significance, and define how they will be managed. The revised version also places stronger emphasis on the lifecycle perspective, encouraging organizations to consider environmental impacts beyond their direct operations, including suppliers, transportation, and product use, even in areas where full control may not exist. Another important addition is Clause 6.3 (Management of Change), which requires environmental impacts to be assessed before organizational or operational changes are introduced. This makes change management more systematic, transparent, and easier to verify. Many of these requirements are closely aligned with occupational health and safety management, where risks are likewise expected to be identified early and managed through a structured and preventive approach. Effective environmental management depends not only on procedures and requirements, but also on the people, resources, communication, and documented information that support the system in everyday practice (Clause 7). Although these elements were included in earlier versions of ISO 14001, the revised approach places greater emphasis on how they function in real organizational conditions. Besides providing adequate training, it is no longer considered sufficient, and organizations are expected to demonstrate that employees understand environmental risks, their responsibilities, and the influence of their activities on environmental performance.

Communication that ensures clear, consistent, reliable, and traceable information is of great importance for effective risk management in both environmental management and

occupational health and safety. Environmental management becomes most visible through everyday operational activities and the way organizations respond to unexpected situations (Clause 8). The revised approach places greater emphasis on practical implementation, including operational control, supplier involvement, and emergency preparedness. Environmental responsibility is no longer limited only to activities within the organization itself; suppliers and externally provided processes are expected to meet environmental requirements as part of procurement and operational control. The standard indicates differentiation between abnormal operating conditions and emergency situations. Routine operational procedures are used to manage abnormal conditions, while emergencies require detailed and adequate response plans, clear coordination, and preparedness measures. Preparedness for emergency situations is continuous process that encompasses primarily identification of potential scenarios, followed by preparation of response measures, testing procedures, and reviewing the effectiveness of actions taken. In addition to what has traditionally been a priority, namely the implementation of emergency drills, greater emphasis is now placed on lessons learned and experience gained in order to support continual system improvement. In both systems, environmental management and occupational health and safety management, emergency preparedness is not viewed as a one-time activity, but as an ongoing process that requires organizations to identify potential risks, test response procedures, analyse weaknesses, and improve preventive and corrective measures based on experience and documented results.

Monitoring and evaluating environmental performance is an essential part of ensuring that the environmental management system functions effectively in practice (Clause 9). This includes measurement, internal audits, and management review, which together represent the “Check” phase of the PDCA cycle. The revised approach places greater emphasis not only on collecting information, but also on demonstrating that implemented processes achieve their intended results. Internal audits are therefore expected to go beyond simple compliance checks and address broader objectives, such as evaluating system effectiveness and verifying whether corrective actions have been successfully implemented. Management review is also presented in a more structured way, with clearer focus on the information used during the review process, how the review is performed, and the decisions and outcomes that follow. Organizations are expected to base decisions on measurable data and translate them to specific actions, including system improvements, operational changes, or allocation of resources. This strengthens transparency, traceability, and accountability, making performance evaluation a more systematic and evidence-based process. Similar principles are widely applied in occupational health and safety management, where monitoring, review, and data-based decision-making are also essential for continual improvement.

Continual improvement is presented as a structured and evidence-based process that focuses not only on correcting problems when they occur, but also on preventing similar issues from happening again (Clause 10). In the revised version of ISO 14001, improvement is more

directly connected to measurable results, meaning that decisions and corrective actions are expected to rely on objective data rather than assumptions or temporary solutions. When environmental problems or nonconformities are identified, organizations are expected to determine their root causes and implement actions that effectively prevent recurrence. The effectiveness of these actions must then be verified through monitoring and documented evidence. In practice, this creates a continuous connection between monitoring activities, internal audits, corrective actions, and management decisions. Results are reviewed, problems are analysed, corrective measures are introduced, and their effectiveness is subsequently evaluated. For example, if monitoring data indicates an increase in pollutant concentration, the organization is expected to identify the underlying cause, such as equipment malfunction or process inefficiency, implement corrective measures, and confirm through additional measurements that the issue has been successfully resolved.

DISCUSSION

The revised ISO 14001 can be interpreted as introducing both gradual updates and more significant changes, including new processes and expanded responsibilities. Environmental and climate issues are no longer treated as separate elements but are integrated across the entire management system. The most significant developments are focused on strengthening risk-based thinking, expanding the lifecycle perspective, and improving the structure and traceability of key processes. Particular emphasis is placed on the integration of climate change and biodiversity into organizational context, a more structured approach to risk identification, and the formalization of change management as a distinct and auditable requirement. The revised standard extends environmental responsibility beyond the organization by placing more emphasis on supply chain control. It also makes a clearer distinction between abnormal situations and emergencies and strengthens performance evaluation through more focused auditing and a more structured approach to management review. The key changes and their practical implications are summarized in Table 1.

Table 1. Key Changes in ISO 14001:2026 and their practical implications.

Clause	Area	Key Change	Practical Implications	Illustrative Example
4.1	Context of the organization	Integration of climate change and biodiversity	Environmental conditions must be considered in decision-making	Including flood or drought risk when planning site operations
4.2	Interested parties	Stronger focus on stakeholder expectations	Expectations must be identified and, where relevant, treated as obligations	Incorporating community concerns about air quality into operational limits
6.1	Risks and opportunities	Clearer structure of risk identification	Risks must be linked to sources and documented	Linking emissions risk to specific process steps in a risk register
6.2	Lifecycle	Strengthened and	Impacts must be	Evaluating

	perspective	more explicit requirement	considered beyond direct operations	environmental impact of raw material sourcing and product disposal
6.3	Management of change	Formal requirement introduced	Environmental impacts must be assessed before implementing changes	Evaluating environmental impact before introducing new chemicals
8.1	Operational control	Expanded to supply chain	Environmental criteria must apply to suppliers	Requiring suppliers to meet environmental standards in contracts
8.1 / 8.2	Operations vs. emergency	Clear distinction introduced	Different approaches required for abnormal operations and emergency situations	Using procedures for process deviations vs. emergency response plans for spills
9.2	Internal audit	Objective-based auditing	Audits must evaluate performance, not only compliance	Conducting an audit focused on energy efficiency improvement results
9.3	Management review	Structured into inputs–process–results	Decisions must be based on data and reasoning	Using monitoring data to justify investment in pollution control equipment
10	Improvement	Root cause focus/ Evidence-based actions	Corrective actions must be based on root cause analysis and measurable evidence	Identifying cause of pollution increase and fixing process failure

The changes introduced in the revised ISO 14001:2026 show that environmental management is transitioning from a primarily compliance-based and pollution reduction approach toward a more performance-oriented and risk-aware system. This shift toward performance orientation is consistent with earlier findings that environmental management systems contribute to improvements in operational practices and environmental performance (Sroufe, 2003). Compared to earlier versions, instead of fulfilling formal requirements the revised standard emphasizes demonstrating the results. The changed expectations for environmental management, with more focus on integration and measurable results, rather than just compliance are observed. One important direction is bringing environmental and social aspects closer together, so that environmental impacts are considered alongside human health, community well-being, and workplace safety during everyday operations. This highlights the need for coordinated management of environmental and safety risks within organizations. Climate change is increasingly treated as a concrete factor influencing planning, risk assessment, and long-term decision-making, rather than a general external condition. Besides managing environmental issues, organizations are expected to clearly demonstrate the process of decision making. They have to document how performance is evaluated, and to enable traceable documented evidence. Environmental management is becoming increasingly data-

driven, with greater reliance on monitoring, analysis, and digital tools to support timely and informed decision-making.

Integration of Environmental Management and Occupational Health and Safety

Although defined by separate standards, in practice environmental management and occupational health and safety to a greater extent rely on the same principles. Environmental risks, such as pollution events, resource depletion, process deviations or operational failures, often become direct risks to people. The distinction between abnormal conditions and emergency situations reflects a similar approach in safety systems, where different types of risks require different responses. In both cases, organizations must have clear procedures, trained personnel, and effective controls. Emergency preparedness shows that these systems together rely on planning, regular testing, and continuous improvement. At the same time, the growing focus on supply chains and lifecycle thinking extends responsibility beyond the organization to suppliers and contractors. Stronger performance evaluation, through audits and management review, supports more integrated decision-making, from the aspects of environmental and safety outcomes. Thus, environmental management and occupational health and safety present closely connected parts of a single, risk-based approach, which is consistent with the concept of integrated management systems (Nunhes et al., 2017) and supported by evidence of their effectiveness in improving organizational performance (Zeng et al., 2010).

CONCLUSION

The latest revision of ISO 14001 shows a clear direction toward a more practical and integrated way of managing environmental performance. The focus is now on understanding risks, considering impacts across the full lifecycle, and using real data to guide decisions. At the same time, the link between environmental management and occupational health and safety is becoming more visible. Many environmental issues also affect human wellbeing, which means these areas are no longer treated separately. Rather than introducing completely new ideas, the 2026 revision builds on existing concepts and makes them more structured, easier to follow, and easier to verify in practice. It reflects a broader shift toward more transparent and accountable management. ISO 14001 is becoming less about formal compliance and more about helping organizations manage real environmental and safety challenges in a clear and consistent way. Future implementation of ISO 14001:2026 will depend on the ability of organizations to translate these structured requirements into measurable and integrated management practices.

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