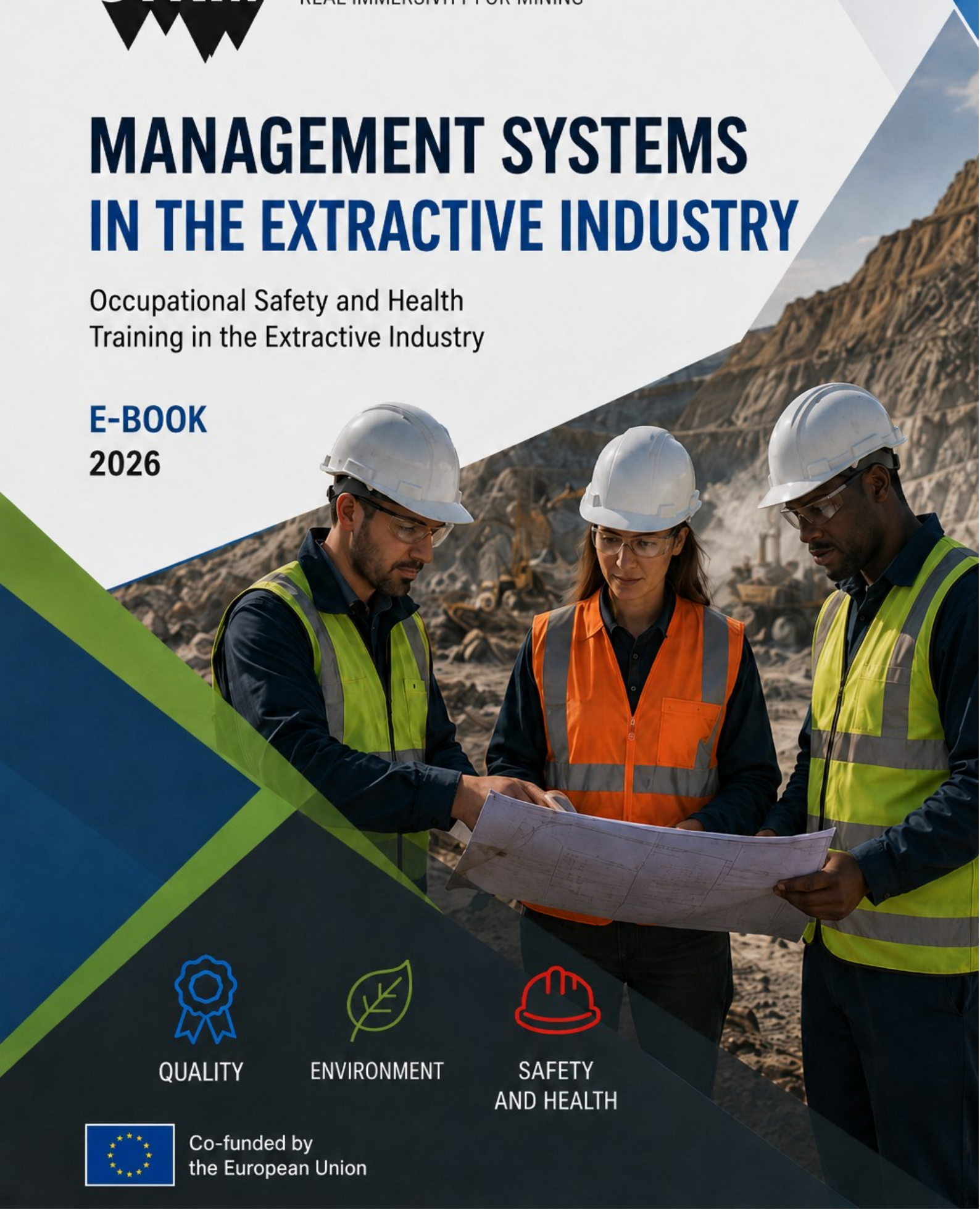
STRIM

SAFETY TRAINING WITH
REAL IMMERSIVITY FOR MINING

MANAGEMENT SYSTEMS IN THE EXTRACTIVE INDUSTRY

Occupational Safety and Health
Training in the Extractive Industry

E-BOOK
2026



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Presentation

This e-book has been designed for professionals working in the extractive industry who wish to deepen and consolidate their knowledge of occupational safety and health, environmental management and integrated management systems.

With an approach applicable to the contexts of Angola, Mozambique and Portugal, the publication brings together theoretical and practical contributions on integrated quality, environmental and safety management systems (QES), leadership, organisational culture, process management, risk assessment and continual improvement. It also addresses environmental management measures applicable to industrial and mining contexts, together with essential components of safety management systems.

The e-book organises these topics with the aim of supporting critical reflection and the practical application of them in professional settings. It is intended to serve as a reference and technical support tool that facilitates the analysis of real situations, the identification of opportunities for improvement, and the formulation of preventive, organisational and operational recommendations.

More than a collection of technical content, this publication seeks to contribute to strengthening safer and more sustainable professional practices that are aligned with the current challenges faced by organisations in the extractive industry across different Portuguese-speaking contexts.

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CHAPTER 1

Fundamentals of Integrated Management Systems

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Chapter 1 – Fundamentals of Integrated Management Systems

Quick chapter map

Pedagogical table. Quick chapter map.

Section	Pedagogical function
1. Before you begin	Activate prior knowledge of quality, the environment, safety and management systems.
2. Learning pathway	Guide the sequence: learn, observe, decide, apply and reflect.
3. Introduction to management systems	Understand the development from stand-alone approaches to integrated models.
4. Fundamental concepts of integrated management	Build a common language relating to IMSs, integration, coherence and systems thinking.
5. High-level structure of ISO standards	Recognise Annex SL as the common basis for integrating management system standards.
6. Process approach	Map processes and understand their interactions within the IMS.
7. PDCA cycle and risk-based thinking	Link planning, implementation, checking, improvement, risks and opportunities.
8. Summary and activities	Consolidate concepts through questions, exercises and a case study.

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1.1. Before you begin

1.1.1. Integrated management framework: quality, environment and safety

This chapter introduces the fundamentals of Integrated Management Systems (IMSs), focusing on the relationship between quality, environmental, and occupational safety and health management. It examines the development of management systems from stand-alone approaches to integrated models, highlighting the strategic, operational and organisational advantages of integration. It also presents the core concepts underpinning an IMS, including a systems view of the organisation, alignment between policy, objectives, processes and results, the high-level structure of ISO standards (Annex SL), the process approach, the PDCA cycle and risk-based thinking as essential foundations for more efficient, coherent management focused on continual improvement.

? KEY QUESTION	How can an organisation move away from managing quality, environment and safety as parallel systems and integrate them into a single, coherent model focused on value, risk and continual improvement?

1.1.2. Learning objectives

1. Distinguish an integrated system from coexisting systems.
2. Identify the benefits and challenges of integrating quality, environment and safety.
3. Recognise the common structure of ISO standards and the importance of Annex SL.
4. Map management, operational and support processes.
5. Relate PDCA, risk and continual improvement within an IMS.

1.1.3. Competences to be developed

- Interpret an organisation as a system of interrelated processes.
- Compare the coexistence and integration of management systems in practice.
- Identify opportunities to reduce duplication in documentation, operations and auditing.
- Construct a simple process map showing inputs, activities, outputs, responsibilities and indicators.
- Justify integration decisions on the basis of value, sustainability, risk and performance.

1.1.4. Key concepts

Pedagogical table. Key concepts.

Concept	Operational definition for this chapter
Management system	A set of interrelated elements that enables an organisation to establish policy, objectives, processes and results.
Integrated management system (IMS)	A common structure that brings together the requirements, processes, responsibilities and evidence of different frameworks, such as quality, environmental and safety management.
Integration	The unification of processes, policies, objectives, risks, audits, documents and management review within a common approach.

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Concept	Operational definition for this chapter
Coexistence	The existence of several systems side by side, with procedures, objectives and audits that are often separate.
Annex SL	The harmonised structure of ISO management system standards, which facilitates integration between different frameworks.
PDCA	The Plan-Do-Check-Act cycle used to structure continual improvement.
Risk-based thinking	An approach to planning and decision-making that considers uncertainties, threats and opportunities affecting the intended results.

1.2. Learning pathway

Pedagogical table. Learning pathway.

Stage	What the trainee does	Resources
LEARN	Reads the essential concepts in chapter 1 and identifies the technical terminology associated with the fundamentals of IMSs.	Core chapter text, table of key concepts, summary tables and examples.
OBSERVE	Analyses examples, figures, tables, practical cases and organisational or operational situations associated with the topic.	Figures, tables, practical examples and a case study.
DECIDE	Classifies situations, identifies priorities, chooses criteria and selects technically justified responses.	Guiding questions, decision criteria, matrices and decision-making exercises.
APPLY	Produces a simple application tool: map, matrix, checklist, plan, record, indicator or improvement proposal.	Templates, worksheets and completed examples.
REFLECT	Records learning, limitations, evidence used and possible improvements for professional practice.	Reflection and final summary; where applicable, a digital portfolio or the platform's forum.

▣ GUIDANCE FOR INDEPENDENT USE

When the chapter is used outside the platform, the trainee should retain completed exercises, filled-in worksheets, reflection records, group outputs and evidence of application. These materials may be used as evidence of learning and as a basis for classroom discussion or continuous assessment.

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1.3. Introduction to management systems

1.3.1. Development of management systems: from stand-alone approaches to integration

A management system is a set of interrelated or interacting elements of an organisation that enables it to establish policies, objectives and processes in order to achieve the intended results.

Traditionally, organisations implemented management systems that addressed the requirements of each standard separately, for example ISO 9001 for quality management systems or ISO 14001 for environmental management systems. This frequently resulted in parallel structures and weaker coordination between functions.

Managing the requirements of several management systems in parallel can create business inefficiencies. Ideally, therefore, an organisation should have a system that operates across the organisation and is capable of integrating different fields, such as quality, environment, and occupational safety and health.

The integration of management systems improves organisational efficiency and effectiveness by optimising resources during implementation, maintenance and auditing.

1.3.2. Strategic benefits of integrating quality, environment and safety systems

The main strategic benefits associated with implementing and maintaining an integrated management system covering quality, environmental, and occupational safety and health (QES) management are as follows:

- Strategic benefits: image, competitive advantage and alignment with objectives.
- Operational benefits: reduced duplication, improved processes and better use of resources.
- Management benefits: better decision-making and an integrated view of risks and opportunities.
- Benefits for interested parties: improved relationships with customers, suppliers and workers.

1.3.3. Integrated management as a tool for value creation and organisational sustainability

The three dimensions that support the concept of sustainable development in a holistic manner – economic, environmental and social – are connected with quality, environmental, occupational safety and health, and social responsibility management systems. These systems in turn support the normative requirements on which an integrated management system is based. An IMS contributes to sustainability by enabling the coordinated management of economic performance, environmental impacts and the protection of people. In summary, the three QES systems are regarded as fundamental pillars of sustainable development. Figure 1 illustrates this relationship and identifies the main reference standards.

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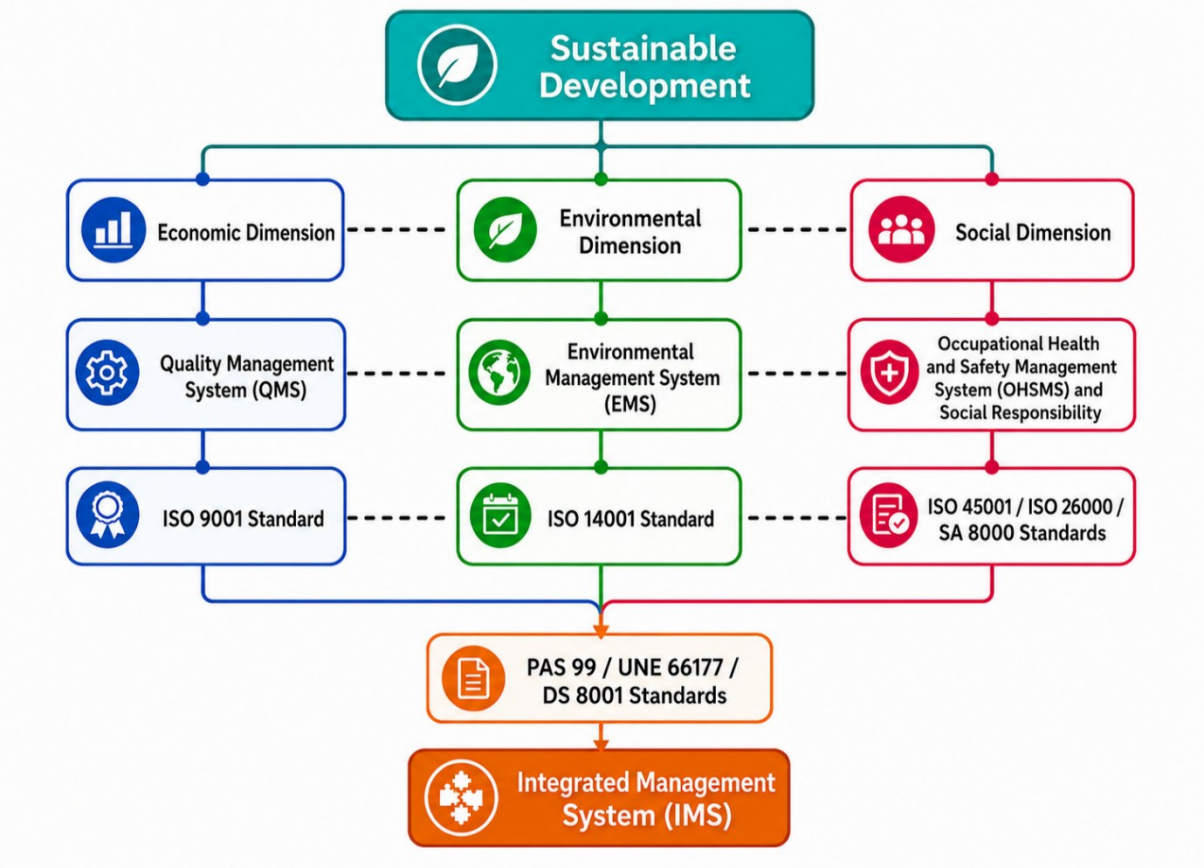

Figure 1. Sustainable development and the integrated management system [1].

1.4. Fundamental concepts of integrated management

1.4.1. A management system as a set of interrelated processes

An Integrated Management System, or IMS, is a single, coherent structure that brings together processes, requirements, responsibilities and objectives from different management fields, such as quality, environment, and occupational safety and health. By integrating frameworks such as ISO 9001 (Quality Management Systems – Requirements), ISO 14001 (Environmental management systems – Requirements and guidance for use) and ISO 45001 (Occupational health and safety management systems – Requirements and guidance for use) on a common platform, the IMS reduces redundancy, optimises resources, aligns decisions and improves the organisation's overall performance.

Some standards against which an IMS may be certified simultaneously through integrated audits include:

- ISO 9001: Quality management systems
- ISO 14001: Environmental management systems
- ISO 45001: Occupational health and safety management systems
- HACCP and ISO 22000: Food safety management systems
- ISO 27001: Information security management systems
- Sector – or customer – specific requirements
- Technical specifications for product or service certification

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Table 1 presents the key terms and definitions used in the context of integrated quality, environmental and safety management systems.

Table 1. Terms and definitions relating to integrated management systems.

Term	Reference standard	Definition
Quality	ISO 9001:2015 [2]	The degree to which a set of inherent characteristics of an object fulfils requirements.
Environment	ISO 14001:2026 [3]	The surroundings in which an organisation operates, including air, water, land, natural resources, flora, fauna, human beings and their interrelationships.
Occupational Safety and Health (OSH)	ISO 45001:2018 [4]	Conditions and factors that affect, or could affect, the safety and health of employees or other workers, including temporary workers and subcontractor personnel, visitors, or any other person in the workplace.

1.4.2. Integration versus coexistence of systems

The main difference between integration and coexistence of management systems lies in the level of synergy, resource sharing and unification of processes between standards such as ISO 9001, ISO 14001 and ISO 45001 [1]. Whilst coexistence keeps the systems separate, integration combines them into a single management system (Figure 2).

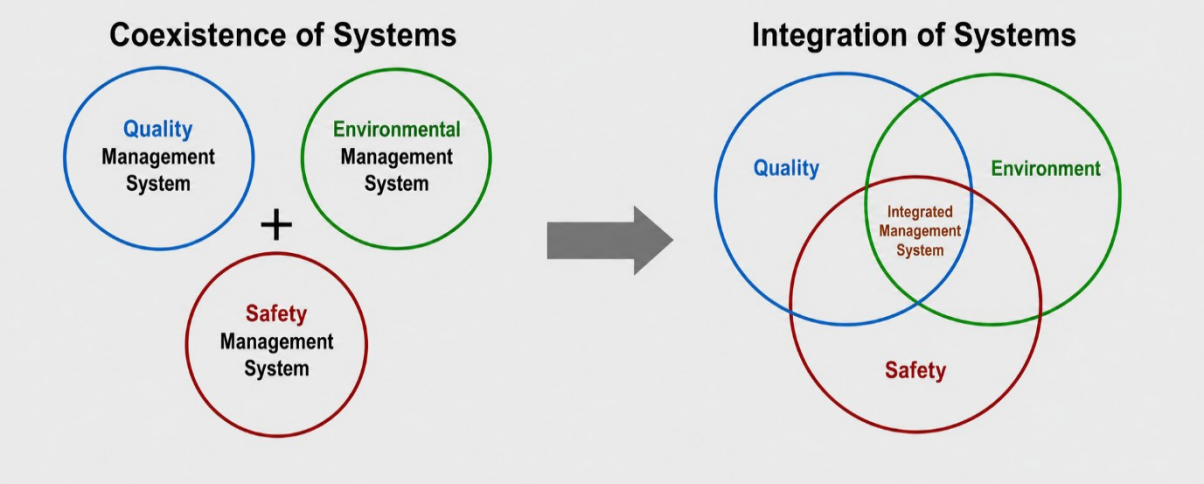

Figure 2. Schematic illustration of the integration versus coexistence of management systems.

Coexistence occurs when an organisation adopts several standards or systems but manages each independently, with separate teams, manuals, audits and objectives.

- Advantages: lower initial implementation complexity; suitable for organisations at an early stage of certification or with very distinct functions.
- Disadvantages: duplicated effort, excessive documentation, inefficient processes and higher maintenance costs due to separate audits.

Integration brings all aspects of organisational management together within a single structure, sharing common processes such as management review, internal auditing and document control.

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- Advantages: efficiency through elimination of redundant processes and lower operating costs; a holistic view of overall risk; stronger strategic alignment; and consistent, unified policies and procedures that are easier for workers to understand.
- Disadvantages: greater initial planning effort, cultural change and specialised training are required for implementation.

Table 2 outlines the distinction between integration and coexistence:

Table 2. Integration vs. coexistence of management systems.

Situation	Characteristic	Example
Coexistence	Separate systems	Independent audits, procedures and objectives
Partial alignment	Some common processes	Shared document control and audits
Integration	A single coherent system	Integrated policy, objectives, processes, risks and management review

1.4.3. Coherence between policy, objectives, processes and results

Coherence between policy, objectives, processes and results is a fundamental pillar of an effective integrated management system. It ensures that an organisation's strategic intentions are translated into practical actions and measurable results. This alignment ensures that all actions contribute to defined targets, promote operational efficiency and reduce waste.

The relationship between these four pillars operates in a continuous cycle, often based on the PDCA cycle: Plan, Do, Check and Act:

1. Policy (the "why" and the "what"): defines the general direction, vision, mission and values. It is the commitment of top management that guides all actions.
2. Objectives (the "where"): specific and measurable targets aligned with the policy and relevant to achieving the organisational strategy.
3. Processes (the "how"): sets of interrelated or interacting activities that transform inputs into outputs and are designed to achieve defined objectives.
4. Results (the "how much"): final evidence obtained through monitoring and evaluation, using performance indicators, showing whether objectives have been achieved.

1.4.4. Systems thinking and a holistic view of the organisation

Management based on systems thinking goes beyond improving operational efficiency. It seeks to understand organisational dynamics, promote continual learning and adapt to environmental change. Rather than concentrating solely on optimising isolated parts, it seeks synergy and recognises that overall performance is greater than the sum of its parts.

Effective leadership cannot be based on one-sided approaches. The holistic view provided by systems thinking enables leaders to understand complex interactions inside and outside the organisation and to recognise how each decision may affect not only one part of the business but the whole system.

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1.5. High-level structure of ISO standards – Annex SL

Annex SL establishes the high-level structure (HLS) defined by the International Organization for Standardization (ISO) to harmonise management system standards such as ISO 9001, ISO 14001 and ISO 45001 [5]. It is published by ISO and has an impact on ISO management systems, both in terms of audits and their implementation [5]. It sets common text, clause titles and definitions, facilitating the integration of multiple systems, combined audits and compatibility between different standards [6].

1.5.1. Origin and objectives of Annex SL

Annex SL was developed as a means of removing barriers to the implementation of integrated systems by making standards more consistent and easier to use [6]. It was designed to help organisations consolidate common management-system requirements and manage them effectively.

1.5.2. Harmonised terminology, concepts and requirements

The basic requirements established by Annex SL for the development of IMSs are:

i. A high-level structure with common requirements applicable to all ISO management systems.
ii. Common subclauses with identical titles and core text.
iii. Common core terms and definitions [5, 6].

1.5.3. Common structure of ISO standards (clauses 4 to 10)

Annex SL applies to all management system standards, including full ISO standards, Publicly Available Specifications (PAS) and Technical Specifications (TS) [6]. According to Annex SL, a management system standard follows this structure:

1. Scope
2. Normative references
3. Terms and definitions
4. Context of the organisation
5. Leadership
6. Planning
7. Support
8. Operation
9. Performance evaluation
10. Improvement

Clauses 1, 2 and 3 are introductory. The following clauses contain the requirements aligned with the stages of the PDCA cycle, as illustrated in Table 3.

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Table 3. Correspondence matrix of the PDCA cycle and the clauses of management system standards.

PDCA	Annex SL clauses	Common focus	ISO 9001 – Quality	ISO 14001 – Environment	ISO 45001 – OSH
Plan	**4. Context; 5. Leadership; 6. Planning; 7. Support**	Define the system framework, objectives, resources, risks and opportunities	Plan objectives, processes and resources to meet customer requirements and improve quality	Plan objectives and processes in line with the environmental policy and relevant environmental aspects	Identify hazards, assess OSH risks and opportunities and set objectives consistent with the OSH policy
Do	**8. Operation**	Implement planned processes	Control production and service provision	Control processes associated with significant environmental aspects	Control operations associated with hazards, risks and working conditions
Check	**9. Performance evaluation**	Monitor, measure, analyse and evaluate system performance	Evaluate processes, products, services, customer satisfaction and quality performance	Evaluate environmental performance and compliance with legal and other requirements	Evaluate OSH performance, legal compliance, incidents, risks and control effectiveness
Act	**10. Improvement**	Correct deviations and promote continual improvement	Continually improve the effectiveness of the quality management system	Improve environmental performance and system effectiveness	Improve OSH performance and prevent injury, ill health and incidents

1.5.4. Advantages of Annex SL for management-system integration

The main advantages of integration with Annex SL are:

- Standardised structure: the same ten-clause structure is used for all standards, facilitating joint understanding and implementation.
- Efficiency and cost reduction: duplicated procedures and documents are removed, reducing maintenance and audit costs.
- Simplified audits: a shared structure makes internal and external audits faster, more efficient and more consistent.
- Integrated view of risks and opportunities: a holistic approach helps identify risks affecting quality, environment and safety simultaneously.
- Improved leadership and planning: the common structure aligns management systems with the organisation's context and strategic objectives.
- Compatibility: future management systems can be integrated more easily because the basic structure is the same.

In summary, Annex SL makes management more agile and less bureaucratic, enabling an organisation to move from isolated systems to an effective integrated management system [5, 6].

NOTE	Annex SL enables different ISO standards to have the same structure, facilitating the creation of common processes, integrated audits and a single set of documentation.

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1.6. The process approach as the basis of integrated management

1.6.1. Definition of a process according to ISO

Within a management system, activities and resources should be managed as processes in order to increase effectiveness.

1.6.1.1. What is a process?

A process is a sequence of linked activities with clearly defined inputs and outputs and quantifiable results, such as quantities, deadlines and processing times.

- A process may cross several functions or departments within an organisation.
- A process requires suitable inputs in order to produce outputs that meet previously defined objectives.
- Resources must be used in the right quantity and sequence. A process therefore helps control what is done, how much is done, when it is done and how it is done.
- Processes may interrelate, with the output of one becoming the input of another, thereby forming a supply chain.

Figure 3 provides a schematic representation of any process and illustrates the interaction between its elements and the applicable standards within the IMS framework.

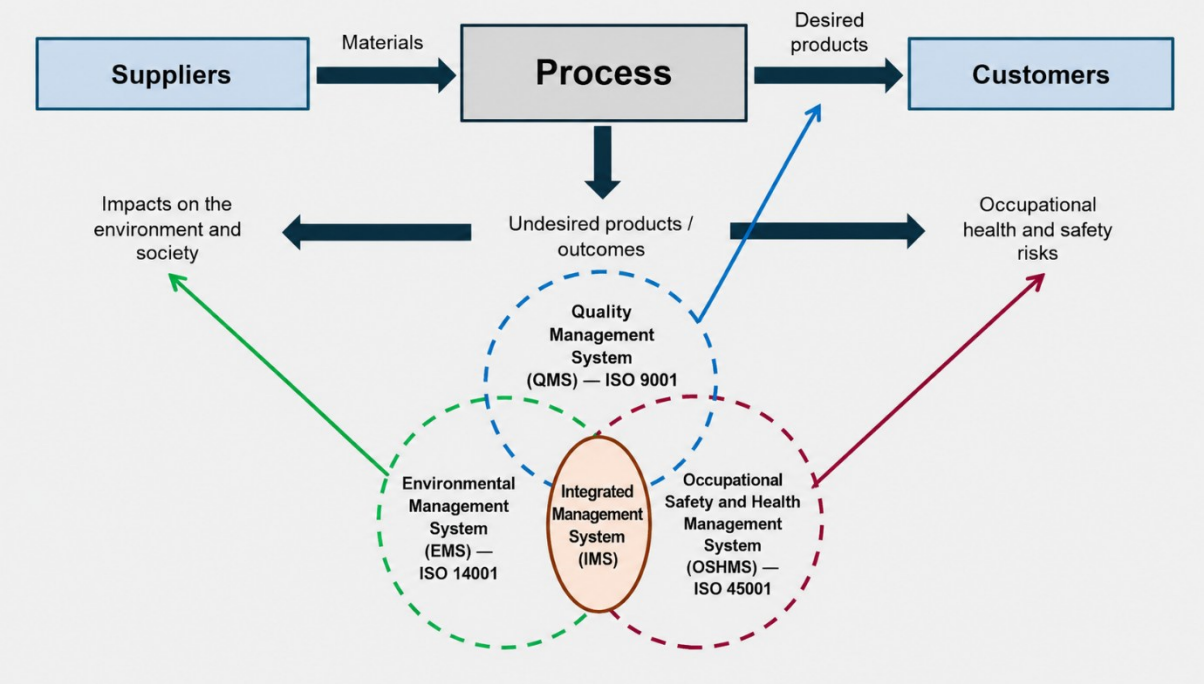

Figure 3. Generic diagram of the process approach within an IMS.

1.6.1.2. Process approach

ISO management system standards adopt the process approach, incorporating the PDCA cycle and risk-based thinking [2-4]. The process approach enables an organisation to plan its processes and their interactions.

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Process management requires:

- Appropriate identification and characterisation of processes.
- Assignment of responsibility for process management or coordination.
- Evaluation of process effectiveness.
- Improvement of process performance.

The PDCA cycle helps ensure that processes are provided with suitable resources, are properly managed, and that opportunities for improvement are identified and implemented [2].

→ **APPLICATION EXAMPLE**	**Applying PDCA to the extraction and production of aggregates in a quarry** **1.** Plan – quarry planning, risk assessment and IMS objectives. **2.** Do – extraction, crushing and grading. **3.** Check – quality control, inspections and indicators. **4.** Act – continual improvement and corrective actions.

Risk-based thinking enables the organisation to identify factors that may cause deviations from intended process and system results and to define suitable preventive and control measures [7].

1.6.2. Identification and mapping of organisational processes

The description of each organisational process should include:

1. Objectives
2. Performance indicators
3. Process owner
4. Inputs, including materials and information
5. Outputs, including products, services and information
6. Critical success factors

One of the main difficulties in implementing the process approach is ensuring effective interrelationships between all organisational processes, particularly through effective communication.

A common problem is the exchange of data between processes, owing either to different data formats or poorly coordinated communication mechanisms.

→ **APPLICATION EXAMPLE**	**Process sheet: Equipment maintenance** **Inputs:** maintenance plan, legal requirements and breakdown history. **Activities:** inspection, preventive maintenance and fault correction. **Outputs:** operational equipment, records and fewer breakdowns. **Indicators:** breakdown rate, plan completion and associated incidents. **QES risks:** quality failure, environmental spill and injury during intervention.

1.6.3. Interaction between management, operational and support processes

For an activity to be considered a process, it should:

- add value for a customer or another process,
- have at least one input and one output, and
- be capable of transforming inputs such as raw materials or knowledge into products or services.

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There are different types of organisational processes, which can be classified according to their nature and purpose into: management (strategic) processes, primary (operational) processes and support processes, as described in Table 4.

Table 4. Types of processes: management, operational and support processes.

Process type	Definition	Common examples
Management processes	They guide and optimise the system as a whole; support continual improvement by measuring what matters, identifying inefficiencies and enabling proactive change.	Information management; Financial resource management; Continual-improvement processes such as audits and customer surveys.
Primary/operational processes	Core workflows that directly create customer value. They reflect the essential business activities that fulfil the organisation's mission.	Production of goods or services; Operations; Outbound logistics; Marketing and sales; Product delivery; After-sales service.
Support processes	They provide the foundation, resources and capabilities needed for primary processes to operate effectively and reliably. Their role is to equip, enable and support the activities of the core processes.	IT services; Human resources; Accounting; Facilities management.

1.6.4. Process map

A process map is a graphical representation of the processes supporting the organisation's management system. It includes management, primary and support processes and shows their interactions [1, 8], as shown in Figure 4.

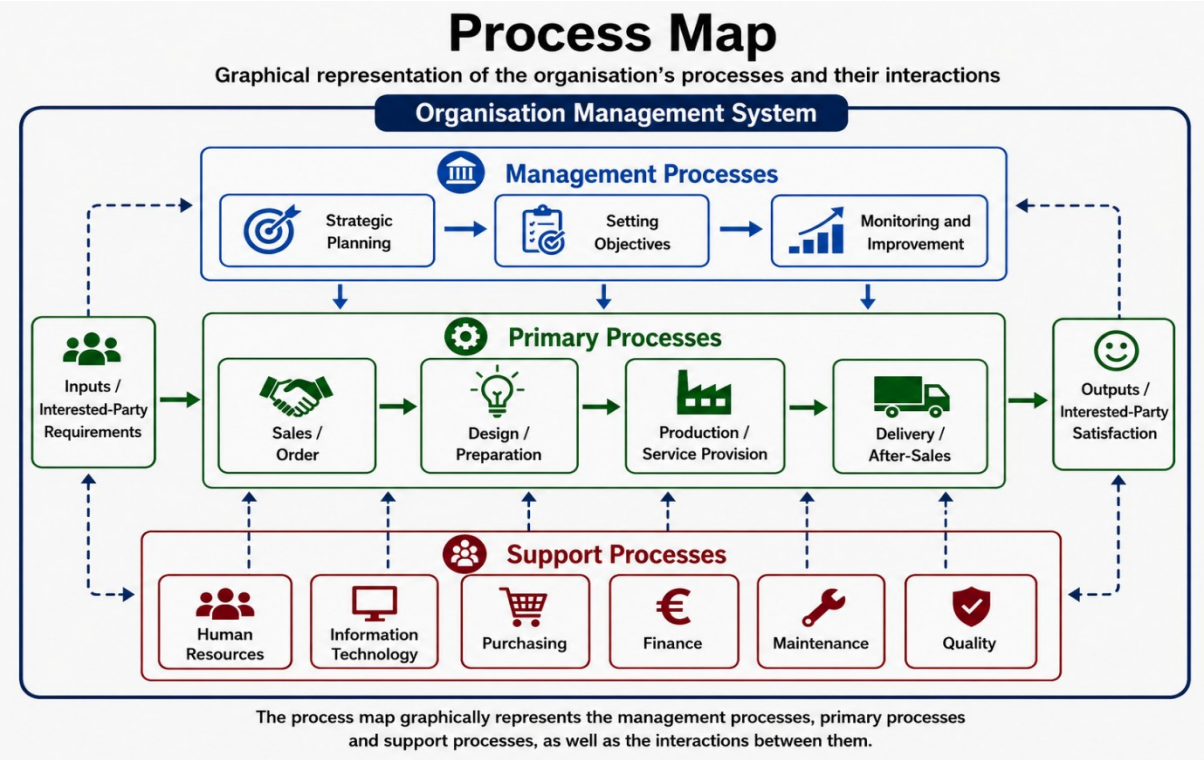

Figure 4. Organisational process map and interactions.

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1.6.5. The process approach as a structuring element of QES systems

The process approach is a structuring element of an IMS because it transforms organisational management into a holistic and interconnected view of activities. It is fundamental to ISO 9001, ISO 14001 and ISO 45001, enabling quality, environmental and safety processes to operate in an integrated manner and achieve consistent, efficient and continually improving results.

Figure 5 illustrates the elements of the process-based approach within the context of an integrated quality, environmental and safety management system.

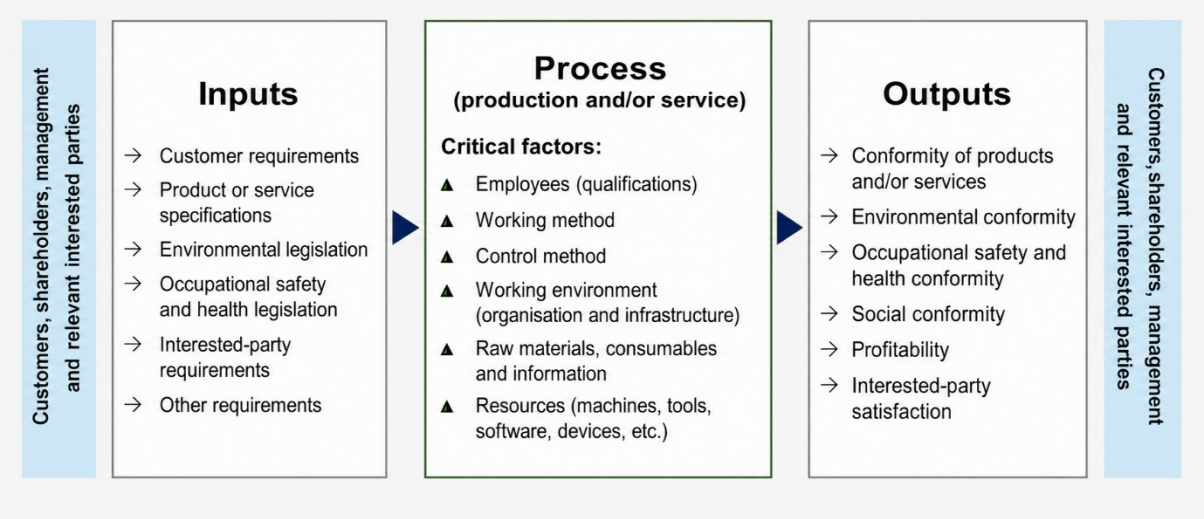

Figure 5. Schematic representation of process elements within a QES Integrated Management System.

1.6.6. Integrating quality, environment and safety requirements into processes

Figure 6 illustrates, in accordance with PAS 99:2012 [9], how the requirements of multiple management-system standards can be integrated within a common system in the manner most beneficial to the organisation. This reduces duplication arising from the application of separate management-system requirements.

Functions commonly integrated include top-management responsibility, work instructions, document and record control, internal communication and the responsibility structure. Tools frequently used in an integrated context include brainstorming, histograms and the Pareto chart.

Each critical process should be analysed to identify applicable quality, environmental and OSH requirements, the controls needed and the evidence demonstrating implementation. For example, in the equipment maintenance process, requirements from all three domains can be integrated as described in Table 5:

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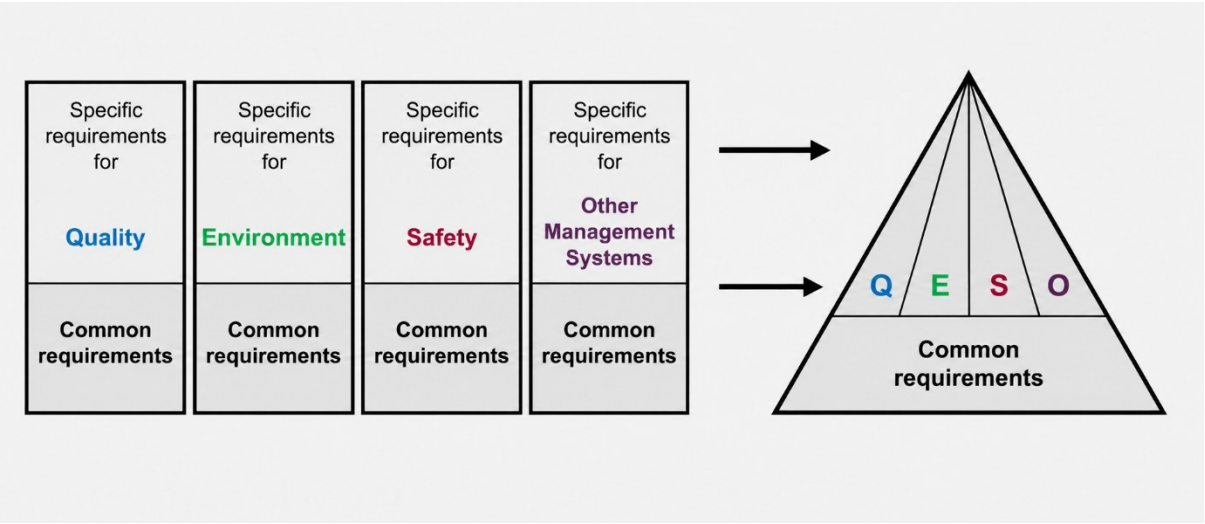

Figure 6. Illustration of how the requirements of management system standards can be integrated into a single system.

Table 5. Practical example: integrating QES requirements into the equipment maintenance process.

Dimension	Requirement integrated into the process	Practical application example	Evidence/record
Quality	Ensure the equipment remains capable of producing within defined requirements	Complete the preventive-maintenance plan and verify equipment performance after intervention	Maintenance plan, work order and post-maintenance verification record
Environment	Prevent spills, emissions or improper waste generation during maintenance	Segregate used oils, collect contaminated waste and use spill-control kits	Waste record, environmental checklist and transfer note to an authorised operator
OSH	Control risks to workers during intervention	Apply lockout/tagout, use PPE, issue work authorisation and conduct prior risk assessment	Permit to work, safety checklist and training/authorisation record

In this way, equipment maintenance ceases to be merely a technical activity and becomes an integrated process contributing simultaneously to product or service quality, environmental prevention and worker safety.

1.7. PDCA cycle and risk-based thinking

Building on the concepts presented in **section 1.6.1.2**, it is now important to analyse how the PDCA cycle and risk-based thinking shape integrated management.

1.7.1. Applying the PDCA cycle to integrated management

Integration of ISO 9001, ISO 14001 and ISO 45001 is facilitated because all three standards are based on the common principle of continual improvement through the PDCA cycle, as illustrated in Figure 7. The PDCA cycle is therefore a fundamental element of approaches and models supporting management-system integration.

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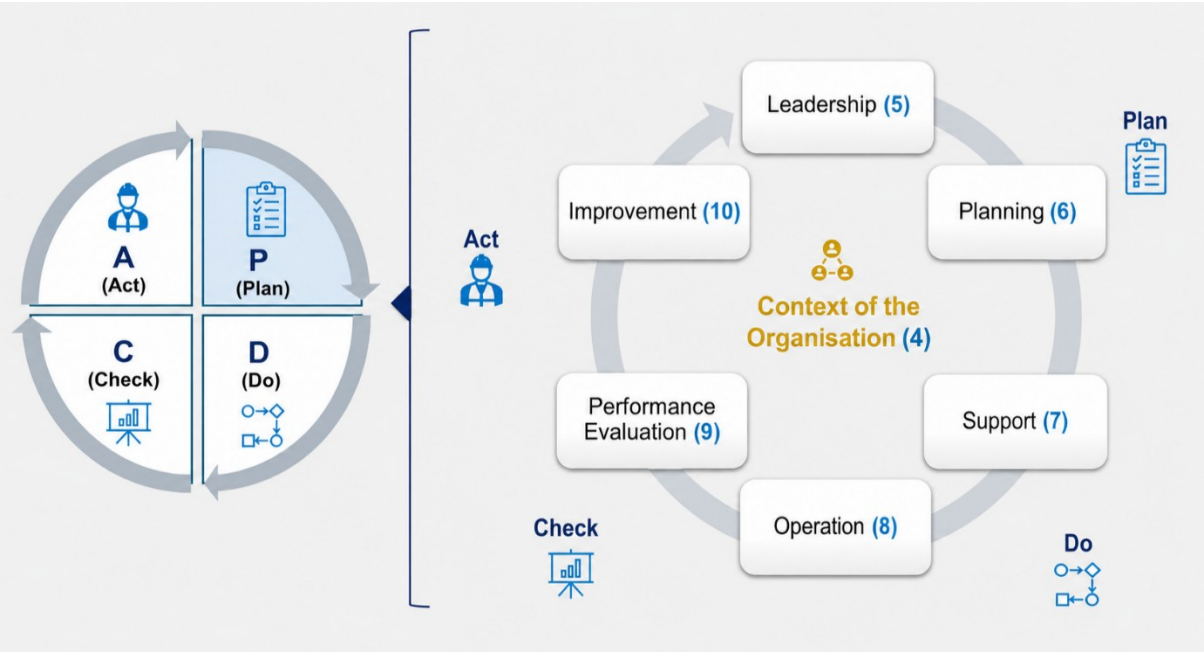

Figure 7. Relationship between common management-system clauses and the PDCA cycle.

1.7.2. Risk-based thinking and opportunities as an integrating factor

Risk-based thinking is essential to an effective management system. Earlier editions of management-system standards already implied this concept through preventive action, analysis of nonconformities and actions to prevent recurrence.

Current standards require an organisation to plan and implement actions to address risks and opportunities, helping ensure that the IMS achieves its intended results, prevents or reduces undesirable effects and achieves continual improvement.

Every decision and activity involves risk. Risk-based thinking means considering uncertainty in each activity, identifying risks and opportunities, defining actions to address them and evaluating the effectiveness of those actions. Addressing risks and opportunities creates a basis for increasing system effectiveness, achieving better results and preventing negative effects [7, 10].

1.7.3. Risks and opportunities associated with quality, environment and occupational safety and health

An organisation is free to select the method used to determine its risks and opportunities. There is no requirement for formal risk management or for a documented risk-management process under ISO 9001 [2]. The method may therefore range from a simple qualitative process to a complete quantitative assessment [5, 7].

Risk-based thinking applies across the entire IMS, including processes, activities, tasks, functions, products, services, environmental aspects and impacts, and occupational hazards, risks and opportunities [1, 7].

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1.7.4. Integrated risk assessment as support for decision-making

The purpose of risk assessment is to support decisions. It involves comparing the results of risk analysis with established risk criteria to determine whether further action is required. This may lead to a decision to:

- take no further action;
- consider risk-treatment options;
- carry out further analysis to understand the risk better;
- maintain existing controls;
- reconsider the objectives.

Decisions should take account of the wider context and the actual and perceived consequences for internal and external interested parties [1]. Risk-assessment results should be recorded, communicated and validated at the appropriate organisational levels [2].

→ APPLICATION EXAMPLE	**Situation: dust emissions** **Risk:** fines and community complaints. **Opportunity:** more efficient water-spraying systems.

1.8. Final summary

An Integrated Management System is not simply the sum of several standards. It is a way of managing the organisation through common processes, aligned objectives, clear responsibilities, risk assessment and continual improvement. Integration reduces duplication, improves decisions and creates value for the organisation and its interested parties.

i NOTE	An effective IMS integrates policies, processes, risks, responsibilities and results within a single system focused on continual improvement.

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Case studies and assessment activities

A. Self-assessment questions

1. What is meant by an Integrated Management System (IMS)?

2. What is the difference between coexisting and integrated management systems?

3. What are the main strategic benefits of integrating Quality, Environment and Safety systems?

4. How can an IMS contribute to organisational sustainability?

5. Which ISO standards are normally associated with quality, environmental, and occupational safety and health management?

6. What is Annex SL and why is it important for management-system integration?

7. What are the common clauses of ISO management-system standards under the high-level structure?

8. Explain the importance of the process approach within an IMS.

9. How are the PDCA cycle, risk-based thinking and continual improvement related within an IMS?

10. Why is integrated risk assessment important for organisational decision-making?

B. Multiple-choice questions

1. An Integrated Management System can be defined as:

A. A set of independent systems managed by separate departments.
B. A single structure that brings together different organisational systems and processes.
C. A system dedicated exclusively to environmental management.
D. A set of audits carried out separately for each standard.
E. An informal method of document control.

2. The main difference between integration and coexistence is:

A. Coexistence always requires external certification.
B. Integration removes all legal requirements.
C. Integration promotes the unification of processes, resources and objectives.
D. Coexistence is mandatory under ISO standards.
F. Integration applies only to ISO 9001.

3. Which option is an operational benefit of system integration?

A. Increased duplication of documentation.
B. Reduced duplication and better use of resources.
C. Independent objectives for each department.
D. Reduced communication between functions.
E. Mandatory separate audits.

4. The three dimensions associated with sustainable development are:

A. Technical, legal and financial.
B. Quality, audit and certification.
C. Economic, environmental and social.

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D. Production, maintenance and logistics.
E. Risk, control and inspection.

5. ISO 9001 is primarily associated with the management of:

A. Quality.
B. Information security.
C. Food safety.
D. Occupational safety and health.
E. Social responsibility.

6. The high-level structure is important because it:

A. Removes the need for organisational policies.
B. Defines completely different requirements for every management system.
C. Harmonises common titles, text and definitions, facilitating integration.
D. Replaces all operational processes.
E. Prevents integrated audits.

7. Under the common ISO structure, clause 9 relates to:

A. Context of the organisation.
B. Leadership.
C. Planning.
D. Performance evaluation.
E. Improvement.

8. Under the process approach, a process should have:

A. Only an output, with no inputs.
B. Inputs, interrelated activities and outputs.
C. Only financial indicators.
D. A structure independent of organisational objectives.
E. Undefined responsibilities.

9. In the PDCA cycle, "Check" means:

A. Plan objectives and processes.
B. Implement defined processes.
C. Monitor, measure and evaluate performance.
D. Carry out corrective action without prior analysis.
E. Eliminate all organisational risks.

10. Risk-based thinking enables an organisation to:

A. Ignore uncertainty in processes.
B. Identify factors that could cause deviations from intended results.
C. Eliminate the need for performance evaluation.
D. Replace top management.
E. Apply only corrective measures after accidents occur.

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C CORRECT ANSWERS	1. B; 2. C; 3. B; 4. C; 5. A; 6. C; 7. D; 8. B; 9. C; 10. B.

C. Exercises

Exercise 1 – Integration versus coexistence

An organisation has three management systems: Quality, Environment, and Occupational Safety and Health. Each system has its own manual, responsible team, internal audit, objectives and documented procedures.

A ACTIVITY	Classify the situation as coexistence, partial alignment or integration. Justify your answer and identify two measures that could move the organisation towards a genuine IMS.

Exercise 2 – Process mapping

Consider the process "Internal training management" within an organisation with an Integrated Management System.

A ACTIVITY	Identify: a. two process inputs; b. three main activities; c. two outputs; d. two performance indicators; and e. two QES risks associated with the process.

Exercise 3 – Applying the PDCA cycle

A company has identified a high number of incidents during maintenance operations. Management intends to apply the PDCA cycle to reduce these incidents.

A ACTIVITY	Propose one action for each stage: Plan, Do, Check and Act.

Exercise 4 – Identifying processes

A ACTIVITY	Classify the following as management, operational or support processes: a. internal audits; b. production of goods; c. human resources management; d. product delivery; e. financial management; f. after-sales service.

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Exercise 5 – Integrated risk assessment

During machine cleaning there is a risk of product contamination, a chemical spill and worker injury.

A ACTIVITY

From an integrated QES perspective, identify:

a. one quality risk,
b. one environmental risk,
c. one OSH risk,
d. one integrated preventive measure and
e. one indicator for monitoring effectiveness

Suggested answers

Exercise 1 – Integration versus coexistence

PROPOSED ANSWER

This is coexistence because the systems are managed separately, with independent structures, teams, audits and objectives. Measures could include establishing an integrated QES policy, unifying common procedures, carrying out integrated internal audits and defining common objectives aligned with organisational strategy.

Exercise 2 – Process mapping

PROPOSED ANSWER

a. Possible inputs include training needs, legal or normative requirements and performance-appraisal results.

b. Activities may include training planning, trainer selection, delivery and effectiveness evaluation.

c. Outputs may include trained workers, training records and improved competence.

d. Indicators may include completion of the training plan, percentage of workers trained and average evaluation score.

e. Risks may include inadequate training affecting work quality, lack of knowledge of environmental or safety procedures and non-compliance with OSH legal requirements.

Exercise 3 – Applying the PDCA cycle

PROPOSED ANSWER

Plan: identify incident causes, assess risks and set reduction objectives.

Do: implement safe-maintenance procedures, training and protective equipment.

Check: monitor incident numbers, maintenance-plan completion and audit findings.

Act: correct failures, revise procedures and improve existing controls.

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Exercise 4 – Identifying processes

PROPOSED ANSWER

a. Internal audits: management process.

b. Production: operational process.

c. Human resources: support process.

d. Product delivery: operational process.

e. Financial management: management or support process depending on organisational structure.

f. After-sales service: operational process because it is directly associated with customer value.

Exercise 5 – Integrated risk assessment

PROPOSED ANSWER

a. Quality risk: product contamination or nonconformity.

b. Environmental risk: chemical spill or contamination of land/water.

c. OSH risk: injury, poisoning or hazardous-substance exposure.

d. Integrated preventive measure: a safe cleaning procedure, worker training, spill containment and suitable PPE.

e. Indicators may include incidents during cleaning, nonconformities, spills and compliance with the cleaning procedure.

D. Case study

CASE STUDY – ROCHA VIVA QUARRY, LTD.

Purpose of the assignment: Analyse the case and apply the concepts of integration, processes, objectives and risks within an integrated management system.

1. Context

→ *Rocha Viva* Quarry, Ltd. extracts and produces aggregates for the construction industry.

→ The company employs 150 people and already has an ISO 9001-certified quality management system.

→ It has recently decided to implement ISO 14001 and ISO 45001 with the aim of creating an integrated management system.

2. Current situation

→ Separate procedures exist for quality, environment and safety, even where they address similar subjects.

→ Environmental and OSH information does not always reach production managers in time.

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→ Risk assessments are completed in separate documents without coordination between quality, environment and OSH.
→ The company policy includes environmental and safety commitments, but these have not yet been translated into clear objectives and indicators.
→ Managers still see the systems as separate functions rather than parts of a single system.

3. Work to be developed

3.1. Integration or coexistence?

State whether the company demonstrates genuine integration or merely coexistence. Justify the answer using three examples from the case.

3.2. Select and describe a process

Select a quarry process, such as drilling, blasting, loading and internal haulage, crushing, grading or dispatch. Describe its objective, process owner, two inputs, two outputs and three indicators: one for quality, one for environment and one for OSH.

Suggestion: Crushing is an accessible example because it involves product quality, dust, noise and worker safety.

3.3. Objectives aligned with policy

Propose three objectives: one for quality, one for environment and one for OSH. Each objective should be clear, measurable, realistic and time-bound.

Example: Reduce incidents involving the movement of internal plant and vehicles by 20% by the end of 2026.

✓ **GOOD PRACTICE**

Avoid vague objectives such as ‘improving safety’ or ‘protecting the environment’. It’s better to set out something that can be measured.

3.4. Identification of integrated risks

Select a quarry process and identify one quality risk, one environmental risk and one OSH risk. For each, state what may happen, a possible consequence and a prevention or control measure.

Example: Excessive dust emissions during crushing and haulage may cause air pollution and community complaints; controls include water sprays, enclosure and regular cleaning.

3.5. Integrated measures

Identify two measures that can improve quality, environmental performance and OSH at the same time.

Explain why each measure supports more than one field.

Example: Implement preventive maintenance.
It reduces failures and nonconforming products, reduces dust, leaks and excessive consumption, and lowers the risk of hazardous breakdowns and worker exposure.

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3.6. Short conclusion

Write a conclusion of 6 to 10 lines answering: **Why would *Rocha Viva* Quarry benefit from a fully integrated management system?**

4. Instructions

→ Individual work.
→ Base answers on the case presented.
→ Use clear and organised language.
→ Justify answers wherever possible.

5. Assessment criteria

→ Understanding of chapter concepts.
→ Ability to apply the concepts to the case.
→ Clarity and coherence of answers.
→ Ability to relate quality, environment and OSH.

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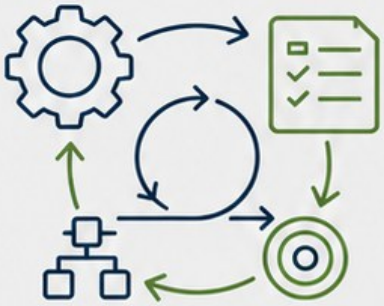
SAFETY TRAINING WITH
REAL IMMERSIVITY FOR MINING

CHAPTER 2

Management Systems



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Chapter 2 – Management Systems

Quick chapter map

Pedagogical table. Quick chapter map.

Section	Pedagogical function
1. Before you begin	Clarify the role of the IMS as a management model rather than merely a set of documents.
2. Learning pathway	Organise learning from organisational context through continual improvement.
3. Context of the organisation and interested parties	Relate internal and external issues and relevant requirements to organisational processes.
4. Leadership, commitment and organisational culture	Understand the role of top management, line managers and supervisors, and people throughout the organisation.
5. Integrated documentation and documented information	Harmonise procedures, records, instructions and document control.
6. Monitoring, performance evaluation and improvement	Define indicators, internal audits, management review and improvement actions.
7. Integrated management as an organisational model	Interpret the IMS as a framework for governance, decision-making and value creation.
8. Summary and activities	Apply the content to cases involving context, communication, auditing and improvement.

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2.1. Before you begin

2.1.1. Background

Following the introduction to the fundamentals of integrated management systems, this chapter focuses on the elements required to implement, maintain and improve them in the organisation's day-to-day operations. It addresses the context of the organisation, interested parties, leadership, organisational culture, communication, documented information, performance evaluation, internal audits and continual improvement. Taken together, these topics show how integrated management contributes to an organisation that is more coherent, efficient and results-oriented.

? KEY QUESTION	Why does an integrated management system create value only when it guides the organisation's day-to-day management, rather than existing merely as documentation for audit purposes?

2.1.2. Learning objectives

1. Identify internal and external issues relevant to an IMS.
2. Map interested parties and their respective requirements.
3. Recognise the responsibilities of leadership and people throughout the organisation.
4. Distinguish between documented information that is maintained and documented information that is retained.
5. Select integrated performance indicators.
6. Understand the role of internal audits and management review.
7. Identify critical success factors in implementing an IMS.

2.1.3. Competences to be developed

- Apply simple tools, such as SWOT or PESTEL, when analysing organisational context.
- Construct a matrix of interested parties, needs, expectations and requirements.
- Analyse how leadership, communication and participation influence IMS performance.
- Assess whether documents, records and indicators effectively support processes.
- Propose realistic improvements to make the system simpler, more useful and more integrated.

2.1.4. Key concepts

Pedagogical table. Key concepts.

Concept	Operational definition for this chapter
Context of the organisation	The set of internal and external issues that influence the organisation's ability to achieve its intended results.
Interested parties	People or entities that affect, or are affected by, the organisation's performance.
Leadership	The commitment of top management to setting direction, responsibilities, resources and culture.
Organisational culture	The values, practices, behaviours and priorities that influence how work is carried out.
Documented information	Information needed to guide processes and provide evidence of results.

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Concept	Operational definition for this chapter
Integrated indicator	A measure used to evaluate process performance while considering quality, environment and safety.
Integrated internal audit	A systematic evaluation that verifies common and specific requirements from different frameworks within the same audit cycle.

2.2. Learning pathway

Pedagogical table. Learning pathway.

Stage	What the trainee does	Resources
LEARN	Reads the essential concepts in chapter 2 and identifies the technical terminology associated with management systems.	Core chapter text, table of key concepts, summary tables and examples.
OBSERVE	Analyses examples, figures, tables, practical cases and organisational or operational situations associated with the topic.	Figures, tables, practical examples and a case study.
DECIDE	Classifies situations, identifies priorities, chooses criteria and selects technically justified responses.	Guiding questions, decision criteria, matrices and decision-making exercises.
APPLY	Produces a simple application tool: map, matrix, checklist, plan, record, indicator or improvement proposal.	Templates, worksheets and completed examples.
REFLECT	Records learning, limitations, evidence used and possible improvements for professional practice.	Reflection and final summary; where applicable, a digital portfolio or the platform's forum.

▣ GUIDANCE FOR INDEPENDENT USE

When the chapter is used outside the platform, the trainee should retain completed exercises, filled-in worksheets, reflection records, group outputs and evidence of application. These materials may be used as evidence of learning and as a basis for classroom discussion or continuous assessment.

2.3. Context of the organisation and interested parties

2.3.1. Understanding the internal and external context

A fundamental aspect of implementing an Integrated Management System (IMS) is the need for the organisation to determine the context in which it operates. This involves identifying internal and external issues that are relevant to its purpose and strategic direction and that affect its ability to achieve the intended results of the Quality, Environment and Occupational Safety and Health Integrated Management System (QES IMS).

A range of management methodologies, tools and techniques can help the organisation determine external context issues, such as legal, technological and market factors, and internal context issues, such as culture, performance and resources. These include SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) and PESTEL analysis (Political, Economic, Social, Technological, Environmental and Legal factors), as shown in Table 6. It is recommended that this analysis be carried out by a multidisciplinary team representing the organisation as a whole, thereby ensuring a holistic view of the various issues. Table 7 shows some examples of the most common external and internal issues.

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Table 6. SWOT and PESTEL and their application within the IMS.

Tool	Application within the IMS
SWOT	Identify strengths, weaknesses, opportunities and threats that affect the IMS.
PESTEL	Analyse political, economic, social, technological, environmental and legal factors.

Table 7. Examples of external and internal issues within the scope of the QES IMS.

External issues	Internal issues
Economic: availability of capital, financial markets and unemployment. **Environmental:** emissions and waste, energy and sustainable development. **Political:** government, legislation, public policy and regulation. **Social:** demographics, social responsibility and terrorism. **Technological:** emerging technology.	**Infrastructure:** availability and capacity of assets and access to capital. **People:** workforce capability and safety. **Processes:** capability for planning, implementation, control of inputs and outputs, knowledge and suppliers. **Technology:** availability and integrity of data and systems, development, production and maintenance.

2.3.2. Identification and expectations of relevant interested parties

Another fundamental and cross-cutting aspect of the quality, environment and safety integrated management system is the need for the organisation to determine the needs and expectations – that is, the requirements – of its relevant interested parties.

Under Annex SL, an interested party is defined as a person or organisation that can affect, be affected by, or perceive itself to be affected by a decision or activity. Figure 8 illustrates some of the principal groups of interested parties of an organisation.

Figure 8. Main interested parties within an organisation.

From among the interested parties analysed, the organisation must determine those that are relevant to its QES integrated management system. Not all interested parties have the same degree of relevance to the IMS. The organisation must assess which parties are relevant and which of their requirements apply. Table 8 provides examples of interested parties and their more general needs and expectations.

Table 8. Examples of interested parties and their needs and expectations.

Interested parties	Needs and expectations	Impact on the QES IMS
Customers	Conforming products and services, delivery on time, an appropriate price, responses to complaints and continual improvement	Quality objectives, control of operational processes, complaint management, evaluation of customer satisfaction and performance improvement
Owners / shareholders	Sustainable profitability, transparency, risk control, legal compliance and a positive reputation	Alignment of the IMS with strategy, monitoring of indicators, management review, risk management and performance-based decision-making
Workers / employees	Safe and healthy working conditions, training, participation, recognition, stability and clear communication	OSH requirements, training and competence, consultation and participation, operational control, internal communication and monitoring of incidents and accidents
Suppliers and partners	Stable relationships, clear requirements, agreed payments, continuity of the business relationship and collaboration	Supplier evaluation and selection, definition of purchasing requirements, control of externally provided supplies and communication of QES requirements
Regulatory authorities	Compliance with legal, normative, environmental, employment and safety requirements	Identification and evaluation of legal compliance, document control, internal audits, corrective actions and reporting where applicable
Society / community	Environmental protection, ethical conduct, prevention of adverse impacts, transparency and social responsibility	Management of environmental aspects and impacts, external communication, control of emissions and waste, accident prevention and reputation management
Certification bodies	Objective evidence of conformity with the requirements of applicable standards	Audit preparation, maintenance of documented information, treatment of nonconformities and continual improvement of the IMS
Contractors	Clear rules, safe working conditions, information on risks and applicable requirements	Control of contracted activities, integration into QES procedures, training and information, performance evaluation and control of operational risks

2.3.3. Alignment of context when defining processes

Identifying the internal and external issues that define the organisation's context makes it possible to ensure that the mapping and operation of organisational activities are directly linked to those issues and to the needs of interested parties. This alignment ensures that processes do not exist in isolation, but serve a strategic purpose and generate consistent results focused on business objectives.

Aligning context when defining processes should be a continual cycle in which relevant issues and the needs and expectations of interested parties are reviewed to ensure that processes remain relevant.

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2.4. Leadership, commitment and organisational culture

2.4.1. Role of leadership in integrated management

Within the organisation, top management – that is, the person or group of people who directs and controls an organisation at the highest level – plays a fundamental role throughout the IMS implementation process. Top management's leadership and commitment must therefore be fully aligned with the principles underpinning sustainable development and with the objectives of the IMS.

Within the IMS, commitments to be assumed and communicated by top management include:

- **Compliance and accountability**: legal requirements, standards, audits and certification.
- **People and culture**: training, competence, participation and transparency.
- **Risk and performance**: risk management, continual improvement, objectives and indicators.
- **Sustainability**: economic, environmental and social balance, and social responsibility.

2.4.2. Responsibilities and involvement of people

People at all levels are the essence of organisations. Only when they are motivated and involved can their capabilities be used to the greatest benefit of both the organisation and themselves. When workers are unmotivated and disconnected from the organisation's objectives, they feel no emotional connection with the business activity and are not focused on creating value.

In practice, workers' understanding of their responsibilities, together with their involvement and motivation, means:

- Each employee understands the importance of their contribution and role within the organisation.
- Each employee identifies the factors that limit or obstruct their performance.
- Each employee accepts responsibility for resolving the problems that fall within their area of responsibility.
- Each employee evaluates their own performance against established objectives and targets.
- Each employee continually seeks opportunities to strengthen their competences and knowledge and to gain experience.
- Knowledge and experience are shared spontaneously.
- Problems and other relevant matters are discussed openly.

2.4.3. Culture of quality, environmental prevention and safety

Organisational culture comprises a range of elements, as shown in Figure 9. These include mission and vision, values, strategy, reward and recognition, and performance indicators. Organisational culture is therefore a system of shared traditions, values and beliefs that has a major influence on how people behave within organisations. Irrespective of the size of the company, organisational culture normally consists of the initiatives and elements that characterise its working environment and the experience of its workers.

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Figure 9. Elements of organisational culture.

Organisational culture is one of the most critical factors in the effective performance of standardised management systems, and is even more important to their integration. Considerable attention must therefore be given to culture-related elements. An integrated culture exists when day-to-day decisions simultaneously consider conformity of the product or service, environmental impacts and people's safety. The development of an IMS must be led by top management, secure the commitment of everyone directly and indirectly involved in the process, and be consistent with the organisation's culture and strategy.

A preliminary diagnosis characterising the organisation's culture is essential to ensure the suitability and success of the IMS. This helps prevent adverse effects during development, such as resistance to change, internal conflict or difficulties with integration.

Examples of signs of a positive culture include:

- workers report problems without fear;
- line managers and supervisors value safety and the environment as highly as productivity;
- nonconformities are viewed as opportunities for improvement;
- audits are used for learning, rather than solely for compliance.

2.4.4. Communication and participation as critical success factors

Communication is essential at every stage of management system implementation because it connects all interested parties. Effective communication makes it possible to achieve the objectives of a project or process and secure successful outcomes. When implementing a QES IMS, the organisation's communication process should generally include a communication plan covering all relevant interested parties, as an efficient means of managing the various communication requirements applicable to quality, environmental and safety management.

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The communication plan established by the organisation must therefore correctly identify the requirements giving rise to the need for communication, as well as all other aspects of internal and external communication. These include what is to be communicated, when, to whom, how, by whom and where – for example, on the organisation's corporate website – as shown in Table 9. Effective communication is essential both to promote sustainable development and to support the organisation's results.

Table 9. Simple communication matrix.

What to communicate	To whom	When	How	Responsible
QES objectives	Workers	Annually / whenever revised	Meeting, intranet	Top management
Audit results	Process owners	After the audit	Report, meeting	IMS manager
OSH incidents	Affected teams	Immediately	Safety alert	OSH function / supervisor
Environmental performance	Relevant interested parties	Periodically	Report / website	Environment / communications function

2.5. Documented information and integrated documentation

2.5.1. Development of the concept of documentation in ISO standards

Earlier editions of management system standards required specific documented procedures and records as evidence that the management system had been implemented. In the current editions of ISO 9001, ISO 14001 and ISO 45001, the expression "documented information" is used where earlier editions referred to documents such as manuals, instructions, procedures, specifications and plans. Similarly, where records were previously required as evidence of conformity with requirements, the standards now use the expression "retain documented information".

Within an IMS, documented information means information that an organisation is required to control and maintain, together with the medium on which it is contained. It may be in any format or medium and may come from any source. It should include the information required by the applicable standards, as well as any other information the organisation determines to be necessary for the effectiveness of the IMS. The organisation should also establish internal arrangements for the effective creation, updating and control of documented information.

It is for the organisation to determine what information supports its management system, in what medium, from which sources and in which formats. The documented information required depends on the organisation's context, size, products and services, associated risks, process complexity, the competence of its people, applicable requirements, the means used to manage organisational knowledge and the resources available. It may therefore relate to the management system and its processes, information created to support operational activities, or evidence of results achieved.

Examples of documented information include process maps, organisation charts, procedures, work instructions, specifications, internal communications, work orders, production schedules, lists of approved suppliers, test and inspection plans, quality, environmental and/or safety plans, the IMS manual, strategic plans, forms, process workflows, document-management applications and databases.

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2.5.2. Documented information as support for processes

One of the main reasons for documenting information within an IMS is to demonstrate the conformity of processes, products and services. Under ISO 9001, ISO 14001 and ISO 45001, the organisation must determine the documented information necessary and appropriate to demonstrate that processes are carried out as planned and that products and services meet applicable requirements.

Documented information should be available to define the characteristics of products to be produced, services to be provided or activities to be performed, together with the results to be achieved. This may include information needed for planning and controlling design and development, such as plans, specifications and records of verification, validation and review, as well as outputs from the plan, such as raw-material specifications, service levels, product or component specifications, service stages, production methods and equipment, post-delivery activities, instructions and drawings.

Table 10 shows an example of a possible structure for documents within the integrated management system.

Table 10. Possible structure for integrated management system documents.

Level	Function	Document	Main content
Strategic	Define the direction, commitment and structure of the IMS	**Integrated management system manual**	IMS scope, integrated policy, organisational structure, process interaction, general responsibilities and references to key documents
	Clarify roles, responsibilities and authority	**Job descriptions**	Responsibilities, authority, required competence, reporting relationships and the contribution of each role to the IMS
Tactical	Define common management methods	**Procedures**	Rules and stages for cross-functional IMS activities, including responsibilities, inputs, outputs, records and control criteria
	Ensure legal and normative compliance	**Legal requirements register**	Identification, updating, evaluation and evidence of compliance with legal, regulatory, normative or contractual requirements
	Support operations and technical conformity	**External standards**	External documents needed to plan, carry out or verify organisational activities
Operational	Guide task execution	**Operating procedures**	How activities are carried out, task sequence, required resources, acceptance criteria, environmental measures and safety measures
	Provide evidence of implementation and results	**Records**	Evidence of activities performed, results obtained, checks, measurements, inspections, training, audits and corrective actions
	Support digital management and traceability	**Databases, platforms, workflows and document-management applications**	Information maintained or retained digitally, with control of access, versions, approval, distribution and archiving

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2.5.3. Harmonisation of procedures, records and instructions

Unlike earlier editions, current management system standards do not require documents and records to be consolidated in a specific manual. Nevertheless, the organisation should standardise information in terms of format, media and sources, distribute it as required, and keep it accessible and up to date. Although not mandatory, an integrated management manual may add value by bringing together and presenting the documents created and maintained within the IMS. Documents and records may also be maintained on the organisation's intranet or in any software or medium considered suitable for its context and operations.

2.5.4. Control of documented information from an integrated perspective

IMS documentation must be controlled. Control should ensure that documented information is available at the appropriate place and time and is suitable for its intended use. For example, operating procedures may be available on a workstation computer or as a paper copy in the supervisor's office, readily accessible to those who need to consult them.

The organisation must also protect documented information against loss of confidentiality, unintended alteration, misuse and loss. Where information is stored digitally, control includes access rules and appropriate read/write permissions.

Documented information from external sources that the organisation considers necessary for the IMS must be controlled in the same way. Examples include legislation, standards, product specifications and information from customers or other interested parties. Document-management tools may use editing, review and approval workflows. For digital systems, access controls, passwords and permission levels may need regular review, including arrangements for lost credentials, system unavailability and information preservation.

Although these rules do not themselves have to be maintained as documented information, the organisation may choose to document them so that they are known and followed by everyone involved.

2.6. Monitoring, performance evaluation and improvement

Monitoring, measurement, analysis and evaluation are essential to ensure that the IMS operates as intended. The organisation must determine what needs to be monitored or measured, the methods to be used, the criteria against which performance will be evaluated, when monitoring and measurement will take place, and when the resulting data will be analysed and evaluated.

Risk-based thinking should also be applied. The degree of monitoring and measurement should be proportionate to the potential consequences of nonconformity. Performance indicators therefore play an important role.

2.6.1. Integrated performance indicators

Key performance indicators (KPIs) are quantifiable measures that provide managers with data on organisational performance and enable progress towards predefined objectives to be monitored.

Appropriate indicators support continuous or periodic evaluation of a process's ability to achieve intended results and may justify either tighter or more flexible monitoring, depending on the level of confidence demonstrated.

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This does not mean that every process must have quantitative measurements or specific KPIs. Indicators should be relevant to assessing whether processes achieve the intended IMS results and the objectives established for those processes.

✓ GOOD PRACTICE	**Select a small number of clear and actionable indicators** Each indicator should support a decision. Avoid measuring everything without being able to interpret or act on the results.

Table 11 andTable 12 set out some typical examples of performance indicators that can be useful for evaluating the IMS.

Table 11. Quality, environmental and safety performance indicators.

Scope	Performance indicator	Unit
Quality management	Customer satisfaction with products and/or services supplied	%
	Profit growth rate	%
	On-time delivery rate	%
	Productivity rate at individual, departmental and/or industrial-unit level	%
	Cost of quality, including prevention, appraisal and failure costs	£ or local currency
	Production cost per unit produced	£ or local currency
	Defective product rate	%
Environmental management	Satisfaction of relevant interested parties with environmental performance	%
	Specific energy consumption, including different energy sources	toe (tonne of oil equivalent)
	Specific water consumption, including different water sources	m^3
	Solid waste generated, by type and disposal method	t/year
	Percentage of waste recycled across the organisation	%
	Number of initiatives implemented to improve environmental performance	No.
	Number of serious environmental incidents	No.
Occupational safety and health	Worker satisfaction with OSH performance	%
	Number of occupational accidents resulting in absence from work	No.
	Working days lost due to occupational accidents or occupational disease	No.
	Frequency rate: lost-time accidents per million hours worked	No./million hours
	Incidence rate: lost-time accidents per 1,000 workers	No./1,000 workers
	Severity rate: working days lost per million hours worked	No./million hours
	Total investment in protecting workers' safety and health	£ or local currency

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Table 12. Performance indicators within a QES integrated management system.

Scope	Performance indicator	Unit
Integrated management	Number of initiatives supporting sustainable development	No.
	Completion rate for integrated corrective actions	%
	Number of integrated audits carried out	No.
	Maintenance plan completion rate	%
	Training plan completion rate	%
	Number of people trained within the IMS	No.
	Number of IMS training hours	No.
	Percentage of processes with QES risks assessed	%
	Number of integrated improvement actions completed on time	No.
	Percentage of operating procedures integrating QES requirements	%

2.6.2. Process monitoring and evaluation of system effectiveness

When applying the process approach within an IMS, the organisation must determine the criteria and methods, including monitoring, measurement and related performance indicators, needed to ensure effective operation and control.

Top management must also review the QES IMS at planned intervals to ensure its continuing suitability, adequacy and effectiveness and its alignment with the organisation's purpose and strategic direction.

Management review inputs: audit results, process performance, complaints, incidents, legal compliance, objectives, risks and opportunities.

Management review outputs: decisions, resources, priorities, system changes, improvement actions and revised objectives.

Table 13 displays a list of the outputs from the management review that should be taken into account within the framework of the IMS.

Table 13. Management review outputs within the IMS.

Management review outputs	ISO 9001	ISO 14001	ISO 45001
Decisions or conclusions on the continuing suitability, adequacy and effectiveness of the management system in achieving intended results		•	•
Decisions and actions relating to opportunities for continual improvement	•	•	•
Decisions and actions relating to any need for changes to the management system	•	•	•
Decisions and actions relating to resource needs	•	•	•
Decisions relating to action, where necessary			•
Decisions relating to action, where necessary, when objectives have not been achieved		•	

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Management review outputs	ISO 9001	ISO 14001	ISO 45001
Decisions relating to opportunities to improve integration of the management system with other business processes, where necessary		•	•
Decisions relating to any implications for the organisation's strategic direction		•	•

APPLICATION EXAMPLE

Management identifies an increase in accidents and delays → decides to strengthen training, review maintenance arrangements and update operational targets.

2.6.3. Integrated internal audits

An audit is a systematic, independent and documented process for obtaining evidence and evaluating it objectively to determine the extent to which audit criteria are fulfilled. Organisations must carry out internal audits, conducted by or on behalf of the organisation, to assess conformity with planned arrangements and the requirements of the relevant standards and to determine whether the system is effectively implemented and maintained. Internal audits must be conducted at planned intervals, supported by an audit programme and retained evidence of implementation and results.

Within a QES IMS, internal audits may be classified by timing and degree of integration as sequential, overlapping, simultaneous or fully integrated. An integrated audit combines the evaluation of different management systems in a single audit undertaken by one audit team (Figure 10).

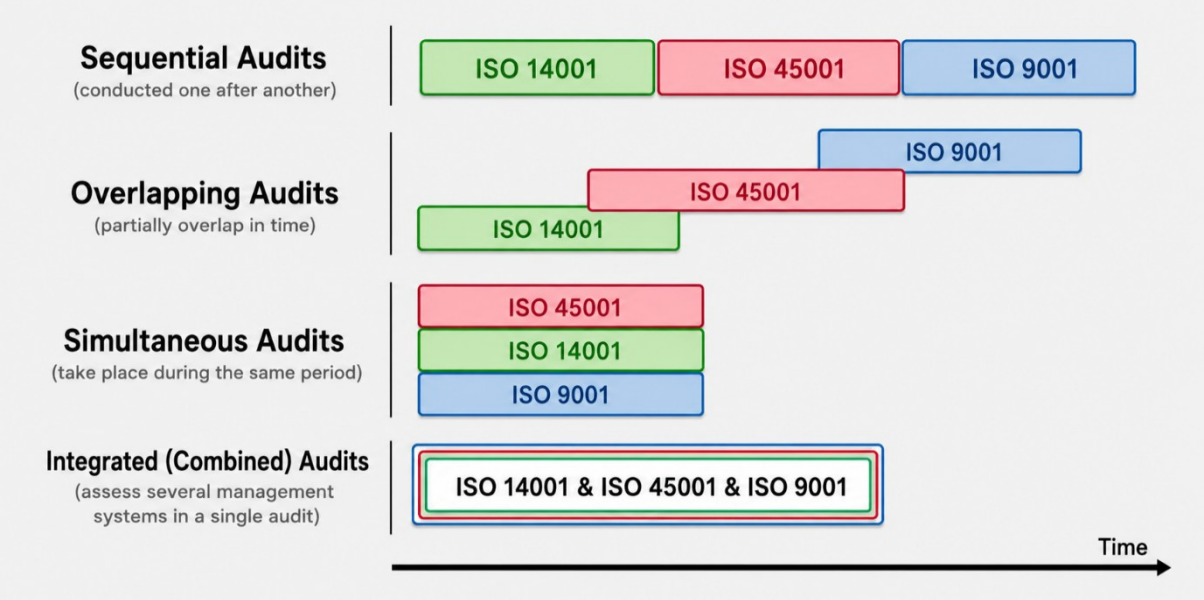

Figure 10. Internal audits within the IMS.

2.6.4. Continual improvement based on process performance

The final clause of the quality, environmental and occupational safety and health standards requires the organisation to continually improve the suitability, adequacy and effectiveness of the QES IMS.

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Performance-evaluation results should therefore be reviewed critically to identify needs and opportunities for continual improvement. Figure 11 illustrates the key role played by the PDCA cycle within the framework of the IMS. Continual improvement must apply across the organisation's products, services, activities and processes.

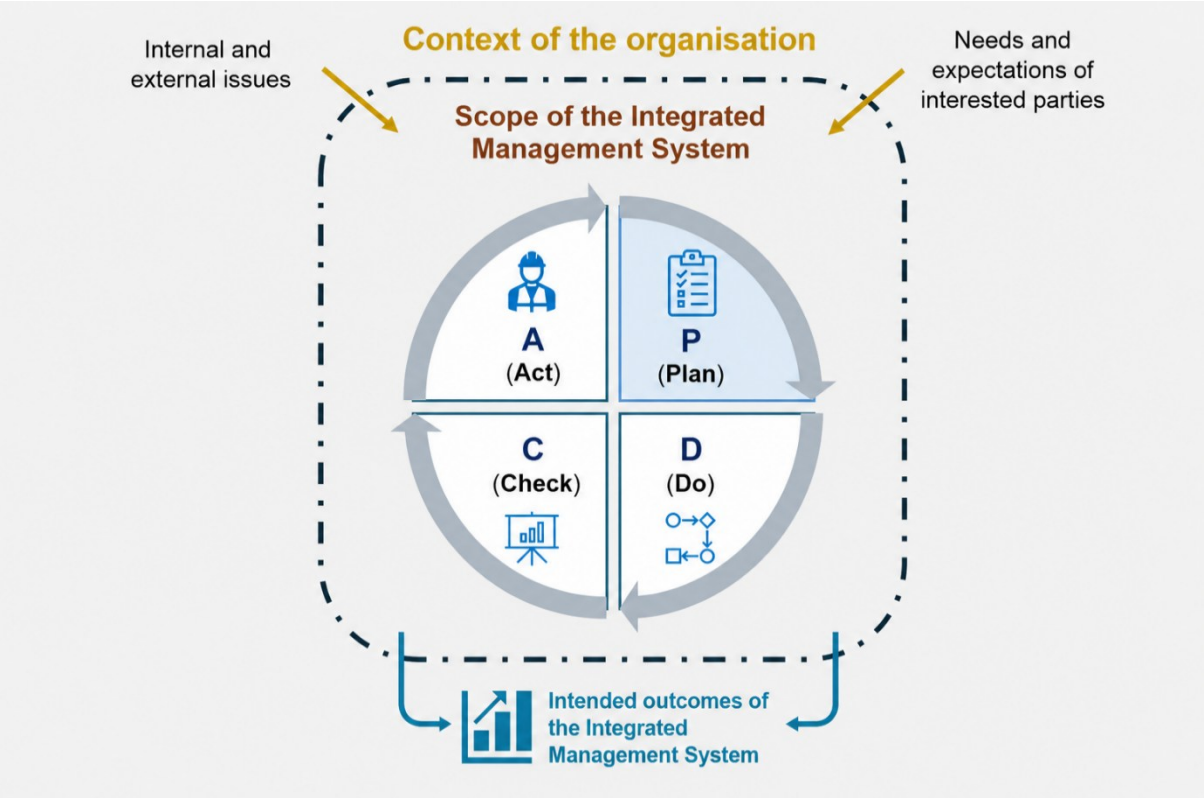

Figure 11. Illustration of the PDCA cycle as the driving "engine" of the IMS.

2.7. Integrated management as an organisational model

Integrated management is an organisational model that unifies processes, functions and systems – quality, environment and safety – under a single strategy, with the aim of improving efficiency, reducing costs, strengthening performance and creating value.

Its implementation requires strong leadership support and effective change management to align organisational culture.

2.7.1. The integrated management system as a corporate governance model

Clauses relating to leadership can be categorised and aligned with the concept of 'Corporate Governance', as illustrated in Figure 12.

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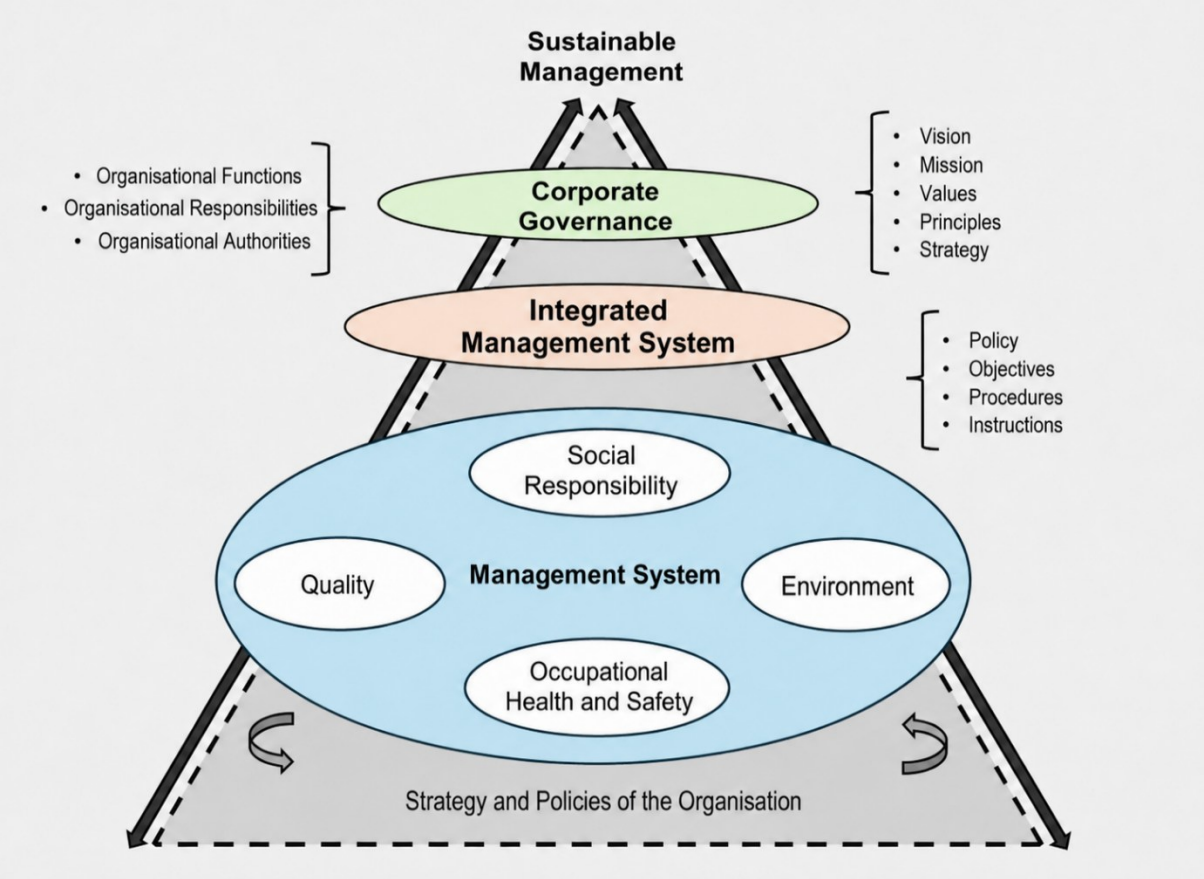

Figure 12. Illustration of the framework for corporate governance within the scope of the IMS.

Corporate governance is the system through which organisations are directed and controlled. Its structure defines the distribution of rights and responsibilities among participants such as top management, managers, shareholders and other interested parties, and establishes rules and procedures for decision-making. It also provides the framework through which objectives are set, achieved and monitored.

As a governance model, the IMS provides a holistic structure for risk and compliance management by enabling:

- A systemic and strategic view: top management aligns ISO 9001, ISO 14001 and ISO 45001 with business objectives and promotes a culture of accountability and continual improvement.
- Self-regulation and control: the system integrates audits and risk management, increasing transparency and interested-party confidence.
- Data-based decision-making: integrated performance indicators help management anticipate failures and identify improvement opportunities.

2.7.2. Integration of QES into the organisation's day-to-day management

Successful IMS implementation requires active leadership involvement and participation by all workers, so that standards and requirements become part of day-to-day management rather than archived documentation.

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NOTE	**An effective IMS does not exist only in manuals, procedures or audits.** It exists in daily decisions, processes, meetings, indicators, corrective actions and people's behaviour.

Examples of QES integration into daily management include:

- Unified documentation and procedures: daily work instructions include quality requirements, waste-management controls and safety measures in one document.
- Risk and opportunity management: daily or weekly meetings consider operational risks across all three areas. Equipment failure, for example, may cause a defective product, an occupational accident and a contaminant spill.
- Combined audits and inspections: processes are evaluated as a whole, reducing duplication and disruption to operations.
- Training and communication: workers receive multidisciplinary training covering quality, safety and environmental compliance.
- Performance monitoring: daily dashboards combine productivity, accident and waste-management data to support integrated decisions.

2.7.3. Organisational, operational and reputational benefits

IMSs connect people, processes and technology and can support continual improvement and competitiveness by aligning quality, environmental and safety functions within a single structure and eliminating unnecessary duplication.

2.7.3.1. Organisational benefits

- Holistic view and strategic decision-making: centralised data provides a broad view of the operation and supports faster, better-founded decisions aligned with strategy.
- Reduced duplication and costs: unified procedures, audits, documentation and training reduce repeated effort and operating costs.
- Collaborative culture: barriers between departments are reduced and communication and cooperation between functions are strengthened.
- Improved risk management: a unified view of corporate risk supports the mitigation of operational and compliance risks.

2.7.3.2. Operational benefits

- Efficiency and productivity: automation and centralised information make processes more agile and efficient.
- Improved logistics and resource management: stock, transport and sales can be controlled more effectively, optimising human and technical resources.
- Legal compliance and certification: integrated, organised documentation supports compliance with ISO standards and legal requirements.
- Standardisation: common procedures improve consistency and the quality of products and services.

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2.7.3.3. Reputational benefits

- Greater confidence among interested parties: clear commitment to quality, sustainability and safety strengthens the organisation's standing with customers, suppliers and investors.
- Market differentiation: certified organisations may be better placed in competitive tenders and international markets.
- Stronger brand image: an IMS reinforces the perception of a robust and responsible organisational culture.
- Resilience and continuity: the ability to respond to crises supports business continuity under adverse conditions.

In summary, an IMS is a strategic tool that converts data into useful information for growth, consolidates procedures and reinforces interested-party confidence.

2.7.4. Challenges and critical success factors in implementing integrated systems

Despite the recognised motivations and benefits, organisations may face several implementation challenges:

1. Perception that the IMS is overly complex, burdensome or not worth the investment. A realistic implementation plan can reduce disruption and unnecessary complexity.
2. Achieving complete integration, especially in large organisations with many functions or sites.
3. Process standardisation, which requires careful attention to differences between activities and locations.
4. Worker resistance and cultural change. Consistent communication and training are needed to secure engagement at all levels.
5. Resource allocation. Smaller organisations may struggle to assign sufficient people, time and financial resources.
6. Ongoing maintenance and monitoring. Audits, reviews and updates require sustained, systematic effort.

In view of these challenges, management experts have identified the following factors as critical to the successful implementation of an IMS:

1. Organisational culture;
2. Top-management commitment and leadership;
3. Clear policies, objectives and targets;
4. Effective transformation and internal communication;
5. Planned integration;
6. Availability of human and material resources.

2.8. Final summary

An effective integrated management system depends on understanding the organisational context, identifying interested parties, leadership, organisational culture, communication, documented information, monitoring, internal audits and continual improvement. Integration creates value only when these elements cease to operate as isolated requirements and begin to guide day-to-day management.

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Case studies and assessment activities

A. Self-assessment questions

1. What is meant by an organisation's internal and external context within an Integrated Management System?

2. Why is it important to identify internal and external issues relevant to the IMS?

3. What is the difference between a SWOT analysis and a PESTEL analysis?

4. What are interested parties and why should they be considered when implementing an IMS?

5. Give three examples of interested parties relevant to a QES IMS and state one associated need or expectation for each.

6. What is the role of top management in implementing, maintaining and improving an IMS?

7. How can organisational culture facilitate or hinder integration of management systems?

8. What should be included in an IMS communication matrix?

9. What is the difference between documented information that is maintained and documented information that is retained?

10. Why are internal audits, management review and performance indicators important to continual improvement of the IMS?

B. Multiple-choice questions

1. Within an IMS, the main purpose of analysing the organisation's context is to:

A. Replace internal audits.
B. Identify internal and external issues that may affect the intended system results.
C. Eliminate all organisational risks.
D. Assess only financial performance.
E. Define customer requirements exclusively.

2. SWOT analysis identifies:

A. Legal and environmental factors only.
B. Strengths, weaknesses, opportunities and threats.
C. Customer and supplier requirements only.
D. Financial performance indicators.
E. Mandatory documented procedures.

3. PESTEL analysis evaluates:

A. Political, economic, social, technological, environmental and legal factors.
B. Production, strategic, social, technical, economic and logistical factors.
C. Process, external, sustainable, technical, environmental and labour factors.
D. Preventive, economic, social, technological, educational and legal factors.
E. Political, business, systemic, technical, energy and legal factors.

4. An interested party is:

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A. Only the final customer.
B. Any person or organisation that can affect, be affected by, or perceive itself to be affected by a decision or activity.
C. Only an external regulator.
D. Any worker with no relationship to the IMS.
E. Only the organisation's shareholders.

5. Which is a typical worker need as an interested party?

A. Agreed payments and commercial continuity.
B. Objective evidence of standards conformity.
C. Safe and healthy working conditions, training and participation.
D. Environmental protection and public transparency.
E. Appropriate price and on-time delivery.

6. Top management demonstrates leadership and commitment by:

A. Fully delegating the system without oversight.
B. Communicating commitments, providing resources and aligning the IMS with strategy.
C. Eliminating performance indicators.
D. Relying exclusively on external audits.
E. Assigning responsibilities only to operational workers.

7. A positive IMS culture is characterised by:

A. Workers avoiding the reporting of problems.
B. Audits used only to meet formal requirements.
C. Nonconformities being concealed.
D. Line managers and supervisors considering quality, environment and safety in daily decisions.
E. Exclusive focus on productivity regardless of risk.

8. An IMS communication matrix should define:

A. Production costs only.
B. What is communicated, to whom, when, how and by whom.
C. Annual financial results only.
D. Workers listed by seniority.
E. Supplier requirements only.

9. "Retain documented information" generally refers to:

A. Information providing evidence of results or activities performed.
B. Information not requiring control.
C. Documents destroyed after each audit.
D. Informal communication without a record.
E. External information not applicable to the IMS.

10. The principal advantage of integrated internal audits is to:

A. Assess each system separately with no relationship between them.
B. Replace management review.
C. Assess different management systems in one audit and obtain a broader view of processes.
D. Eliminate the need for objective evidence.

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E. Carry out visual inspections only, without records.

C CORRECT ANSWERS	1. B; 2. B; 3. A; 4. B; 5. C; 6. B; 7. D; 8. B; 9. A; 10. C.

C. Exercises and practical cases

Case 1 – Analysis of the organisation's context

A food-production company intends to implement a QES IMS. In recent months, it has experienced rising energy costs, greater customer expectations regarding sustainable packaging, difficulty retaining skilled workers and a need to update equipment.

A ACTIVITY	a. Identify two external issues relevant to the IMS. b. Identify two internal issues relevant to the IMS. c. Classify each issue as economic, environmental, technological, social, human resources, infrastructure or process-related. d. Explain how the issues may affect IMS planning.

Case 2 – Mapping interested parties

An industrial organisation has identified customers, workers, suppliers, the local community, regulatory authorities and a certification body as interested parties.

A ACTIVITY	Construct a three-column table showing the interested party, its need or expectation, and its impact on the QES IMS. Include at least four interested parties.

Case 3 – Communication within the IMS

An internal audit found that workers did not know the QES objectives, process owners had not received the results of the latest audit, and an OSH incident was reported only two weeks after it occurred.

A ACTIVITY	a. Identify three communication failures. b. Propose a simple communication matrix. c. State who should be responsible for each communication.

Case 4 – Integrated documented information

A company has outdated paper procedures in production, work instructions stored on personal computers, incomplete training records and applicable legislation filed without update control.

A ACTIVITY	a. Identify four document-control problems. b. Classify the examples as maintained or retained documented information. c. Propose three improvement measures.

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Case 5 – Monitoring, audit and continual improvement

IMS indicators show increases in customer complaints, non-lost-time accidents, overdue corrective actions and water consumption. The internal audit also confirmed that some procedures were out of date and workers were unaware of recent changes.

A ACTIVITY

a. Identify at least four relevant indicators for analysing the performance of the IMS.
b. Indicate which topics should be referred to management for review.
c. Propose three integrated improvement actions.
d. Explain the relationship between monitoring, internal audit, management review and continual improvement.

Suggested answers

Case 1 – Analysis of the organisation's context

PROPOSED ANSWER

a. Possible external issues: rising energy costs and increased customer expectations regarding sustainable packaging.

b. Possible internal issues: difficulty retaining skilled workers and the need to update equipment.

c. These may be classified respectively as economic, environmental/social, human resources, and infrastructure/technology issues.

d. They can affect objectives, resources, indicators, risks, opportunities, training requirements, operational control and investment priorities.

Case 2 – Mapping interested parties

PROPOSED ANSWER

Customers – conforming products, on-time delivery and response to complaints – operational process control, quality objectives and customer-satisfaction evaluation.

Workers – safe conditions, training and participation – OSH management, training, consultation, internal communication and incident monitoring.

Regulatory authorities – compliance with legal and normative requirements – compliance evaluation, document control, audits and corrective actions.

Local community – prevention of environmental impacts and transparency – emissions and waste management, external communication and accident prevention.

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Case 3 – Communication within the IMS

PROPOSED ANSWER
a. Failures include lack of communication of QES objectives, inadequate communication of audit results and late reporting of OSH incidents. b. The matrix should include annual or revised-objective communication to workers, prompt communication of audit results to process owners and immediate incident communication to affected teams. c. Possible responsibilities are top management for objectives, the IMS manager for audit results and the relevant supervisor/OSH function for incidents.

Case 4 – Integrated documented information

PROPOSED ANSWER
a. Problems include outdated documents, lack of version control, decentralised access, incomplete records and legislation without systematic updating. b. Procedures and work instructions are maintained documented information; training records are retained documented information; applicable legislation is controlled external information. c. Improvements include approval and review rules, a common document platform, defined ownership, version control, access levels and periodic review of external documents.

Case 5 – Monitoring, audit and continual improvement

PROPOSED ANSWER
a. Relevant indicators include customer complaints, accident numbers, percentage of corrective actions completed on time, water consumption, percentage of procedures updated and numbers of workers trained. b. Management review should consider process performance, complaints, OSH incidents, environmental performance, action effectiveness, resource needs, document updates and training. c. Improvement actions may include revising operating procedures, strengthening training and communication, reducing water consumption, analysing complaint causes and improving follow-up of corrective actions. d. Monitoring identifies deviations, audit confirms evidence and causes, management review sets decisions and resources, and continual improvement converts findings into action.

D. Case study

CASE STUDY – METALOMECÂNICA ATLÂNTICO, S.A.

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Purpose of the assignment: Apply the concepts from chapter 2 to a simple industrial-sector case, focusing on organisational context, interested parties, leadership, documented information, indicators, audits and improvement.

1. Context

Metalomecânica Atlântico, S.A. is a Portuguese industrial company with 240 workers that manufactures metal components for the automotive industry and industrial equipment.

In recent years, the company has faced several issues affecting overall performance:

- → customer complaints regarding late deliveries and nonconforming components;
- → increased energy consumption and generation of metal waste and used oils;
- → occupational accidents and near misses involving presses, welding and load handling;
- → communication failures between production, maintenance, quality and safety;
- → difficulty standardising procedures and responsibilities between sections and shifts.

Management has therefore decided to implement an IMS based on ISO 9001, ISO 14001 and ISO 45001.

2. Initial organisational diagnosis

Information box 1 summarises the main external and internal issues identified in the initial assessment.

Information box 1. External and internal issues identified at *Metalomecânica Atlântico*, S.A.

External issues	Internal issues
Increasing legal requirements relating to the environment and industrial safety	Insufficient communication between functions and shifts
Customer pressure regarding quality, traceability and delivery times	Dispersed documentation and outdated versions
Technological development of automation and process-control equipment	Organisational culture with limited focus on integration
Rising energy and raw-material costs	Limited involvement of middle management
Growing competition in industrial markets	No integrated performance indicators

3. Relevant interested parties

The organisation considers the following to be its most important interested parties:

- → **Customers**: quality, technical conformity, traceability and on-time delivery.
- → **Workers**: safety, training and employment stability.
- → **Suppliers**: clear planning, effective communication and stable relationships.
- → **Regulatory authorities**: legal compliance, environmental control and operational safety.
- → **Shareholders**: profitability, productivity and sustainable growth.
- → **Local community**: control of noise, emissions and traffic associated with industrial activity.

4. Problems observed during IMS implementation

Despite the decision to implement the IMS, the organisation faces some challenges:

- → Top management formally supports the project but has limited involvement in practical decisions.
- → Some middle managers view the IMS as a bureaucratic requirement.

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→ Procedures and records are distributed across different media without adequate control.
→ Internal communication is reactive and poorly structured.
→ There are no clear KPIs for quality, environment and OSH.
→ Internal audits are irregular and focus excessively on documents.

5. Work to be developed

5.1 Analysis of the organisation's context

i. Identify the three external and three internal issues you consider most critical to IMS success.

Examples
External Issue: Increasing legal requirements regarding the environment and industrial safety.
Internal Issue: Insufficient communication between departments and between shifts.

ii. Briefly explain why they are critical.

iii. Describe how they may influence IMS results.

5.2 Interested parties and expectations

i. Select four relevant interested parties.

ii. State their main needs and expectations.

iii. Explain why they are relevant to the IMS.

Example
Interested party: Customers
Needs/expectations: They expect compliant parts, traceability, adherence to deadlines and a swift response to non-conformities.

5.3 Leadership and organisational culture

i. Analyse how limited leadership involvement and a resistant culture may hinder IMS implementation.

ii. Refer to consequences for processes, people's involvement and system effectiveness.

5.4 Structure of documented information

Propose a simple integrated structure organised as:

→ Level A – Strategic
→ Level B – Tactical
→ Level C – Operational

Give two suitable document examples for each level.

5.5 Integrated performance indicators

Propose three indicators: one for quality, one for environment and one for OSH.

For each, state what it measures, its unit and its practical usefulness.

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Example
Quality indicator: Internal non-conformance rate.
What it measures: It measures the number of non-conforming parts per batch or per thousand parts produced.
Unit: % or ppm.
Use: It enables the assessment of process stability, the reduction of rework, and the addressing of the root causes of quality failures.

5.6 Challenges and critical success factors

i. Identify three principal implementation challenges

Example: Low level of practical involvement on the part of top management and mid-level managers.

ii. Identify three critical success factors for an effective system.

Example: A demonstrated commitment from leadership, with clearly defined objectives, resources and regular monitoring.

5.7 Conclusion

Write a brief conclusion of 8–12 lines answering: **How can a well-implemented IMS improve the overall performance of *Metalomecânica Atlântico*?**

6. Instructions

- → Individual assignment.
- → Answer on the basis of the case study presented.
- → Use clear, technical and objective language.
- → Justify answers wherever possible.

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STRIM

SAFETY TRAINING WITH
REAL IMMERSIVITY FOR MINING

CHAPTER 3

Environmental Management

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Chapter 3 – Environmental Management

Quick chapter map

Pedagogical table. Quick chapter map.

Section	Pedagogical function
1. Before you begin	Activate prior knowledge of environmental impacts and sustainability in the extractive sector.
2. Learning pathway	Guide learning from environmental concepts through performance and improvement.
3. Fundamentals of environmental management	Distinguish between the environment, aspects, impacts and an environmental management system.
4. ISO 14001	Understand the requirements and guidance for structuring an EMS.
5. Environmental management in the extractive industry	Apply context, interested parties, obligations, risks, objectives and operational control.
6. Green mining	Explore sustainable practices, technologies and opportunities for improvement.
7. Environmental performance monitoring	Define measurement, communication, compliance, audits, nonconformities and improvement.
8. Critical environmental factors in the extractive industry	Analyse waste, emissions, hazardous materials, water, rehabilitation and closure.

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3.1. Before you begin

3.1.1. Background

This chapter addresses the fundamentals of environmental management in the extractive industry, with particular emphasis on mining. It presents the concepts of environmental aspect and environmental impact, together with the main challenges associated with the extraction of natural resources, such as land degradation, water consumption, atmospheric emissions and waste generation. It also explores environmental management practices that can prevent and reduce these impacts, including performance monitoring, resource management and the adoption of more sustainable solutions within the framework of ISO 14001.

? KEY QUESTION	How can an organisation, particularly in the extractive sector, identify its significant environmental aspects and convert them into controls, objectives and measurable improvements?

3.1.2. Learning objectives

1. Distinguish an environmental aspect from an environmental impact.
2. Identify significant environmental aspects in an extractive operation.
3. Relate ISO 14001 requirements to environmental management practices.
4. Propose control measures for waste, emissions, water and hazardous materials.
5. Select environmental performance indicators.
6. Recognise opportunities for improvement associated with green mining.

3.1.3. Competences to be developed

- Observe an activity and identify its inputs, outputs, environmental aspects and environmental impacts.
- Prioritise environmental aspects according to significance, compliance and risk.
- Define environmental objectives that are consistent with policy, significant aspects and indicators.
- Propose operational controls for waste, dust, noise, water, chemicals and emergencies.
- Assess opportunities for environmental improvement from a life-cycle and sustainability perspective.

3.1.4. Key concepts

Pedagogical table. Key concepts.

Concept	Operational definition for this chapter
Environment	Surroundings in which an organisation operates, including air, water, land, natural resources, flora, fauna, people and their interrelationships.
Environmental aspect	Element of an organisation's activities, products or services that can interact with the environment.
Environmental impact	Adverse or beneficial change to the environment resulting from environmental aspects.

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Concept	Operational definition for this chapter
Environmental management system (EMS)	Part of the management system used to manage environmental aspects, compliance obligations, risks, opportunities and performance.
Compliance obligation	A legal requirement or other requirement that an organisation must comply with or chooses to comply with.
Operational control	A measure implemented to ensure that processes and activities are carried out under controlled conditions.
Green mining	An approach aimed at mining that is more sustainable, efficient and transparent, and compatible with environmental and social objectives.

3.2. Learning pathway

Pedagogical table. Learning pathway.

Stage	What the trainee does	Resources
LEARN	Reads the essential concepts in chapter 3 and identifies the technical terminology associated with environmental management.	Core chapter text, table of key concepts, summary tables and examples.
OBSERVE	Analyses examples, figures, tables, practical cases and organisational or operational situations associated with the topic.	Figures, tables, practical examples and a case study.
DECIDE	Classifies situations, identifies priorities, selects criteria and chooses technically justified responses.	Guiding questions, decision criteria, matrices and decision-making exercises.
APPLY	Produces a simple practical tool: a map, matrix, checklist, plan, record, indicator or improvement proposal.	Templates, worksheets and completed examples.
REFLECT	Records learning, limitations, evidence used and possible improvements to professional practice.	Reflection and final summary; where applicable, a digital portfolio or the platform's forum.

▣ GUIDANCE FOR INDEPENDENT USE

When the chapter is used outside the platform, the trainee should retain completed exercises, filled-in worksheets, reflection records, group outputs and evidence of application. These materials may be used as evidence of learning and as a basis for classroom discussion or continuous assessment.

3.3. Fundamentals of environmental management

Responsible management of natural resources and ecosystems – including land, water, air, flora, fauna and the services they provide – is essential for any society seeking sustainability. These resources support the health of communities and economies and must therefore be protected to ensure long-term prosperity.

3.3.1. Environment

The surroundings in which an organisation operates, including air, water, land, natural resources, flora, fauna, people and their interrelationships [3].

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3.3.2. Environmental aspects and impacts

An environmental aspect is an element of an organisation's activities, products or services that can interact with the environment. This interaction may result in an environmental impact, understood as any adverse or beneficial change to the environment that is wholly or partly caused by the organisation's environmental aspects (Figure 13).

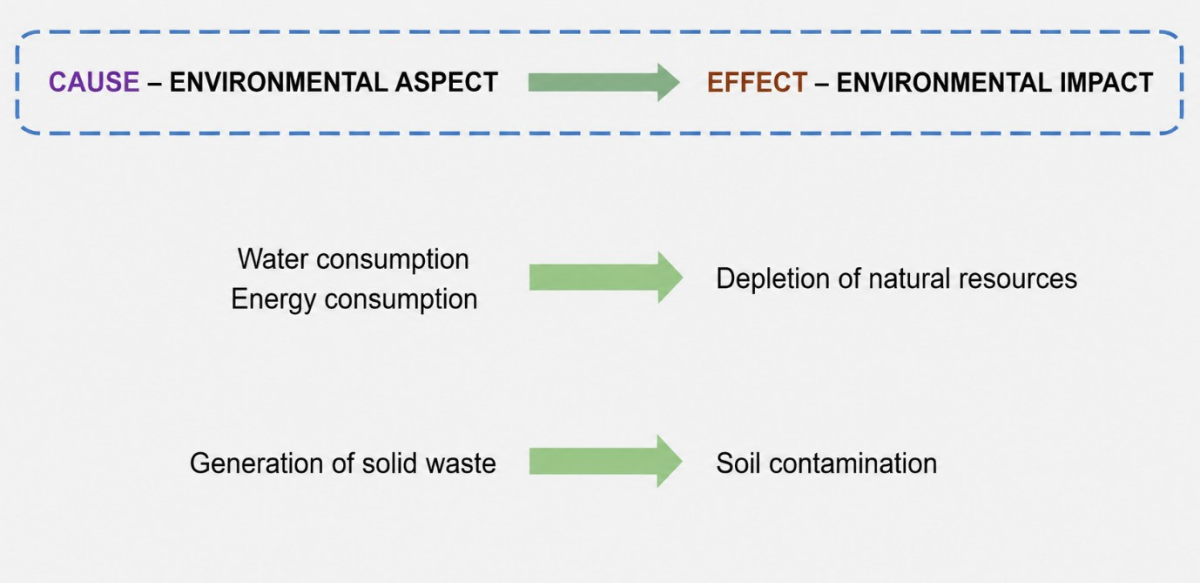

Figure 13. Relationship between an environmental aspect and an environmental impact.

To help distinguish between concepts used throughout this chapter, Table 14 explains the differences between an environmental aspect, environmental impact, environmental risk and environmental opportunity.

Table 14. Difference between an environmental aspect, environmental impact, environmental risk and environmental opportunity.

Concept	Guiding question	Example in the extractive industry
Environmental aspect	Which element of the activity, product or service interacts with the environment?	Generation of dust during crushing
Environmental impact	What change to the environment may result from that aspect?	Deterioration of air quality
Environmental risk	What may go wrong, and with what consequence?	Dust emissions above legal limits or complaints from the community
Environmental opportunity	What improvement may be created from the identified situation?	Installation of a more efficient water-spraying system or partial enclosure of the crushing plant

3.3.3. Environmental management system

An environmental management system (EMS) is a tool that enables organisations to manage systematically and continually improve the environmental aspects associated with their production and/or service-delivery processes.

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The International Organization for Standardization (ISO) defines an EMS as the part of the overall management system that includes the organisational structure, planning activities, responsibilities, practices, procedures, processes and resources required to develop, implement, review and maintain the environmental policy [3] (Figure 14).

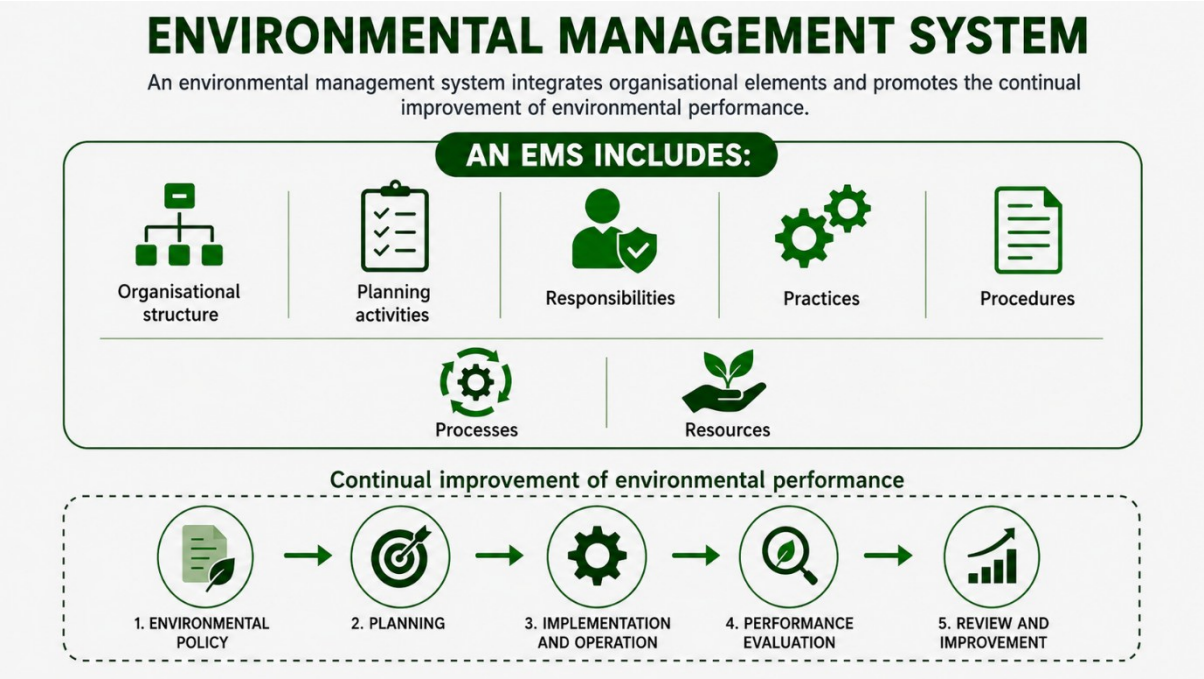

Figure 14. Schematic representation of the main elements of an EMS and their contribution to continual improvement in environmental performance.

3.3.4. Main environmental challenges in the mining industry

Extractive-industry operations face complex environmental challenges that vary according to geological conditions, extraction methods and the characteristics of the local ecosystem. Understanding these challenges makes it possible to develop appropriate management strategies and technological solutions, including mine-site rehabilitation approaches aimed at long-term environmental restoration [11].

The main environmental impacts and challenges in the mining industry include:

- Land degradation and loss of biodiversity: extraction, especially open-pit mining, removes vegetation, alters the landscape and promotes erosion.
- Water-resource management: mining uses large volumes of water and presents risks of chemical contamination, with effects on local ecosystems.
- Greenhouse-gas (GHG) emissions: mining operations, which are often dependent on fossil fuels, contribute to global CO_2 emissions.
- Waste management: the activity generates large volumes of waste, including overburden and tailings, requiring continuous monitoring of disposal facilities to prevent accidents and environmental impacts.
- Sustainability and efficiency: the sector has been moving towards equipment electrification, renewable energy and water recirculation in order to reduce its environmental impact.

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3.4. ISO 14001: Environmental management systems – Requirements with guidance for use

3.4.1. What is ISO 14001:2026 and who uses it?

ISO 14001 is the internationally recognised standard for environmental management systems. It provides a framework through which organisations can design and implement an EMS and continually improve their environmental performance. By adopting the standard, organisations can demonstrate that they are taking proactive measures to minimise their environmental footprint, comply with relevant legal requirements and achieve their environmental objectives. The framework covers matters ranging from resource use and waste management to environmental-performance monitoring and the involvement of interested parties in environmental commitments [1].

The 2026 edition reinforces what matters most: environmental protection and organisational results. The updated standard builds on the established ISO 14001 structure, with clearer organisation, easier navigation and stronger alignment with current environmental priorities [3].

Organisations adopt ISO 14001 when they wish to:

- reduce their environmental footprint
- improve resource-use efficiency
- demonstrate responsible environmental practices
- strengthen compliance with environmental obligations
- respond to the expectations of customers, investors or regulatory authorities

It is widely used in manufacturing, energy, transport, construction, waste management, public administration and service sectors [12].

3.4.2. ISO 14001 certification and fundamental requirements

Certification to ISO 14001 is voluntary. Organisations choose certification when they want independent confirmation that their environmental management system meets the requirements of ISO 14001:2026. ISO does not certify organisations. Certification is carried out by independent certification bodies, which may be accredited by national accreditation bodies. Certification may be required by customers, supply chains or public procurement procedures in which environmental performance forms part of the selection criteria [12].

The main elements of ISO 14001 include:

- understanding environmental aspects and impacts
- setting environmental objectives and performance indicators
- ensuring compliance with environmental legislation and regulations
- managing risks and opportunities
- training and awareness
- monitoring, measurement and continual improvement

ISO 14001 requires organisations to integrate environmental considerations into strategic planning and day-to-day operations [12].

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3.4.3. Practical first steps towards ISO 14001

Organisations can begin strengthening environmental management through the following measures:

- identify the main environmental aspects (waste, water, energy and emissions)
- check legal obligations and compliance requirements
- monitor resource use and environmental performance
- assign responsibilities for environmental management
- train personnel in environmental awareness
- integrate environmental criteria into procurement decisions

These actions provide a sound basis before implementation of an environmental management system [12].

3.4.4. Application to the extractive industry

ISO 14001 is particularly relevant to the extractive industry because its activities may generate significant and visible environmental impacts, including landscape change, water and energy consumption, waste generation, dust, noise, emissions and the risk of land and water contamination.

NOTE	In the extractive industry, ISO 14001 does not eliminate environmental impacts, but establishes a system for identifying, controlling, monitoring and continually improving them.

Its application should consider the entire life cycle of the operation, from site selection through to closure and rehabilitation of the affected area.

In a mining context, this approach should take account of geological uncertainty, the different operational phases, the complexity of interested parties and long-term environmental responsibilities that may continue after mine closure.

3.4.5. Structure of ISO 14001:2026

The structure of ISO 14001:2026 is based on the high-level structure (Annex SL) and follows the PDCA cycle for continual improvement. Organised into 10 clauses, it focuses on leadership, risk planning, a life-cycle perspective and evaluation of environmental performance (Figure 15).

The high-level structure (Clauses 1–10) may be summarised as follows:

1. Scope: defines the purpose of an Environmental Management System (EMS).

2. Normative references: reference documents.

3. Terms and definitions: applicable terminology.

4. Context of the organisation: understanding internal and external issues and interested parties, and defining the scope of the EMS.

5. Leadership: top-management commitment, environmental policy and responsibilities.

6. Planning: identification of risks, opportunities, environmental aspects and impacts, and legal requirements.

7. Support: management of resources, competence, awareness and documented information.

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8. Operation: operational control and emergency preparedness/response based on the life-cycle perspective.

9. Performance evaluation: monitoring, measurement, internal audit and management review.

10. Improvement: management of nonconformities and continual improvement of the system. The standard applies to any organisation seeking to reduce its environmental impact, improve efficiency and comply with legislation.

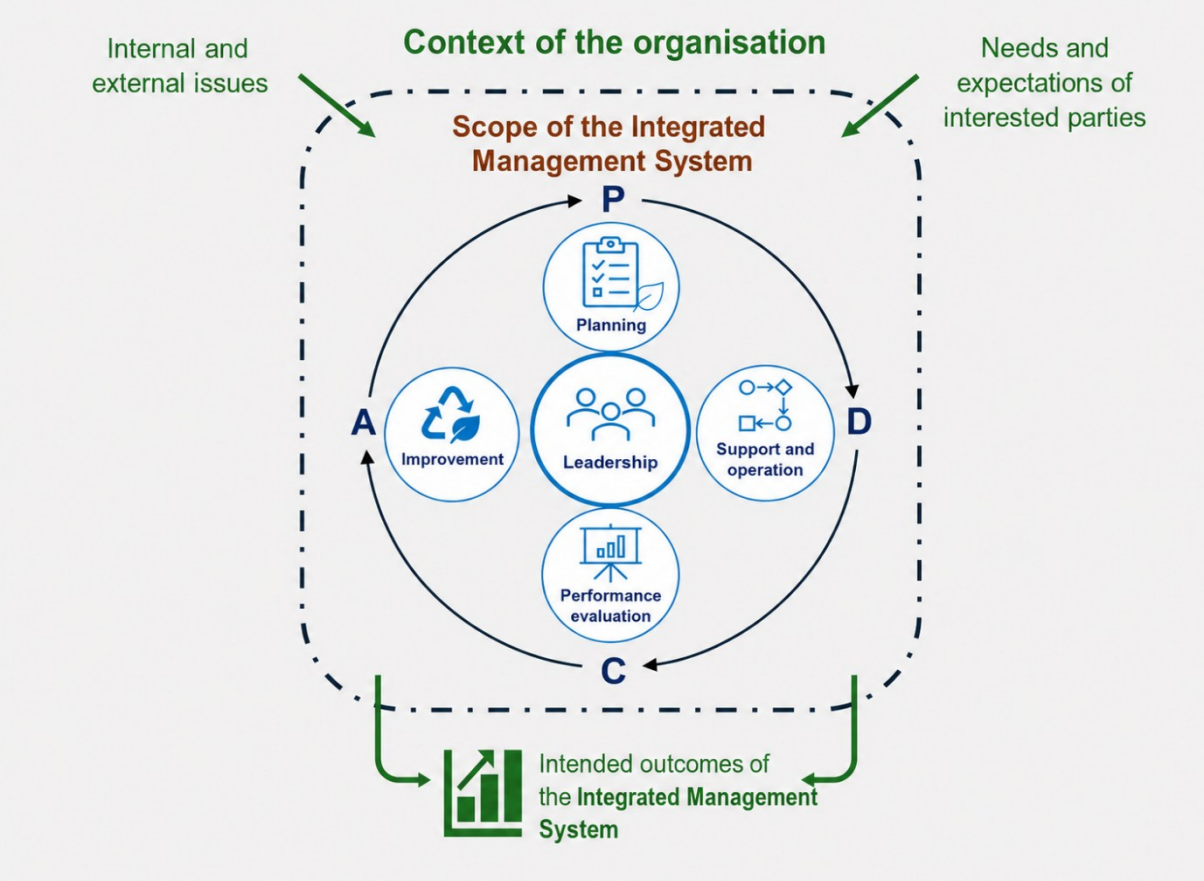

Figure 15. Structure of ISO 14001:2026 and the PDCA cycle.

3.5. Environmental management in the extractive industry

3.5.1. Context of the organisation

Every organisation is different and operates in a different context. Understanding the organisation's context can be regarded as an activity involving observation, analysis and evaluation of the organisation's internal and external environment in order to determine the issues that influence it positively or negatively. These internal and external issues may affect its purpose and its ability to achieve the intended results of the EMS, including improved environmental performance, fulfilment of compliance obligations and achievement of the defined environmental objectives [13].

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When determining its context, the organisation may consider internal and external issues associated with:

- political and legal framework
- technological capacity
- human resources
- activities and products
- location
- groundwater levels and land
- watercourses
- prevailing winds
- liquid effluents
- gaseous emissions
- environmental noise
- waste

The identified internal and external issues may generate risks and opportunities, as exemplified in Table 15.

Table 15. Examples of internal and external issues for determining the context of the organisation and their classification as risks and opportunities.

Context	Internal or external	Description	Risk	Opportunity
Technological capacity	**Internal**	New, more efficient equipment. New effluent-treatment technology (osmosis or compact wastewater treatment plant).	No	Yes
Location	**External**	The organisation is situated in [town/city], in an industrial zone. The boundaries of the area occupied by the organisation are as follows: to the north, [specify boundary or neighbouring entity]; to the south, [specify boundary or neighbouring entity]; to the east, [specify boundary or neighbouring entity]; to the west, [specify boundary or neighbouring entity]. In the organisation's surroundings, no receiving environments or environmentally sensitive areas have been identified (or the following receiving environments or environmentally sensitive areas have been identified: [identify and describe]).	No	No
Effluents	**Internal**	The discharge permit imposes flow-rate and concentration limits.	Yes	No
	External	No municipal sewer is available.	Yes	No

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Context	Internal or external	Description	Risk	Opportunity
Waste	**Internal**	All generated waste is segregated and sent to authorised operators. A scientific article was recently published demonstrating the possibility of recycling the waste identified by code [specify waste code].	No	Yes

3.5.2. Relevant interested parties

By applying the general principles described in **section 2.3.2** to the EMS, the organisation shall identify the interested parties relevant to the EMS, their needs and expectations, and those that give rise to compliance obligations.

Needs and expectations may also give rise to risks and opportunities, as illustrated in Table 16.

Table 16. Examples of interested parties, their needs and expectations, and classification as a compliance obligation, risk or opportunity.

Interested party	Internal or external	Need or expectation	Compliance obligation?	Risk	Opportunity
Parent company	**External**	The parent company has published a policy for all group companies concerning prevention of spills to land	Yes	Yes	No
Customer	**External**	Certification and/or submission of environmental information is required	Yes	Yes	No
Neighbours	**External**	Although the organisation complies with environmental-noise legislation, neighbours continue to report disturbance from the noise generated by the organisation	No	No	Yes
Contractors and resident companies within the organisation's premises	**External**	Need to obtain the best conditions for chemical storage	Yes	Yes	No
Supplier	**External**	Keep drums organised and undamaged; return containers	Yes	Yes	No

Note: The classifications of Table 15 and Table 16 should be adjusted to the organisation's actual context.

3.5.3. Environmental aspects and impacts

After understanding the context and the needs and expectations of interested parties, the organisation should identify its environmental aspects and impacts. This is one of the central themes of ISO 14001.

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The organisation must analyse its processes, products and services, and determine the environmental aspects and impacts that it can control and those that it can influence, taking account of the life cycle perspective of products and services (Figure 16).

Figure 16. Life cycle perspective.

A life cycle perspective requires consideration of the material life cycle associated with products and services. The organisation should therefore determine which life cycle stages it can control or influence; this may vary considerably according to the context.

In the extractive industry, the application of this perspective is particularly clear (Figure 17). Drilling and crushing, for example, generate dust; blasting generates noise and vibration; washing consumes large quantities of water; maintenance may cause spills; and tailings may affect land and water.

Each stage of the operation may therefore have associated environmental aspects and different impacts (Table 17). This analysis makes it possible to identify what is most critical and where action is required first. It provides the basis for control priorities and many practical environmental-management decisions.

Table 17. Examples of environmental aspects and impacts in the extractive industry.

Activity	Environmental aspect	Potential impact	Operational control	Indicator
Drilling	Dust	Deterioration of air quality	Water spraying, equipment maintenance and use of extraction systems	PM10/PM2.5; number of complaints
Washing	Water consumption	Pressure on water resources	Recirculation, consumption measurement and loss control	m^3/tonne produced
Maintenance	Oil spills	Land contamination	Secondary containment, spill kits and training	Number of spills; response time

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Figure 17. Life cycle in the extractive industry.

3.5.4. Compliance obligations

Compliance obligations are an input to risks and opportunities. Under this approach, the organisation identifies the compliance obligations that it must fulfil (for example legislation, requirements imposed by government or regulatory authorities, and court decisions) and those that it chooses to fulfil (arising from the needs and expectations of interested parties, sector guidance and similar sources).

In the extractive industry, this means ensuring the management of factors such as:

- environmental permitting
- control of emissions and dust
- waste management
- effluent monitoring
- protection of surface water and groundwater
- landscape-rehabilitation plans
- contractual requirements and public commitments

The compliance obligations to which the organisation subscribes should be reviewed periodically so that the organisation remains up to date with its obligations.

3.5.5. Actions to address risks and opportunities

The organisation must determine the risks and opportunities that need to be addressed in order to:

- ensure that the EMS can achieve its intended results

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- prevent or reduce undesired effects, including the potential for external environmental conditions to affect the organisation
- achieve continual improvement

As illustrated in Figure 18, risks and opportunities may arise from environmental aspects, compliance obligations and other matters identified through understanding the organisation and its context and the needs and expectations of interested parties.

Figure 18. Sources of risks and opportunities.

It is also necessary to identify potential emergency situations that could cause environmental impacts. These situations include fires, spills, leaks and floods.

3.5.6. Environmental objectives

In accordance with ISO 14001:2026, the organisation must establish environmental objectives at relevant functions and levels, taking account of its significant environmental aspects, associated compliance obligations, and its risks and opportunities.

Environmental objectives must be consistent with the environmental policy, measurable, monitored, communicated and updated as appropriate (Figure 19).

Table 18 provides examples of environmental objectives.

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Figure 19. Points to consider when defining environmental objectives.

Table 18. Examples of environmental objectives.

Significant environmental aspect	Environmental objective	Indicator	Target	Deadline	Responsible
Energy consumption	**Reduce specific energy consumption in crushing and processing operations**	kWh/tonne produced	Reduce by 3% compared with the previous year	By 31 December	Production / Environment Manager
Water consumption	**Increase water recirculation in the washing process**	Percentage of water recirculated	Achieve at least 70% recirculation	By year-end	Environment / Maintenance Manager
Waste generation	**Increase the segregation and recovery rate of non-hazardous waste**	Percentage of waste recovered	Increase by 5% compared with the previous year	By 31 December	Environment Manager
Dust emissions	**Reduce fugitive emissions on internal roads and in crushing areas**	PM10; number of dust complaints	Reduce complaints by 20% and keep PM10 below applicable limits	Quarterly review	Environment / Operations Manager
Oil and fuel spills	**Prevent spills in maintenance and refuelling areas**	Number of recorded spills	Zero significant spills	Ongoing, with monthly review	Maintenance / OSH / Environment

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Significant environmental aspect	Environmental objective	Indicator	Target	Deadline	Responsible
Environmental training	**Strengthen environmental awareness among workers and contractors**	Percentage of workers trained	Train at least 80% of workers exposed to significant environmental aspects	By year-end	Human Resources / Environment
Compliance obligations	**Improve monitoring of environmental legal obligations**	Percentage of obligations assessed on time	Assess 100% of applicable obligations within the defined frequency	Six-monthly review	Environment Manager / Management

3.5.7. Support: competence, communication and documented information

Without the necessary support, the EMS will not deliver the expected results. ISO 14001 therefore requires worker competence and environmental training, awareness at operational work fronts, internal and external communication mechanisms, controlled procedures and records, and assurance that information is accessible and up to date.

In practice, operators must know what to do, supervisors must communicate correctly, and the appropriate documents must be available at the appropriate time. An outdated procedure or incomplete record may compromise environmental control across the entire operation.

3.5.8. Operation and operational control

This section corresponds to the “Do” phase of the PDCA cycle and to operation of the system in order to ensure the intended results and implement the actions determined during planning. These may include actions to address significant environmental aspects, compliance obligations, risks and opportunities, or actions to ensure achievement of environmental objectives.

The organisation must establish, implement, control and maintain the processes needed to ensure the intended results of the EMS. These processes must be supported by operating criteria and controlled in accordance with those criteria. The organisation must determine the documented information required to provide confidence that the processes are carried out as planned.

The type and extent of controls should be proportionate to the environmental significance of the activity, the identified risks and opportunities, compliance obligations and the competence of the people involved. The organisation may choose different control practices, including:

- establishing procedures or work instructions so that processes are carried out in a specified manner
- controlling process parameters through technology (engineering controls)
- designing processes to prevent errors and ensure consistent results (error-proofing systems, redundancy and error prevention devices)
- assigning competent people
- monitoring and measuring processes to ensure that they remain controlled
- determining the necessary documented information, including documents and records

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Controls may, for example, require the elimination or substitution of a raw material, component, activity, item of equipment or infrastructure in order to eliminate or minimise adverse effects. Controls may also be administrative, for example by ensuring monitoring and measurement to verify that compliance with obligations is maintained.

In the mining industry, this involves very practical measures such as controlling dust by spraying haul roads, preventing spills through secondary containment, segregating waste, controlling contaminated stormwater and requiring environmental practices from service providers (Table 19). The objective is to ensure that processes presenting the greatest environmental risk are effectively controlled. Criteria, procedures, controls – whether internal or contracted – and management of change used to mitigate environmental impacts should take account of the product life-cycle perspective.

Table 19. Example of an operational control plan.

Process / activity	Significant aspect	Operational criterion	Control	Record
Traffic on internal roads	Dust emissions	Roads kept damp during dry weather	Scheduled water spraying	Daily checklist
Oil storage	Potential spill	Secondary containment available	Weekly inspection	Inspection record
Aggregate washing	Water consumption	Defined minimum recirculation rate	Flow measurement	Consumption record

3.5.9. Environmental emergency preparedness and response

The organisation must be prepared for and respond to emergency situations. This requires a process that may be represented as shown in Figure 20.

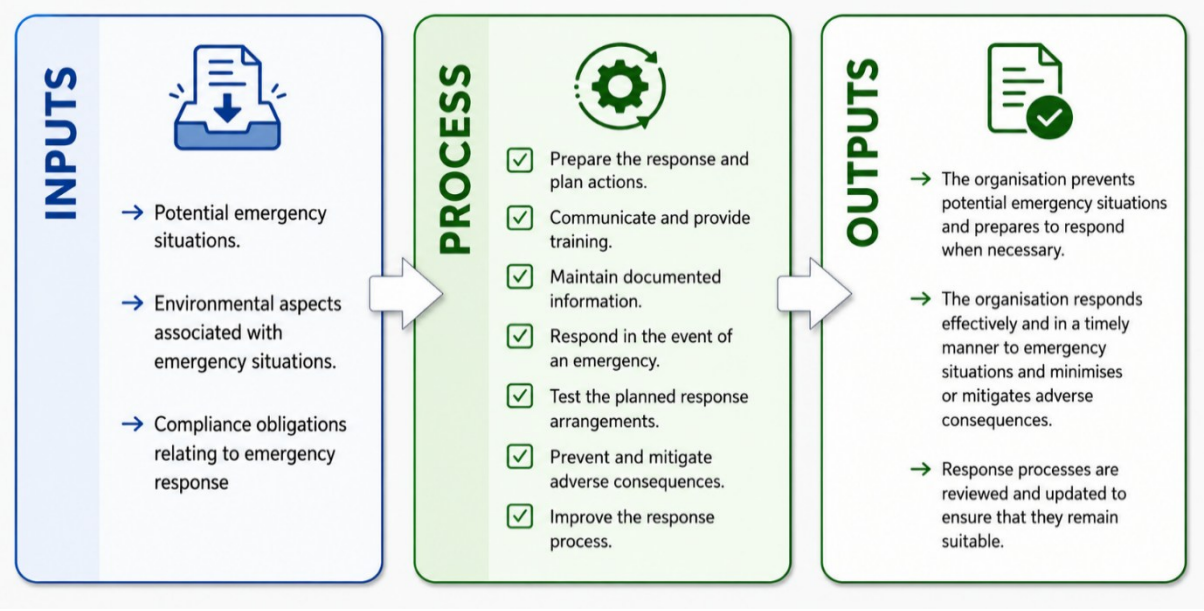

Figure 20. Example process for preparing for and responding to potential emergency situations.

At this stage, actions are required such as carrying out periodic drills, training teams, maintaining documented information and reviewing plans after incidents.

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Examples of typical emergencies in the extractive industry include:

- fuel or oil spill
- failure of secondary containment
- fire
- accidental effluent discharge
- contaminated run-off following heavy rainfall
- instability in a tailings storage facility
- failure of a treatment plant

3.6. Green mining

3.6.1. Green mining: from concept to practice

Green mining is essentially the idea of making the mining industry more sustainable and more compatible with environmental and climate objectives, without losing sight of operational viability. It represents an evolution of the traditional model, with a stronger focus on efficiency, innovation, prevention, and the creation of environmental and social value.

In general, green mining involves:

- prevention and minimisation at source;
- efficient use of resources;
- environmental rehabilitation;
- relations with communities;
- transparency and governance;
- circularity and waste reduction.

3.6.2. Pillars of green mining

In simplified terms, the green mining approach is based on the pillars presented in Table 20:

1. Energy and emissions.
2. Water and effluents.
3. Waste, tailings and circular economy.
4. Environmental rehabilitation and biodiversity.
5. Community relations and the generation of wider benefits.
6. Innovation and digitalisation.

Table 20. Pillars of green mining.

Green mining pillar	Practical example in the extractive industry	Possible indicator
Energy and emissions	Electrification of equipment, use of renewable energy, optimisation of haulage routes and reduction of fuel consumption	kWh/tonne produced; litres of fuel/tonne; tCO_2e/year
Water and effluents	Water recirculation, effluent treatment, separation of clean and contaminated water, and reduction of abstraction	m^3 of water/tonne produced; % water recirculated; number of discharge non-compliances

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Green mining pillar	Practical example in the extractive industry	Possible indicator
Waste, tailings and circular economy	Recovery of waste rock, reuse of materials, dry-stacked tailings and recovery of useful materials from waste streams	% waste recovered; tonnes of tailings reused; volume sent for final disposal
Environmental rehabilitation and biodiversity	Progressive rehabilitation of worked areas, revegetation, habitat protection and erosion control	hectares rehabilitated; vegetation survival rate; number of conservation actions
Community and transparency	Communication with interested parties, response to complaints, disclosure of environmental performance and local engagement	number of environmental complaints; average response time; number of community meetings
Innovation and digitalisation	Environmental sensors, real-time monitoring, drones, warning systems and data analysis	number of monitored points; % data collected automatically; deviation detection time

3.6.3. Incorporating sustainable technologies into mining operations

Applying this approach to mining operations also involves technology (Figure 21). Solutions such as electrification, automation, digitalisation, smart sensors and artificial intelligence help to reduce impacts, increase efficiency and improve operational control. At the same time, regenerative processes and more sustainable treatment of materials demonstrate that innovation can directly support environmental management. The basic idea is simple: to make mining more efficient, but also more responsible and better prepared for future challenges.

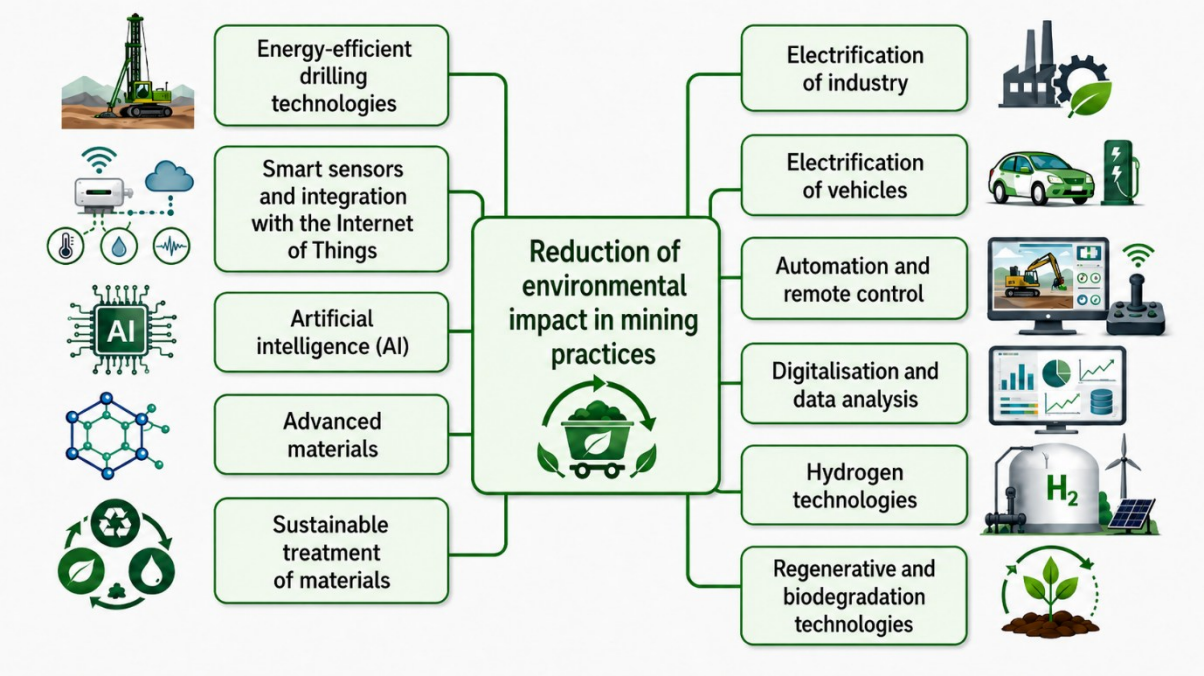

Figure 21. Incorporation of sustainable technologies into mining operations.

3.6.4. Green mining and ISO 14001:2026

Although green mining is not a separate requirement of ISO 14001:2026, its principles can be implemented through the identification of environmental aspects, the assessment of risks and opportunities, the setting of objectives, operational control and continual improvement. Green mining can therefore be regarded as a more advanced and strategic application of environmental management itself.

NOTE	ISO 14001 provides the management framework, while green mining provides more advanced practices and ambitions.

3.6.5. Future prospects for green mining technology

Future mining operations are expected increasingly to incorporate low-impact technologies, renewable energy sources, digitalisation, real-time monitoring, circular-economy principles, ecosystem restoration and greater transparency in relations with interested parties. Figure 22 summarises some of these trends.

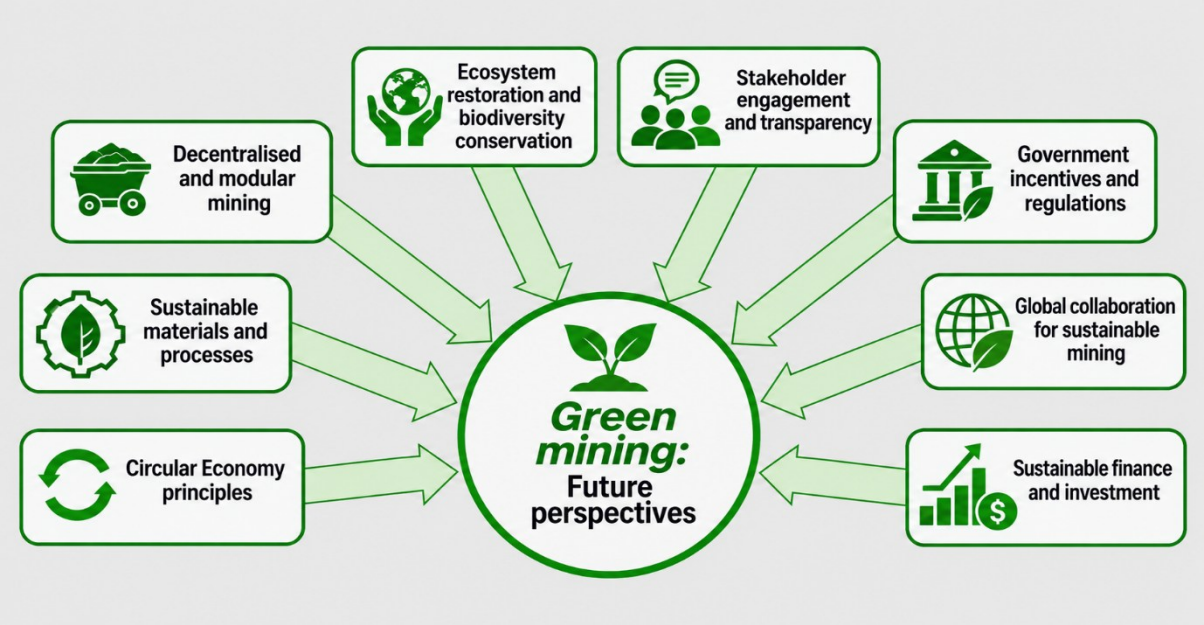

Figure 22. Future prospects for green mining technology [14].

3.7. Monitoring and evaluation of environmental performance

According to ISO 14001:2026 [3], organisations must monitor, measure, analyse and evaluate their environmental performance. For this purpose, each organisation must determine:

- what needs to be monitored and measured;
- the monitoring, measurement, analysis and evaluation methods, as applicable, needed to ensure valid results;
- the criteria against which the organisation will evaluate its environmental performance and the appropriate indicators;

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- when monitoring and measurement are to be carried out;
- when the results of monitoring and measurement are to be analysed and evaluated.

3.7.1. Environmental performance evaluation

Environmental performance evaluation is a systematic process for measuring, analysing and evaluating an organisation's impact on the environment, using performance indicators to monitor legal compliance and continual improvement. The organisation must define what is to be monitored, how monitoring will be carried out, when results will be evaluated and who is responsible.

3.7.2. Measurement, monitoring and communication

Environmental performance requires clear, comparable metrics that are useful for decision-making. When selecting environmental indicators, the following principles should be applied. Indicators should:

1. be simple, easy to interpret and capable of showing trends;
2. be relevant to environmental issues and values;
3. facilitate understanding of the management system implemented;
4. be based on a scientific foundation;
5. take account of how easily information can be obtained in terms of time, technology and cost;
6. provide a sound basis for comparisons and decision-making.

In addition, under Regulation (EC) No 1221/2009 of 25 November, environmental performance indicators should:

1. provide an accurate assessment of environmental performance;
2. be understandable and unambiguous;
3. allow year-on-year comparison of environmental performance;
4. allow comparison with sectoral, national or regional benchmarks;
5. allow comparison with regulatory requirements.

According to ISO 14031 (Environmental management – Environmental performance evaluation – Guidelines [15]), three types of environmental indicators may be used (Table 21):

- **Management performance indicators** (MPIs), which provide information on management efforts to influence the organisation's environmental performance.
- **Operational performance indicators** (OPIs), which support the evaluation and control of environmental impacts and may include indicators relating to materials, energy, infrastructure and transport.
- **Environmental condition indicators** (ECIs), which provide information on local, regional, national and global environmental conditions.

Table 21. Examples of environmental performance indicators.

Indicator type	Indicator	Unit	Suggested frequency	Notes
MPI	**Percentage of environmental objectives achieved**	%	Quarterly / annually	Useful for management review
MPI	**Costs associated with environmental management**	£ or € / year	Annually	May include monitoring, treatment, permits, training and audits

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Indicator type	Indicator	Unit	Suggested frequency	Notes
MPI	**Number of environmental incidents**	number	Monthly / quarterly	Should distinguish minor, significant and major incidents
MPI	**Percentage of environmental actions completed on time**	%	Monthly / quarterly	Useful for monitoring action plans
OPI	**Specific water consumption**	m^3/tonne produced	Monthly	May be monitored by process or production unit
OPI	**Specific energy consumption**	kWh/tonne produced	Monthly	May be separated into electricity, fuel or total energy
OPI	**Quantity of waste generated**	tonnes/month or tonnes/year	Monthly / annually	Should distinguish hazardous and non-hazardous waste
OPI	**Percentage of waste recovered or recycled**	%	Monthly / quarterly	Measures circularity and the effectiveness of segregation
OPI	**Number of recorded spills**	number	Monthly	May be supplemented by spill volume and response time
ECI	**PM10 concentration in ambient air**	µg/m^3	Continuous, daily or as required by permit	Relevant to dust at quarries and open-cast mines
ECI	**PM2.5 concentration in ambient air**	µg/m^3	Continuous, daily or as required by permit	Particularly relevant to air-quality assessment
ECI	**Pollutant concentration in surface water**	mg/L	Monthly / quarterly / as required by permit	May include suspended solids, metals, pH, conductivity and hydrocarbons
ECI	**Heavy-metal concentration in soil**	mg/kg	Annually / according to monitoring plan	Useful in storage, maintenance or waste-disposal areas
ECI	**Environmental noise level**	dB(A)	Six-monthly / annually / after relevant changes	Important near sensitive receptors and neighbouring communities

3.7.3. Evaluation of compliance

The purpose of this stage is to verify that all compliance obligations are being met. Identifying compliance obligations is not sufficient; the organisation must also define how, when and by whom compliance with each obligation will be verified (see Table 22).

Table 22. Examples of defined evaluations for selected compliance obligations.

Obligation	Evidence	Verification frequency	Responsible person/function
Effluent discharge permit	Analytical results for effluents	Monthly / as required by permit	Environmental manager
Waste management	Electronic waste consignment notes, contracts with operators	Per consignment / quarterly	Production / Environment
Atmospheric emissions	Emission-monitoring reports	As required by permit	Environment / Maintenance

The organisation must plan and establish a methodology for evaluating compliance. The frequency established should take account of the type of requirement concerned. For example, an organisation that

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abstracts water should assess consumption daily to verify that it remains within the values established by the abstraction licence.

By contrast, where an organisation has fluorinated gases in its equipment, the evaluation frequency for that requirement may be lower. It should verify that maintenance records are being kept for equipment above the applicable 5 tCO_2 threshold and that the required information is submitted to the relevant regulatory authority within the established deadlines.

The methodology defined by the organisation may vary, but it must ensure that all compliance obligations – not merely a sample – are verified at an appropriate frequency. The organisation may choose to conduct compliance audits together with more frequent operational-control checks.

Whenever a situation of non-compliance exists, the organisation must establish corrective actions or an action plan to achieve compliance with the relevant obligation.

3.7.4. Internal audits

Internal auditing is a very important management tool for the Environmental Management System (EMS), as it enables the organisation to evaluate the conformity and effectiveness of the system implemented. An audit is a systematic, independent and documented process for obtaining objective evidence – such as records and observations of practices – and evaluating it objectively in order to determine the extent to which the audit criteria are fulfilled. These criteria may include standards, manuals, procedures, work instructions and other applicable requirements.

ISO 14001 specifically states that audits should assess whether the EMS:

- conforms to the organisation's own requirements for its environmental management system;
- conforms to the requirements of the reference standard;
- is effectively implemented and maintained.

The organisation must conduct internal audits at planned intervals.

→ **APPLICATION EXAMPLE**	**Audit questions** • Are wastes stored correctly? • Is water monitoring up to date? • Do operators know the procedures? • Are the dust controls working?

3.7.5. Nonconformities and continual improvement

Within the EMS, the organisation must define its methodology for dealing with nonconformities and ensure that it is understood and internalised by all workers [16]. It must likewise seek continually to improve the suitability, adequacy and effectiveness of the EMS in order to improve its environmental performance.

For this purpose, it may adopt the following approaches:

- Implement actions to reduce the consumption of utilities, including water and energy.
- Implement ecodesign principles, environmental labelling and life-cycle assessment.
- Reduce waste generation or promote waste recovery.

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3.7.6. Benefits of ISO 14001 in the mining industry

The effective implementation of ISO 14001 can bring operational, legal, reputational and strategic benefits. In the mining sector, this translates into fewer incidents, greater operational predictability, better dialogue with the community, greater trust from the authorities and better integration with other management systems (Figure 23). In summary, the implementation of an EMS helps to transform environmental management into a factor of stability and value.

Figure 23. Benefits of ISO 14001 in the mining industry.

3.8. Key environmental management factors in the extractive industry

3.8.1. Waste management

The extractive industry and its associated treatment and processing activities generally generate significant volumes of waste of widely differing types and hazard levels. If this waste is not managed properly, it may create serious risks to the environment, public health and the safety of local populations. This makes it necessary to adopt waste-management measures focused on prevention, recovery and, as a subsidiary

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option, final disposal under appropriate conditions of stability, safety, integration with the surrounding environment, and protection of the environment and public health.

3.8.1.1. Types of waste

When considering waste management, it is important to recognise that not all waste is necessarily harmful to the environment. Some waste may be recovered and used in other applications, including construction materials. However, where rocks contain certain minerals in significant quantities and waste is managed inadequately, relevant risks may arise for the environment and the health of local communities.

Waste is generated at several stages of the mining process and throughout the entire life of a mine, from initial exploration to closure. The main types of waste generated include:

- mining gangue and waste rock;
- waste resulting from mineral processing (tailings);
- overburden from the deposit, including soil;
- low-grade ore;
- waste from non-conventional treatment processes, such as heap-leach pads;
- wastewater and acid mine drainage (AMD).

3.8.1.2. Main aspects of waste management

Waste management in the mining industry involves the safe and sustainable handling of waste rock and tailings, using measures such as dry disposal to reduce environmental risks. It focuses on minimising, reusing and recycling materials, promoting circular-economy principles and complying with stringent safety requirements, such as Decree-Law No. 10/2010 in Portugal.

Waste arising from the extraction of mineral resources may be sent to:

1. Waste facilities: structures such as tailings ponds or inert-waste landfills intended for the final disposal of waste from mines and quarries.
2. Backfilling of voids: the use of inert waste, such as soil and rock, to fill excavations in quarries or mines for environmental rehabilitation and stabilisation.

3.8.1.3. Smart and sustainable waste management

Companies are increasingly adopting strategies that prioritise waste reduction and the efficient management of tailings. Innovative approaches, such as dry-stacked tailings and alternative storage methods, seek to make waste management more sustainable and effective. In addition to reducing environmental impact, the aim is to ensure long-term operational sustainability.

Table 23 presents examples of impacts, measures and indicators for waste management.

Table 23. Examples of impacts, measures and waste indicators identified in mining operations.

Source / activity	Waste generated	Potential impact	Control measure	Indicator
Extraction and blasting	Waste rock and rock material	Land take, landscape alteration and erosion	Planned disposal, stabilisation, reuse for backfilling or rehabilitation	Tonnes generated; % reused
Mineral processing	Tailings	Contamination of soil and water; instability of storage facilities	Dry-stacked tailings, geotechnical monitoring and runoff control	Tonnes of tailings; number of anomalies detected

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Source / activity	Waste generated	Potential impact	Control measure	Indicator
Maintenance	Used oils, filters and contaminated absorbents	Contamination of soil and water	Storage on an impermeable surface, suitable containers and a licensed operator	kg of hazardous waste; number of spills
Offices and support areas	Paper, cardboard, packaging and municipal-type waste	Increase in waste sent for disposal	Separate collection, recycling and awareness-raising	% waste recycled
Water treatment	Treatment sludge	Contamination if improperly stored or disposed of	Characterisation, suitable storage and authorised consignment	Tonnes produced; final destination

3.8.2. Atmospheric pollution

Atmospheric pollution in the extractive industry –including mining, quarrying, and oil and gas extraction– is a significant environmental issue characterised by emissions of particulate matter, gaseous pollutants and greenhouse gases. Operations from extraction through to transport affect local air quality and contribute to global climate change.

3.8.2.1. Main sources and pollutants

- Suspended particulate matter (dust): rock fragmentation, crushing, drilling, blasting and vehicle traffic on unpaved roads generate large quantities of dust, including PM10 and PM2.5.
- Greenhouse gases (GHGs): coal mining is a significant source of methane (CH_4) and carbon dioxide (CO_2) emissions.
- Volatile organic compounds (VOCs) and toxic gases: gas flaring in oil-extraction operations releases VOCs, sulphur dioxide (SO_2) and nitrogen oxides (NOx).
- Heavy metals: extraction may release heavy metals such as zinc, nickel, cadmium and chromium into the atmosphere.

3.8.2.2. Impacts of pollution in the extractive industry

- Community and occupational health: inhalation of dust and toxic gases may cause respiratory and cardiovascular disease among local populations and workers.
- Environmental damage: particle deposition affects local ecosystems, soils and water bodies and may contribute to acid rain and contamination.
- Climate change: the release of methane and CO2 contributes to global warming.
- Visual and landscape impact: blasting and earthworks remove vegetation, alter the landscape and also encourage dust dispersion.

Regulation and monitoring, particularly through environmental permits, are essential for minimising these impacts. Table 24 presents examples of impacts, measures and indicators for selected sources of atmospheric pollution.

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Table 24. Examples of impacts, measures and indicators for pollutants identified in mining operations.

Source / activity	Pollutant	Potential impact	Control measure	Indicator
Drilling and blasting	Dust / particulate matter	Deterioration of air quality and nuisance to the community	Water spraying, operational planning and protection of sensitive areas	PM10; PM2.5; number of complaints
Crushing and screening	Particulate matter	Fugitive emissions and dust deposition	Enclosure, filters, sprays and preventive maintenance	Particle concentration; filter efficiency
Traffic on internal roads	Resuspended dust	Nuisance and deposition in neighbouring areas	Road watering, partial paving and speed limits	Watering frequency; complaints
Mobile equipment	NOx, CO_2 and combustion particles	Climate change and deterioration of air quality	Maintenance, fleet renewal, electrification and route optimisation	Litres of fuel/tonne; tCO2e
Material storage	Wind-blown dust	Deposition on soil, vegetation and nearby homes	Covering, windbreaks, dampening and revegetation	Visual observations; PM10; complaints

3.8.3. Management of hazardous materials

The management of hazardous materials in the extractive industry is a critical process involving the safe handling, storage, transport and disposal of toxic, flammable, explosive or radioactive substances throughout the life cycle of the operation, in order to minimise risks to human health, worker safety and the environment.

The main hazardous materials in the extractive industry include:

- Process chemicals: cyanide used in gold extraction, sulphuric acid, caustic soda and leaching agents.
- Explosives: ammonium nitrate and other blasting agents.
- Mining waste: tailings, waste rock, drilling muds and contaminated soils.
- Hydrocarbons and solvents: oils, fuels and lubricants.

Table 25 displays some examples of impacts, measures and indicators for specific sources of hazardous materials.

Table 25. Examples of impacts, measures and indicators for hazardous materials identified in mining operations.

Hazardous material	Potential risk / impact	Control measure	Record / evidence	Indicator
Fuels and lubricants	Spills and contamination of soil and water	Secondary containment, spill kits and periodic inspections	Inspection records; spill records	number of spills; response time
Process chemicals	Toxicity, contamination and incompatible reaction	Available safety data sheets, segregation, labelling and training	Chemical inventory; current SDSs	% products with current SDS
Explosives	Major-accident risk and localised contamination	Authorised storage, access control and specific procedures	Storage and use records	number of deviations or incidents
Hazardous waste	Environmental contamination and legal non-compliance	Suitable containers, licensed operator and consignment documentation	Waste consignment notes	% correctly consigned
Solvents and paints	VOC emissions, flammability and spills	Ventilated storage, containment and substitution with less hazardous products	Consumption records; inspections	Quantity consumed; number of nonconformities

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3.8.4. Water management and recirculation

Efficient water management in the mining sector has become an operational imperative, particularly in water-scarce regions. It requires closed-loop reuse systems, dewatering technologies and strict discharge controls.

Water management is one of the most critical environmental challenges in mining operations [11]. These activities require significant volumes of water and may generate contaminated runoff that must be treated before discharge.

The main water-management challenges include:

- acid mine drainage (AMD);
- heavy-metal contamination with persistent effects after closure;
- depletion of groundwater in arid mining regions;
- diversion of surface water affecting downstream communities;
- failure of treatment systems during extreme weather events.

Modern water-management approaches favour closed-loop systems and advanced treatment technologies, such as reverse osmosis, ion exchange and biological treatment, to improve water quality and reduce the need for freshwater abstraction. Table 26 presents examples of impacts, measures and indicators for effective water-resource management.

Table 26. Examples of impacts, measures and indicators for water management in mining operations.

Source / process	Environmental aspect	Potential impact	Control measure	Indicator
Material washing	Water consumption	Pressure on water resources	Recirculation, flow measurement and leak detection	m^3/tonne; % water recirculated
Contaminated stormwater	Runoff containing solids or contaminants	Contamination of watercourses and soil	Drainage ditches, retention ponds and separation of clean and contaminated water	TSS in effluent; volume treated
Industrial effluents	Discharge of contaminated water	Legal non-compliance and impact on receiving waters	Wastewater treatment plant, analytical monitoring and control of pH and metals	mg/L per parameter; number of non-compliances
Acid mine drainage	Acidity and dissolved metals	Persistent contamination of water and soil	Neutralisation, active/passive treatment and continuous monitoring	pH; dissolved metals; conductivity
Water abstraction	Use of a natural resource	Local depletion or conflict with other users	Licensing, metering and reduction of consumption	m^3 abstracted/month; licence compliance

3.8.5. Environmental rehabilitation and closure

Environmental rehabilitation and closure should be planned from the early stages of the operation, rather than only at the end. Early planning helps to reduce environmental liabilities, stabilise disturbed areas, restore ecological functions and ensure that the site is safe and compatible with its intended future use.

Wherever possible, rehabilitation should be progressive and should follow the development of the operation. Areas that are no longer required should be restored in phases, reducing visual impacts,

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controlling erosion, improving landscape integration and demonstrating environmental commitment to interested parties.

Table 27 provides some examples of factors to be taken into account when planning the environmental restoration and closure of a site.

Table 27. Examples of aspects to consider when planning environmental rehabilitation.

Aspect	Practical measure	Indicator
Progressive rehabilitation	Restore areas as they cease to be worked	Hectares rehabilitated per year
Slope stability	Landform design, drainage and geotechnical control	Number of inspections; number of instabilities detected
Topsoil	Appropriate removal, storage and replacement of topsoil	m^3 topsoil reapplied; % topsoil reused
Revegetation	Seeding, planting and control of invasive species	Vegetation survival rate; area revegetated
Post-closure monitoring	Monitoring of water, soil, vegetation and stability	Compliance with monitoring plan; number of deviations identified
Community engagement	Consultation on future land use and communication of rehabilitation results	Number of meetings; contributions received; complaints recorded

In this way, closure ceases to be merely a final obligation and becomes part of environmental management throughout the entire life cycle of the operation.

3.9. Final summary

Environmental management in the extractive industry should be understood as a strategic component of operations, not merely as a legal obligation. Applying an environmental management system based on ISO 14001:2026 makes it possible to identify significant environmental aspects, control risks, fulfil compliance obligations and continually improve environmental performance. When combined with green mining practices, effective monitoring, efficient water and waste management and engagement with interested parties, environmental management contributes to safer, more resilient and socially responsible operations.

NOTE	Effective environmental management goes beyond compliance with permits: it converts significant environmental aspects into control priorities, measurable objectives, monitored indicators and continual operational improvement.

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Case studies and assessment activities

A. Self-assessment questions

1. What is meant by the environment in the context of an Environmental Management System?

2. What is the difference between an environmental aspect and an environmental impact?

3. Give three examples of environmental aspects associated with the extractive industry and state their potential impacts.

4. What is an environmental management system and what is its main purpose?

5. Why is ISO 14001 particularly relevant to the extractive industry?

6. What elements should be considered when setting environmental objectives?

7. What are compliance obligations in environmental management?

8. Why is operational control important in preventing environmental impacts?

9. How can green mining help improve the environmental performance of mining operations?

10. Why is it important to monitor, measure, analyse and evaluate an organisation's environmental performance?

B. Multiple-choice questions

1. An environmental aspect is:

A. An adverse change in the environment caused by an organisation.
B. A legal requirement applicable to an environmental activity.
C. An element of activities, products or services that can interact with the environment.
D. An indicator used to measure environmental performance.
E. A corrective action after a nonconformity.

2. An environmental impact is:

A. A legal obligation of the organisation.
B. Any change to the environment, whether adverse or beneficial, resulting from environmental aspects.
C. A mandatory operating procedure.
D. An internal-audit tool.
E. An environmental target set by top management.

3. In the extractive industry, dust generation during crushing is an example of:

A. An environmental impact.
B. An environmental aspect.
C. A compliance obligation.
D. An environmental indicator.
E. An environmental objective.

4. The main purpose of ISO 14001 is to:

A. Directly certify organisations through ISO.

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B. Eliminate all environmental impacts.
C. Provide a framework for implementing and improving an Environmental Management System.
D. Replace applicable environmental legislation.
E. Define requirements only for waste management.

5. In the extractive industry, ISO 14001 should consider:

A. Only the extraction stage.
B. Only hazardous waste.
C. The full life cycle of the operation, from site selection to closure and rehabilitation.
D. Only community complaints.
E. Only customer requirements.

6. Which of the following is an environmental compliance obligation?

A. An informal worker preference.
B. An effluent discharge permit.
C. A suggestion with no practical application.
D. An improvement idea with no associated requirement.
E. A productivity indicator.

7. An environmental objective should be:

A. Generic, non-measurable and not communicated.
B. Defined only to fulfil formalities.
C. Consistent with the environmental policy, measurable where practicable, monitored and communicated.
D. Independent of significant environmental aspects.
E. Defined only after environmental accidents occur.

8. In environmental operational control, watering internal roads in dry weather is primarily a measure to control:

A. Groundwater consumption.
B. Dust emissions.
C. Hazardous-waste generation.
D. Oil spills.
E. Occupational noise.

9. Green mining includes principles such as:

A. Increasing final disposal of untreated waste.
B. Reducing environmental monitoring.
C. Resource efficiency, circularity, environmental rehabilitation and innovation.
D. Eliminating communication with interested parties.
E. Replacing ISO 14001 with informal practices.

10. Environmental performance indicators should:

A. Be ambiguous and difficult to interpret.
B. Be defined only for administrative processes.
C. Make it possible to track trends, support decisions and evaluate environmental performance.
D. Replace all legal obligations.

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E. Be evaluated only once during the life of the mine.

C CORRECT ANSWERS	1. C; 2. B; 3. B; 4. C; 5. C; 6. B; 7. C; 8. B; 9. C; 10. C.

C. Exercises and practical cases

Case 1 – Environmental aspects, impacts and operational controls

A quarry carries out drilling, blasting, crushing, internal haulage and aggregate-washing operations. The following situations have been identified: dust generation, high water consumption, noise and vibration, waste generation, and the possibility of an oil spill during equipment maintenance.

A ACTIVITY	a. Identify five environmental aspects associated with the activities described. b. State one potential environmental impact for each aspect identified. c. Propose an operational control measure for each aspect. d. Define an environmental performance indicator for monitoring each situation.

Case 2 – Compliance obligations and evaluation of compliance

A mining company holds an environmental permit and an effluent discharge permit, has obligations relating to waste management and atmospheric-emission monitoring, and has made a contractual commitment to provide annual environmental information to a customer.

A ACTIVITY	a. Identify four applicable compliance obligations. b. For each obligation, state evidence that could demonstrate compliance. c. Define a suitable verification frequency. d. State a possible person or function responsible for verification.

Case 3 – Setting environmental objectives

At a mining operation, energy consumption, water consumption, dust emissions and waste generation have been identified as significant environmental aspects. Management intends to define environmental objectives for the coming year.

A ACTIVITY	For each significant environmental aspect, define: a. an environmental objective; b. an indicator; c. a target; d. a deadline; e. a responsible person/function.

Case 4 – Environmental emergency

During refuelling, a fuel spill occurs in an area close to a watercourse. The operator does not know where the spill kit is located, the supervisor is informed only at the end of the shift, and no record of the event is made.

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A ACTIVITY	a. Identify failures in emergency preparedness and response. b. State the immediate actions that should have been taken. c. Propose preventive measures to avoid recurrence. d. State what documented information should be maintained or retained.

Case 5 – Green mining and improvement of environmental performance

An extractive-industry company wishes to make its operation more sustainable. It currently has high fuel consumption, a low water-recirculation rate, a large volume of tailings sent for final disposal and several community complaints relating to dust and noise.

A ACTIVITY	a. Relate each problem to a green mining pillar. b. Propose an improvement measure for each problem. c. Define an indicator to monitor the effectiveness of each measure. d. Explain how these actions can be integrated into an Environmental Management System based on ISO 14001.

Suggested answers

Case 1 – Environmental aspects, impacts and operational controls

PROPOSED ANSWER
Drilling/crushing – dust emissions – deterioration of air quality – water sprays, dust extraction or partial enclosure – PM10/PM2.5 concentration or number of complaints. Aggregate washing – water consumption – pressure on water resources – water recirculation and metering – m^3 water/tonne produced. Blasting – noise and vibration – community nuisance and disturbance to fauna – scheduling and noise/vibration monitoring – dB(A), peak particle velocity or number of complaints. Maintenance – oil spills – contamination of soil and water – secondary containment, spill kits and training – number of spills and response time. Processing/deposition – waste or tailings generation – land take, instability or contamination – segregation, recovery, controlled disposal and monitoring – tonnes generated and percentage recovered.

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Case 2 – Compliance obligations and evaluation of compliance

Response template. Case 2 – Compliance obligations and evaluation of compliance.

Compliance obligation	Evidence	Verification frequency	Responsible person/function
Effluent discharge permit	Effluent analytical results	Monthly or as required by permit	Environmental manager
Waste management	Consignment notes, contracts with authorised operators and transfer records	Per consignment / quarterly	Production / Environment
Atmospheric emissions	Emission- or dust-monitoring reports	As required by permit	Environment / Maintenance
Submission of environmental information to customer	Environmental report and proof of submission	Annually	IMS / Environment manager

The organisation should ensure that all compliance obligations are evaluated at an appropriate frequency, rather than checking only a sample.

Case 3 – Setting environmental objectives

Response template. Case 3 – Setting environmental objectives.

Significant environmental aspect	Environmental objective	Indicator	Target	Deadline	Responsible function
Energy consumption	Reduce specific energy consumption in crushing operations	kWh/tonne produced	3% reduction compared with previous year	By 31 December	Production / Environment
Water consumption	Increase water recirculation in the washing process	% water recirculated	Achieve 70% recirculation	By year end	Environment / Maintenance
Dust emissions	Reduce fugitive emissions from internal roads	PM10; number of complaints	Reduce complaints by 20%	Quarterly review	Environment / Operations
Waste generation	Increase recovery of non-hazardous waste	% waste recovered	Increase by 5% compared with previous year	By 31 December	Environment

Objectives should be consistent with the environmental policy, measurable where practicable, monitored, communicated and updated.

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Case 4 – Environmental emergency

PROPOSED ANSWER

a. Failures: no spill kit or lack of knowledge of its location; late communication; inadequate training; no record; and possible absence or ineffectiveness of the emergency procedure.

b. Immediate actions: contain the spill, protect the watercourse, use absorbent materials, notify the supervisor and environmental manager, collect contaminated waste and assess whether the competent authorities must be informed.

c. Preventive measures: operator training, periodic drills, clear signage and accessible spill-kit locations, regular inspections, review of the emergency procedure and clear allocation of responsibilities.

d. Documented information: emergency procedure, incident record, response report, training evidence, spill-kit inspection records and implemented corrective actions.

Case 5 – Green mining and improvement of environmental performance

Response template. Case 5 – Green mining and improvement of environmental performance.

Problem	Green mining pillar	Improvement measure	Indicator
High fuel consumption	Energy and emissions	Route optimisation, gradual equipment electrification or preventive maintenance	Litres of fuel/tonne; tCO_2e/year
Low water recirculation	Water and effluents	Install or improve a recirculation system and loss control	% water recirculated; m^3/tonne
Tailings sent for final disposal	Waste, tailings and circular economy	Assess recovery, reuse or dry-stacked tailings	% waste recovered; tonnes reused
Dust and noise complaints	Community and transparency	Increase watering, acoustic barriers, suitable operating hours and community communication	Number of complaints; average response time

These actions can be integrated into the EMS through the identification of significant environmental aspects, assessment of risks and opportunities, setting of environmental objectives, implementation of operational controls, indicator-based monitoring and continual improvement.

D. Case study

CASE STUDY – ECOMINAS MINING COMPANY

Purpose of the assignment: Apply the concepts of chapter 3 to a mining-industry case, focusing on environmental management, identification of environmental aspects and impacts, operational control, resource management and improvement of environmental performance, based on ISO 14001.

1. Context

→ EcoMinas is a copper-ore extraction and processing company that has operated for 15 years in a semi-arid region.

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→ In recent years, the company has faced several problems affecting its environmental performance:
→ increased community complaints about dust, noise and heavy-vehicle traffic;
→ notices from the environmental authority concerning failures in waste and wastewater management;
→ increased water and energy consumption and associated costs;
→ an incident involving inadequate storage of chemicals;
→ communication difficulties between production, maintenance and environmental functions;
→ a need to strengthen environmental monitoring and relations with interested parties.

In response, the company decided to strengthen its environmental management system (EMS) on the basis of ISO 14001.

2. Initial organisational diagnosis

Information box 2 summarises the main external and internal issues identified in the initial assessment.

Information box 2. External and internal issues identified at EcoMinas Mining.

External issues	Internal issues
Community pressure to reduce environmental impacts	Communication failures between departments
Scarcity of water resources	Insufficient control of operational processes
More stringent legal requirements	Organisational culture with limited environmental focus
Rising energy costs	Limited environmental monitoring

3. Relevant interested parties

The company regards the following as its most relevant interested parties:

→ **the local community,** which expects control of dust, noise and environmental impacts;
→ **workers,** who value safe working conditions and training;
→ **regulatory authorities,** which require legal compliance and environmental monitoring;
→ **customers,** who value sustainable practices;
→ **shareholders,** who seek efficiency and sustainability.

4. Problems observed in environmental management

Despite its intention to strengthen the EMS, the company faces several difficulties:

→ insufficient control of dust and atmospheric emissions;
→ failures in mining-waste management;
→ intensive water use in a water-scarce context;
→ inadequate storage of hazardous materials;
→ absence of consistent environmental indicators;
→ irregular and poorly integrated monitoring;
→ a reactive approach to environmental problems.

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5. Work to be developed

5.1. Analysis of the organisational context

i. Identify the three external issues and the three internal issues that you consider most critical to EcoMinas's environmental performance.

ii. Briefly explain why they are critical.

iii. State how they may influence the outcomes of the EMS.

Example of an external issue
Water scarcity
Rationale: The operation depends heavily on water in a semi-arid region.

5.2. Environmental aspects and impacts

i. Identify three relevant environmental aspects associated with EcoMinas's activities.

ii. For each one, state:

- the originating activity;
- the environmental aspect;
- the associated environmental impact.

iii. Explain why you consider each aspect significant.

Example
Activity: Drilling
Environmental aspect: Dust emissions
Environmental impact: Deterioration of air quality
Significance rationale: Community complaints and health impact

5.3. Operational control and atmospheric pollution

i. Identify two problems relating to atmospheric emissions.

ii. Propose control measures for each problem.

iii. Briefly explain the expected environmental benefit.

Example
Problem: Dust emissions caused by traffic on unpaved roads
Proposed measure: Regular road watering
How it works: Reduces the suspension of particles in the air
Environmental benefit: Improved air quality and fewer complaints

5.4. Environmental performance indicators

Propose three environmental indicators:

→ one management performance indicator (MPI);
→ one operational performance indicator (OPI);
→ one environmental condition indicator (ECI).

For each indicator, state:

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→ what it measures;
→ the unit of measurement;
→ its practical usefulness.

Example
Indicator type: MPI
Indicator: % of environmental objectives achieved
What it measures: Effectiveness of the EMS
Unit: %
Usefulness: Evaluation of management performance

5.5. Conclusion

Write a brief conclusion of 8 to 12 lines answering the question: **How can strengthening the EMS improve EcoMinas's environmental performance?**

6. Instructions

→ Individual assignment.
→ Answer on the basis of the case study presented.
→ Use clear, technical and objective language.
→ Wherever possible, justify your answers.

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STRIM

SAFETY TRAINING WITH
REAL IMMERSIVITY FOR MINING

CHAPTER 4

Safety Management: Management Structure and Risk Management

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Chapter 4 – Safety Management: Management Structure and Risk Management

Quick chapter map

Pedagogical table. Quick chapter map.

Section	Pedagogical function
1. Before you begin	Clarify that managing risk means turning assessment into action, responsibility and evidence.
2. Learning pathway	Structure the pathway from OSH management through to risk treatment and monitoring.
3. Management framework	Define components, ISO 31000 principles and implementation recommendations.
4. Leadership, responsibilities and organisation	Clarify commitment, roles, authority, the responsibility matrix and resources.
5. Participation, communication and consultation	Involve workers and interested parties in identifying and controlling risks.
6. Risk management process	Apply context, identification, analysis, evaluation and treatment.
7. Monitoring and reporting	Establish reporting criteria, essential records and review of effectiveness.
8. Applied example	Consolidate the process through a priority occupational risk.

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4.1. Before you begin

4.1.1. Background

Chapter 4 focuses on the management framework and the occupational risk management process. It demonstrates that effective prevention is not limited to identifying hazards or carrying out a formal risk assessment. The essential requirement is to ensure that the results of the assessment are converted into decisions, responsibilities, control measures, monitoring and documented evidence. The chapter therefore links ISO 31000 [7], as general guidance on risk management, with ISO 45001 [4], as an auditable Occupational Safety and Health management system. It reinforces the principle that risk management must be integrated into the organisation's decision-making processes rather than operating only as documentation for formal compliance.

? KEY QUESTION	How can an occupational risk assessment be converted into concrete decisions, assigned responsibilities, implemented controls, evidence and monitoring of effectiveness?

4.1.2. Learning objectives

1. Identify the elements of an OSH management framework.
2. Construct a simple responsibility matrix.
3. Apply the risk management cycle to a practical situation.
4. Define risk treatment measures, responsible persons, deadlines, evidence and indicators.

4.1.3. Competences to be developed

- Organise responsibilities among top management, line managers and supervisors, specialists, workers and contractors.
- Apply the stages of risk management to real or simulated tasks.
- Prioritise control measures on the basis of the hierarchy of prevention.
- Construct an action plan with responsible persons, deadlines, resources, evidence and indicators.
- Assess whether monitoring confirms the effectiveness of the measures implemented.

4.1.4. Key concepts

Pedagogical table. Key concepts.

Concept	Operational definition for this chapter
OSH management framework	The organisation of responsibilities, authority, resources and processes required to manage OSH risks.
Risk management	A systematic process for establishing the context, identifying, analysing, evaluating, treating, monitoring and communicating risks.
Risk criteria	References used to determine likelihood, severity, acceptability and priority.
Risk treatment	The selection and implementation of measures to eliminate hazards or reduce risks.

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Concept	Operational definition for this chapter
Hierarchy of prevention	Preference for elimination, substitution and collective controls before administrative controls and PPE.
Responsibility matrix	A tool that clarifies who decides, carries out, supports, is consulted on and verifies control actions.
Evidence of effectiveness	A record or observation demonstrating that a control has been implemented and is working.

4.2. Learning pathway

Pedagogical table. Learning pathway.

Stage	What the trainee does	Resources
LEARN	Reads the essential concepts in chapter 4 and identifies the technical terminology associated with management frameworks and risk management.	Core chapter text, table of key concepts, summary tables and examples.
OBSERVE	Analyses examples, figures, tables, practical cases and organisational or operational situations associated with the topic.	Figures, tables, practical examples and a case study.
DECIDE	Classifies situations, identifies priorities, chooses criteria and selects technically justified responses.	Guiding questions, decision criteria, matrices and decision-making exercises.
APPLY	Produces a simple application tool: map, matrix, checklist, plan, record, indicator or improvement proposal.	Templates, worksheets and completed examples.
REFLECT	Records learning, limitations, evidence used and possible improvements for professional practice.	Reflection and final summary; where applicable, a digital portfolio or the platform's forum.

▣ GUIDANCE FOR INDEPENDENT USE

When the chapter is used outside the platform, the trainee should retain completed exercises, filled-in worksheets, reflection records, group outputs and evidence of application. These materials may be used as evidence of learning and as a basis for classroom discussion or continuous assessment.

4.3. Management framework

Effective prevention of occupational risks depends on a clear organisation of functions, responsibilities, authority and resources. Risk management should not be understood merely as a technical exercise in identifying and assessing hazards, but as a process integrated into organisational decision-making. It involves top management, line managers and supervisors, occupational safety and health specialists, workers, occupational health services and, where applicable, contractors and suppliers. This framework enables the results of risk assessment to be converted into concrete actions, ensuring that every preventive measure has an assigned responsible person, the resources needed for implementation, follow-up mechanisms and documented evidence confirming its execution and effectiveness.

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4.3.1. Components of the management framework

Before presenting the components of the management framework, it is important to understand the principles that should guide occupational risk management. Good risk management should be integrated into organisational processes, structured and systematic, adapted to the actual work context, inclusive of workers and interested parties, dynamic enough to respond to change, and based on reliable and up-to-date information. It should also take account of human and cultural factors and promote continual improvement.

On the basis of these principles, the management framework should define how the organisation assumes, distributes and monitors prevention. It converts risk assessment into decisions, responsibilities, actions and documented evidence. For this purpose, the chapter organises management into five principal blocks (Table 28).

Table 28. Components of the management framework.

Component	What it means in practice
Management commitment	Management establishes the policy and objectives, provides the necessary resources and demonstrates visible leadership in Occupational Safety and Health.
Responsibilities	Each function knows what it must do, with defined authority, clear duties and accountability.
Participation and consultation	Workers and interested parties participate in hazard identification, risk analysis and improvement of preventive measures.
Risk management process	The organisation defines the context, identifies hazards, analyses and evaluates risks, selects risk treatment measures and promotes continual improvement.
Monitoring and reporting	Indicators, records, audits and reports are used to monitor the effectiveness of measures and support decision-making.

This approach is aligned with ISO 31000, Risk management – Guidelines [7] and ISO 45001, Occupational health and safety management systems – Requirements with guidance for use [4] (Table 29). ISO 31000 provides the general logic of risk management through principles, a framework and a process [7]; ISO 45001 translates that logic into auditable requirements for an OSH management system [4]. In other words, ISO 31000 helps the organisation think about risk [7]; ISO 45001 helps it demonstrate, through evidence, that risk is being managed within the OSH system. The management framework should therefore be designed not merely as a set of documents, but as a system that integrates prevention into decisions and daily organisational practices.

Table 29. Risk management reference standards.

Aspect	ISO 31000 [7]	ISO 45001 [4]
Nature	General risk management guidance	Auditable requirements for an OSH management system
Certification	Not a certification standard	Allows voluntary third-party certification
Focus	Risk management principles, framework and process	Leadership, consultation, hazards, operational control, audits and improvement
Evidence	Guides good practice and benchmarking	Requires records, objectives, evidence, audits and management review
Usefulness	Explains the logic of risk management	Demonstrates that the system functions and is maintained

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4.3.2. ISO 31000 principles applied to OSH

The principles set out in ISO 31000 [7] provide the basis for risk management in an organisation. Table 30 illustrates how these principles can be translated into concrete actions in a quarry context.

Table 30. Principles of ISO 31000 in the context of a quarry.

Principle	Interpretation for OSH	Quarry example
Creates and protects value	Risk management protects people, operational continuity and reputation	Prevent serious accidents, stoppages, fines and loss of trust
Integrated	Risk is managed in planning, production, maintenance and procurement, rather than in a separate document	Include traffic risks in production planning and maintenance shutdowns
Structured and comprehensive	The same logical stages and criteria are applied consistently	Use a defined method for drilling, blasting, crushing and haulage tasks
Customised	The method reflects the organisation, its activity, resources and actual conditions	Adapt controls to geology, equipment, weather and workforce profile
Inclusive	Relevant knowledge and viewpoints are incorporated into decisions	Consult operators, supervisors, contractors and occupational health staff
Dynamic	Risk management anticipates, detects and responds to changes	Review assessments after new equipment, changed benches, incidents or extreme weather
Best available information	Decisions use historical data, monitoring, expertise and acknowledged limitations	Combine exposure measurements, incident records, inspections and worker reports
Human and cultural factors	Behaviour, workload, communication, competence and organisational culture are considered	Assess production pressure, fatigue, language barriers and informal work practices
Continual improvement	Experience, indicators, inspections, incidents and audits are used to improve controls	Revise procedures and engineering controls on the basis of monitoring results

4.3.3. Implementation recommendations

- Integrate risk management into planning, procurement, maintenance, change management and operational decision-making.
- Use a multidisciplinary approach and involve workers who understand the work as actually carried out.
- Define risk criteria before assessment and apply them consistently.
- Link every significant risk to a control measure, responsible person, deadline, evidence and effectiveness indicator.
- Review assessments when incidents, near misses, process changes, new equipment or changes in working conditions occur.
- Use indicators, inspections, incident investigations, internal audits and management review to support continual improvement.

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4.4. Leadership and management commitment

Management commitment makes prevention a genuine priority. Top management must ensure safe and healthy working conditions and must not limit its role to approving documents. It must provide resources, define objectives, monitor indicators, prioritise high risks, and hold line managers, supervisors and other responsible persons accountable for implementing the planned measures (Table 31).

Table 31. Principal commitments of top management.

Commitment element	Practical application
Policy and objectives	Integrate OSH into strategy and operational objectives
Resources	Provide time, people, budget and technical resources to control risks
Example and consistency	Comply with, require and monitor safe practices in the workplace
Risk-based decision-making	Prioritise measures according to risk level, effectiveness and feasibility
Authority to intervene	Allow unsafe work to be stopped and corrected before the task continues

4.5. Responsibilities and organisational structure

Clear responsibility prevents grey areas in prevention. It is not enough to identify who performs a task; the organisation must also define authority to decide, accountability, and communication and reporting channels. Table 32 presents the principal responsibilities in OSH management. A useful practice is to construct a RACI matrix identifying who is Responsible, Accountable, Consulted and Informed for each critical activity (Table 33).

Table 32. Typical roles in an OSH management framework.

Function	Principal responsibility
Top management / Board	Approve the policy, objectives, resources, responsibilities, authority and management review
Technical management / quarry manager	Ensure that the working method is safe and compatible with the risk assessment
OSH manager / coordinator	Organise the system, support risk assessment, monitor action plans, promote training and maintain records.
Line managers and supervisors	Implement and control measures in the workplace and integrate OSH into daily planning
Workers	Follow procedures, use defined controls, report dangerous situations and participate in improvement
Occupational health / HR	Coordinate health surveillance, fitness for work, training and preventive measures
Contractors and suppliers	Comply with internal rules, demonstrate competence and report occurrences

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Table 33. Example RACI matrix.

OSH activity	Top management	OSH manager	Supervisor	Workers	Occupational health/HR
Define OSH policy	**A**	**C**	**C**	**I**	**C**
Assess risks by task	**I**	**R**	**R**	**C**	**C**
Select PPE	**I**	**R**	**C**	**C**	**C**
Implement operational controls	**I**	**C**	**R/A**	**R**	**I**
Investigate incidents	**I**	**R**	**R**	**C**	**C**
Review indicators and resources	**A**	**R**	**C**	**I**	**C**

R = responsible for carrying out the work; **A** = accountable or gives approval; **C** = consulted; **I** = informed.

4.5.1. Example management framework and responsibility matrix

To illustrate practical application of the management framework, consider the fictitious company Pedra Forte, Ltd., an open-cast quarry extracting ornamental or industrial stone. Typical risks include mobile plant movements, falls from height or on the same level, exposure to dust and silica, noise, vibration, flying material, severe weather and heat stress.

This example demonstrates that a management framework is not limited to an organisation chart. The organisation must clearly define who decides, who implements, who monitors, who carries out the work and who reports. It should therefore establish a responsibility matrix in which every function understands its role in preventing and controlling occupational risks (Table 34).

Table 34. Responsibility matrix for the fictitious company Pedra Forte, Ltd.

Function	Responsibility within the management framework
Board / CEO	Approves the OSH policy, objectives, necessary resources, responsibilities and management review
Quarry technical director	Ensures that the extraction method is safe and compatible with the risk assessment
OSH manager	Coordinates the OSH system, maintains the risk register, and monitors audits, training, incident investigation and indicators
Production manager	Integrates OSH controls into daily production planning and monitors application of procedures
Working-face supervisor	Checks conditions before work starts, communicates risks and may stop unsafe work
Workers	Report hazards, near misses and difficulties in applying preventive measures
Occupational physician	Supports health surveillance, particularly in relation to exposure to dust, noise and vibration, and fitness for safety-critical tasks

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This matrix helps convert risk assessment into concrete actions. For example, if a high risk associated with exposure to silica dust is identified, the decision does not remain only in the risk assessment: the Board provides resources; the technical director validates technical solutions; the OSH manager defines measures and indicators; the production manager incorporates controls into planning; the supervisor verifies application in the workplace; workers report failures; and the occupational physician monitors health surveillance. The management framework thus becomes a practical tool for prevention, accountability and continual improvement.

4.6. Participation, communication and consultation

Worker participation improves the quality of decisions and increases acceptance of measures. Workers understand the work as actually performed, including shortcuts, constraints and factors that can make a measure impracticable. They should therefore be heard before the final decision, particularly when controls, procedures and personal protective equipment are selected. Communication may be one-way or two-way, but consultation requires the organisation to listen to, consider and incorporate contributions. Examples of failure include changing a procedure without consultation, selecting PPE without testing comfort and fit, starting contractor work without providing information on local hazards, or failing to investigate reported near misses. Table 35 illustrates the differences between participation, communication and consultation.

Table 35. Differences between participation, communication and consultation.

Concept	Objective	Examples
Communication	Ensure that the right information reaches the right person at the right time	Procedures, alerts, training, lessons learned and process changes
Consultation	Obtain contributions before deciding or changing practices	PPE selection, task review, control measures, incident investigation and planning of change.
Participation	Integrate knowledge of actual work into the design and verification of measures	Walk-throughs, safety meetings, procedure trials, near-miss reporting and improvement suggestions

4.7. Risk management process

The risk management process is a continuous cycle: understand the context, identify risks, analyse them, evaluate them, treat them and then monitor, review, communicate, record and report the results.

4.7.1. Risk management process cycle

The process follows a sequential logic:

Input → Scope, context and criteria → Risk identification → Risk analysis → Risk evaluation → Risk treatment → Decision

Monitoring, review, communication, consultation, recording and reporting must take place throughout the cycle. Risk management does not end when the risk level has been calculated; it continues until the organisation has demonstrated that the measures work.

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4.7.2. Principal stages

4.7.2.1. Defining the scope, context and criteria

Before risks are assessed, the organisation must understand its context: activities, tasks, people exposed, equipment, working conditions, legal requirements and available resources. It must also define the criteria used to decide whether a risk is acceptable or requires treatment.

4.7.2.2. Risk identification

The organisation should identify sources of risk, areas of impact, events, causes and potential consequences. This includes changes in circumstances, such as changes to the production process, teams, equipment or environmental conditions.

4.7.2.3. Risk analysis

The analysis may be qualitative, semi-quantitative or quantitative, depending on the production process and the type of risk. It may use observational methods, comparison with legal and normative requirements, traditional assessment methods, event analysis, functional analysis, or measurements of physical, chemical, biological and ergonomic agents.

A simple approach to determining the level of risk is:

$$RL = L \times S$$

The **Risk Level (RL)** is obtained by combining **Likelihood (L)** and **Severity (S).** Likelihood takes account of factors such as the number of people exposed and the frequency and duration of exposure; severity considers the extent and seriousness of the harm.

4.7.2.4. Risk evaluation

Following the analysis, the risk level is compared with the defined criteria (Table 36). This comparison supports the decision on whether the risk is acceptable or requires treatment. In the example matrix, low risks may be maintained under control and monitored; moderate risks require a proportionate improvement plan; and high or unacceptable risks may require work to be stopped or not started until the risk has been reduced.

Table 36. Risk evaluation criteria.

Risk level	Interpretation	Strategy
1 to 6	**Low risk**	Maintain existing controls and monitor
7 to 12	**Moderate risk**	Define and implement an improvement plan proportionate to the risk level, with responsible persons, deadlines and verification of effectiveness
13 to 25	**Unacceptable risk**	Stop or do not start the activity until the risk has been reduced to an acceptable level

4.7.2.5. Risk treatment

Risk treatment is the process of identifying, assessing, selecting and implementing options to reduce risk to acceptable levels. It should take account of organisational constraints, such as human, technical and financial resources, implementation timescales, cost, complexity and operational impact.

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Priority should follow the hierarchy of prevention outlined in Table 37.

Table 37. Hierarchy of preventive preference.

Preventive priority	Type of measure	Examples
1	**Eliminate or avoid**	Remove the hazard, change the method or prevent exposure
2	**Engineering controls**	Isolation, enclosure, automation, capture at source and machine guarding
3	**Organisational measures**	Procedures, shift planning, training, signs, permits to work and supervision
4	**Personal protective equipment**	Respiratory, hearing and eye protection, hard hats, footwear and high-visibility clothing

Questions to consider before implementation

Before implementing a measure, the following critical questions should be asked:

- Will the planned controls reduce risk to tolerable levels?
- Will they create new hazards or new forms of exposure?
- Has the most effective solution proportionate to the cost and effort been selected?
- Do the people affected consider the measure necessary, practicable and applicable to actual work?
- Will the controls be used in practice, including under production pressure?
- Does the plan define responsible persons, deadlines, resources, records and reassessment criteria?

The outcome of treatment should be an inventory of prioritised actions to eliminate, improve or maintain control systems. Where risk remains unacceptable, additional treatment and a new assessment must be planned.

✓ **PRACTICAL RULE**

A significant risk is genuinely managed only when there is a defined measure, a responsible person, a deadline, evidence and a method for verifying effectiveness.

4.7.3. Expected outcome

The outcome of the process should be a prioritised action plan containing measures to eliminate, reduce, improve or maintain existing controls. The plan should identify responsible persons, deadlines, resources, evidence and monitoring indicators.

Measures may address five areas: working conditions, work equipment, work organisation, worker training and information, and health surveillance.

! **ATTENTION**

Frequent errors
Carrying out risk assessment without involving workers;
Defining measures without assigning a responsible person;
Using PPE as the first solution;

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Failing to verify whether the measure works;
Keeping risk matrices out of date; and
Filing assessments without an action plan.

4.8. Monitoring and reporting

4.8.1. Monitoring and review

Ongoing monitoring and periodic review should be planned and linked to clear responsibilities. It is necessary to check whether the measure has been implemented, whether it is being used, whether the risk has been reduced and whether new hazards have arisen. The results feed into performance management, management review and continual improvement. Table 38 summarises the most important points to monitor and provides examples of indicators that may be defined in each case.

Table 38. Examples of indicators to be monitored within an OSH management system.

What to monitor	Examples of indicators
Implementation of actions	Percentage of actions completed within the deadline; corrective actions closed
Effectiveness of controls	Reduction in exposure; measurement results; reduction in nonconformities
Behaviour and practices	Behavioural observations; compliance with procedures; effective use of PPE
Events and learning	Incidents, accidents, near misses, investigations and lessons learned
Compliance and the system	Audits, inspections, training records, health surveillance and management review

4.8.2. Records and reporting

Document decisions, evidence, deviations, indicators and matters requiring management decisions.

4.8.2.1. Reporting criteria

- Define the recipients, frequency and format of reporting.
- Ensure relevance to objectives and decision-making.
- Balance the cost, timeliness and usefulness of information.
- Convert data into priorities, decisions and corrective actions.
- Ensure traceability between assessment, action, evidence and review.

4.8.2.2. Essential records

- Assessment records: hazards, risks, criteria and results.
- Action plan: measures, persons responsible, resources, deadlines and priorities.
- Evidence of implementation: inspections, training, maintenance, PPE issue, permits and checklists.
- Indicators and review: results, deviations, corrective actions and verification of effectiveness.
- Reporting to management: priorities, resource needs and pending decisions.

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4.9. Example of the risk management process: dust/silica in an open-pit quarry

To understand how the risk management process is applied in practice, exposure to silica dust in an open-pit quarry can be considered as an example. In this context, workers may be exposed during activities such as drilling, crushing, materials handling and cleaning of work areas. This risk is particularly significant because prolonged exposure to silica dust can cause serious respiratory diseases, including silicosis.

The process begins with hazard identification, in this case the presence of dust generated by quarry operations. Risk analysis and evaluation are then carried out, considering factors such as the number of workers exposed, the frequency and duration of exposure, the conditions under which the work is performed and the potential severity of harm to health. If the risk is considered significant or unacceptable, it should not merely remain recorded in the risk matrix; it should lead to a management decision and an action plan.

Applying the expected outcome described in **section 4.7.3** to the quarry, a prioritised action plan must be drawn up, containing measures designed to eliminate or reduce risks and to improve or maintain existing controls. For each measure, the plan must specify the person responsible, the necessary resources, the deadlines, evidence of implementation and monitoring indicators (Table 39). The measures may cover different areas, including working conditions, work equipment, work organisation, training and information for workers, and health surveillance.

Table 39. Action plan for the open-pit quarry example.

Action	Responsible person/function	Evidence
Measure exposure to dust/silica	OSH practitioner	Measurement report
Install water suppression or capture at source	Technical manager / maintenance	Installation and maintenance records
Use wet cleaning methods	Production manager	Procedure and checklists
Introduce worker rotation	Production manager	Work schedules
Provide suitable respiratory protection	OSH manager	Issue and training records
Carry out health surveillance	Occupational physician	Fitness certificates and medical examinations
Monitor the effective use of controls	Quarry face supervisor	Daily observations and indicators

This example shows that risk treatment should follow a preventive logic: first seek to eliminate or reduce the hazard at source through technical solutions such as water suppression, local extraction or wet methods; then reinforce organisational measures such as rotation, procedures and training; and finally use PPE as a supplementary barrier. During drilling, for example, work should not begin if the water supply or dust extraction system is not operational.

The risk management process therefore turns assessment into concrete decisions. Every identified risk should lead to a measure, a responsible person, a deadline, an indicator and evidence. Without this connection, risk assessment remains merely a formal document; with it, risk assessment becomes an effective tool for prevention, monitoring and continual improvement.

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4.10. Final summary

An effective management framework turns intentions into preventive action. To achieve this, the organisation should ensure commitment, accountability, participation, communication, a structured process, monitoring, records and reporting (Table 40). Managing occupational risks means ensuring that each decision has a responsible person, a deadline, evidence and review.

Table 40. Final summary of the chapter.

Dimension	Summary
Commitment	Priority, resources, consistency and risk-based decision-making
Accountability	Authority, clear functions and accountability
Participation	Integration of real work and practicable measures
Communication and consultation	Appropriate information, dialogue and informed decisions
Process	Context, assessment, treatment and continual improvement
Monitoring and reporting	Evidence, learning, indicators and decision support

Risk management does not end when the risk level has been classified. A risk can only be considered controlled when the planned measures have been implemented, responsible persons have been assigned, evidence of implementation exists, and effectiveness has been verified in real work. Whenever incidents, near misses, process changes, new equipment or changes in working conditions occur, the risk assessment should be reviewed.

! **ATTENTION**	**Risk management does not end with the matrix.** It ends only when measures have been implemented, verified and integrated into the organisation's day-to-day management.

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Case studies and assessment activities

A. Self-assessment questions

1. Why should occupational risk management not be regarded merely as a documentary assessment of hazards and risks?

2. How does top management commitment influence the effectiveness of prevention in Occupational Safety and Health?

3. What are the main components of an effective OSH management framework?

4. Why is it important to define responsibilities, authority and accountability within an OSH management framework?

5. What is the purpose of a RACI matrix in occupational safety and health management?

6. How do communication, consultation and worker participation differ?

7. Why does worker participation improve the quality of preventive measures?

8. What are the main stages of the risk management process?

9. Why should risk treatment follow a preventive hierarchy?

10. What types of evidence can demonstrate that a control measure has been implemented and is effective?

B. Multiple-choice questions

1. The main purpose of an OSH management framework is:

A. To create documents in order to comply with legal requirements.
B. To ensure that prevention is organised through functions, responsibilities, authority, resources and follow-up.
C. To replace risk assessment with informal inspections.
D. To transfer responsibility for safety solely to workers.
E. To reduce the number of safety meetings.

2. Risk management should be:

A. Isolated from the organisation's decision-making processes.
B. Applied only after serious accidents occur.
C. Integrated, structured, adapted to the context, inclusive, dynamic and based on reliable information.
D. Exclusively documentary and the responsibility of the OSH practitioner.
E. Based only on top management experience.

3. Which option correctly describes a difference between ISO 31000 and ISO 45001?

A. ISO 31000 permits certification, whereas ISO 45001 does not.
B. ISO 31000 is a standard exclusively for quarries.
C. ISO 31000 provides general risk management guidelines, whereas ISO 45001 specifies auditable requirements for OSH management systems.
D. ISO 45001 does not require documented evidence.

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E. ISO 31000 replaces the need for worker participation.

4. In a RACI matrix, the letter R means:

A. Reviewer.
B. Responsible for carrying out the task.
C. Available resource.
D. Residual risk.
E. Mandatory record.

5. Which of the following functions is normally associated with top management/the board?

A. Correctly using PPE while carrying out the task.
B. Reporting near misses in the workplace.
C. Approving the policy, objectives, resources, responsibilities and management review.
D. Completing daily operational checklists.
E. Carrying out dust measurements only.

6. Worker consultation means:

A. Informing workers after the decision has been made.
B. Obtaining input before deciding or changing practices.
C. Giving documents to workers without discussion.
D. Replacing mandatory training with informal meetings.
E. Delegating all management decisions to all workers.

7. The logical sequence of the risk management process is:

A. Risk treatment → Decision → Identification → Communication.
B. Input → Scope, context and criteria → Risk identification → Risk analysis → Risk evaluation → Risk treatment → Decision.
C. Evaluation → Filing → Audit → Closure.
D. Training → PPE issue → Record → Enforcement.
E. Communication → Accident → Investigation → Penalty.

8. In a simple risk matrix, the risk level may be calculated using the formula:

A. RL = Cost x Time.
B. RL = Likelihood x Severity.
C. RL = Frequency + Training.
D. RL = Exposure / Resources.
E. RL = Hazard – Control.

9. According to the preventive hierarchy, what should be the first priority when treating risk?

A. Provide PPE.
B. Put up signs.
C. Eliminate or avoid the hazard.
D. Provide training after the accident.
E. Increase supervision without changing the process.

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10. A significant risk is only genuinely managed when there is:

A. A filed record requiring no review.
B. A worker who has been verbally informed.
C. A defined measure, a responsible person, a deadline, evidence and a means of verifying effectiveness.
D. PPE that has been issued, regardless of whether it is used.
E. An assessment carried out only once.

C CORRECT ANSWERS

1. B; 2. C; 3. C; 4. B; 5. C; 6. B; 7. B; 8. B; 9. C; 10. C.

C. Practical problems

Problem 1 – Risk-level assessment in crushing operations

At an open-pit quarry, high levels of dust are released during crushing operations. Workers remain in the area for several hours per shift, and some report respiratory discomfort. The company has assigned the following values:

- Likelihood: 4
- Severity: 5

Use the formula: **RL = Likelihood x Severity**

Evaluation criteria:

- 1–6: low risk;
- 7–12: moderate risk;
- 13–25: unacceptable risk.

A ACTIVITY

a. Calculate the risk level.
b. Classify the risk.
c. State the decision to be taken.
d. Propose three control measures.
e. Identify two items of evidence that should be retained.

Problem 2 – Constructing a simple responsibility matrix

An aggregates extraction company has identified a high risk of workers being struck by vehicles because lorries, wheel loaders and pedestrians circulate at the same time. The company wishes to define responsibilities for controlling this risk.

A ACTIVITY

Construct a simple matrix indicating the main responsibility of each function:
• Board/top management
• Technical manager
• OSH manager
• Production manager
• Quarry face supervisor
• Workers

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Problem 3 – Applying the preventive hierarchy

During drilling at a quarry, workers are exposed to silica dust. The company has proposed the following measures:

A. Mandatory use of respiratory protective equipment;
B. Installation of a dust extraction system at source;
C. Worker training;
D. Changing the drilling method to reduce dust generation;
E. Daily supervision of compliance with procedures.

A ACTIVITY

Arrange the measures according to the preventive hierarchy, from most effective to least prioritised. Justify the order selected.

Problem 4 – Action plan for a fall-from-height risk

During an inspection, a fall-from-height risk was identified near a blasting face. The area does not have suitable physical barriers, signage is insufficient and workers circulate close to the slope.

- Likelihood: 3
- Severity: 5

A ACTIVITY

a. Calculate the risk level.
b. Classify the risk.
c. Prepare an action plan with four measures, indicating the responsible person, deadline, evidence and indicator.

Problem 5 – Monitoring and verifying the effectiveness of measures

After implementing measures to reduce dust exposure during crushing, the company wishes to verify whether they are effective. The following actions have been implemented:

- Water suppression system;
- Wet cleaning methods;
- Use of respiratory protection;
- Worker training;
- Health surveillance.

A ACTIVITY

a. Identify five indicators that may be used to monitor the effectiveness of the measures.
b. Identify five records/items of evidence that should be retained.
c. Explain why monitoring is essential in risk management.

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Suggested answers

Problem 1 – Risk-level assessment in crushing operations

PROPOSED ANSWER

a. RL = 4 × 5 = 20.

b. The risk is classified as unacceptable because it falls between 13 and 25.

c. The activity should not continue under the same conditions. An action plan should be defined and implemented before work continues, or the risk should be reduced to an acceptable level.

d. Possible control measures:

- Install a water suppression or dust capture system at source;
- Use wet cleaning methods;
- Provide suitable respiratory protection and training in its correct use;
- Carry out periodic dust/silica measurements;
- Reduce exposure time through worker rotation.

e. Possible evidence:

- Dust measurement report;
- Installation and maintenance records for the control system;
- Respiratory protection issue and training records;
- Daily checklists;
- Health surveillance records.

Problem 2 – Constructing a simple responsibility matrix

Response template. Problem 2 – Constructing a simple responsibility matrix.

Function	Main responsibility
Board/top management	Approve resources for signage, training, route separation and improvement of traffic conditions.
Technical manager	Ensure that the traffic management plan is compatible with the quarry extraction method.
OSH manager	Support risk assessment, propose measures, monitor indicators and maintain records.
Production manager	Integrate traffic rules into daily production planning.
Quarry face supervisor	Check in the workplace that rules are followed and stop unsafe work.
Workers	Follow traffic rules, wear high-visibility clothing and report hazardous situations.

This matrix helps avoid grey areas because each function knows what it must do, who decides, who carries out the work and who follows up.

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Problem 3 – Applying the preventive hierarchy

PROPOSED ANSWER

The most appropriate order is:

D – Change the drilling method to reduce dust generation;

B – Install a dust extraction system at source;

C – Train workers;

E – Carry out daily supervision of compliance with procedures;

A – Require the use of respiratory protective equipment.

Justification:

The first priority should be to eliminate or reduce the hazard at source. Changing the drilling method is therefore more effective than relying solely on worker behaviour. Installing dust extraction is an engineering control and is also highly relevant. Training and supervision are important organisational measures to ensure that controls are correctly applied. PPE should be used as a supplementary barrier, not as the first solution.

Problem 4 – Action plan for a fall-from-height risk

PROPOSED ANSWER

a. RL = 3 × 5 = 15.

b. The risk is unacceptable because it falls between 13 and 25.

c. Proposed action plan:

Response template. Problem 4 – Action plan for a fall-from-height risk.

Measure	Responsible person/function	Deadline	Evidence	Indicator
Install physical barriers in risk areas	Technical manager / maintenance	15 days	Installation record and photographs	Percentage of areas protected
Improve hazard signage and demarcation of the area	Production manager	7 days	Signage checklist	Number of nonconformities found during inspections
Define a traffic procedure near the blasting face	OSH manager	10 days	Approved and communicated procedure	Percentage of workers informed
Conduct a toolbox talk on falls from height	Quarry face supervisor	Before work restarts	Attendance record	Number of workers covered

The activity should be restricted until the essential measures have been implemented, particularly physical barriers and demarcation of the area.

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Problem 5 – Monitoring and verifying the effectiveness of measures

PROPOSED ANSWER

a. Possible indicators:

- Percentage of actions completed within the deadline;
- Results of dust/silica measurements;
- Number of nonconformities observed during inspections;
- Percentage of workers correctly using respiratory protection;
- Number of complaints, incidents or symptoms reported;
- Percentage of workers covered by training;
- Health surveillance results.

b. Possible records/evidence:

- Dust measurement reports;
- Maintenance records for the water suppression system;
- Wet-cleaning checklists;
- PPE issue records;
- Training records;
- Fitness certificates and medical examination records;
- Inspection reports;
- Corrective action records.

c. Monitoring is essential because it makes it possible to verify whether the measure has actually been implemented, whether it is being used correctly, whether the risk has been reduced and whether new hazards have arisen. Without monitoring, risk assessment remains merely a formal document. With monitoring, the organisation can make decisions, correct failures and promote continual improvement.

D. Case study

CASE STUDY – CONSTRUCTING AN OSH MANAGEMENT FRAMEWORK

Purpose of the assignment: Consolidate the concepts of management frameworks and occupational risk management presented in the chapter by applying them to a work context selected by the trainee.

1. General framework

Each trainee is expected to develop a simple and coherent proposal for an Occupational Safety and Health management framework for an organisation, sector, workstation or activity, demonstrating how risks can be translated into decisions, responsibilities, control measures, indicators, records and reporting.

The exercise is organised into three main stages:

1. **Select the context**: choose an organisation, sector, workstation or activity;
2. **Design the framework**: prepare an organisation chart or responsibility scheme;
3. **Operationalise it**: apply the framework to a priority risk by defining risk criteria, treatment measures, responsible persons, resources, consultation, communication, indicators, records and reporting.

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The focus is not merely on completing tables, but on demonstrating that there is a coherent framework for decision-making, accountability, participation, control, evidence and continual improvement.

2. Work scenario

Each trainee should select a work context for the exercise. The context may be an organisation, a sector, a workstation or an activity.

Examples of possible contexts: quarry, workshop, laboratory, industrial cleaning, construction, healthcare facility, warehouse, manufacturing industry or maintenance activity.

After selecting the context, the trainee should provide a brief description, including:

Response template. Constructing an OSH management framework and operationalising a priority risk.

Element	Expected description
Organisation, sector or activity	State the selected context and the main activity
Main tasks	Identify the critical or most relevant tasks
People involved	Identify workers, line managers and supervisors, specialists, contractors, visitors or other interested parties
Typical risks	State the main hazards and risks associated with the context
Existing resources	State the equipment, procedures, emergency arrangements, OSH services or other relevant resources

Application example: An open-pit quarry may be used as an application example. In that case, risks may include mobile equipment, rockfalls, dust/silica, noise, vibration, flying materials, adverse weather and heat stress.

3. Task to be developed

Each trainee should submit an individual document organised according to the three stages of the exercise:

1. **Selection and description of the context;**
2. **Design of the OSH management framework;**
3. **Operationalisation of a priority risk.**

1. Selection and description of the context

1.1. Selected context

Suggested options: quarry; workshop; laboratory; industrial cleaning; construction; healthcare; warehouse/logistics; manufacturing industry; maintenance; other.

1.2. Main activity

1.3. Main critical tasks

Response template. Main critical tasks.

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N.º	Critical task
1	
2	
3	
4	
5	

1.4. People involved

Tick/list the applicable people or interested parties.

1.5. Typical risks in the context

Response template. Typical risks in the context.

N.º	Typical risk
1	
2	
3	
4	
5	

2. OSH management framework

2.1. Functions included in the framework

Suggestion: top management; line managers and supervisors; OSH manager/practitioner; workers; worker representative; occupational health; maintenance; contractors; suppliers; other interested parties.

2.2. Brief description of the framework

2.3. Simple responsibility matrix

Complete each cell with one of the following letters: **D** = decides/approves; **E** = carries out; **A** = provides technical support; **C** = consulted; **I** = informed; **N/A** = not applicable.

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Response template. Simple responsibility matrix.

OSH activity	Top management	Line managers / supervisors	OSH	Workers	Occupational health	Contractors
Define OSH commitment or policy						
Identify hazards						
Assess risks						
Define control measures						
Implement measures						
Consult workers						
Communicate risks and controls						
Monitor indicators						
Record evidence						
Report to management						

3. Operationalisation of a priority risk

→ Selected priority risk:

→ Type of risk:

Suggested options: serious accident; occupational disease; emergency; contractor-related risk; ergonomic risk; chemical risk; physical risk; biological risk; psychosocial risk; other.

3.3. Description of the hazard, risk and consequence

Response template. Description of the hazard, risk and consequence.

Field	Response
Hazard	
Risk	
Likely consequence	

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3.4. Risk criteria

Response template. Risk criteria.

Criterion	Value
Likelihood	1 / 2 / 3 / 4 / 5
Severity	1 / 2 / 3 / 4 / 5
Risk level: L x S	value between 1 and 25
Classification	low / moderate / high / unacceptable
Is the risk acceptable?	yes / no / only with additional measures

3.5. Risk treatment measures

Response template. Risk treatment measures.

N.º	Treatment measure	Type of measure	Responsible person/function	Resources required
1		elimination / engineering / organisational / PPE / training / health		
2		elimination / engineering / organisational / PPE / training / health		
3		elimination / engineering / organisational / PPE / training / health		
4		elimination / engineering / organisational / PPE / training / health		
5		elimination / engineering / organisational / PPE / training / health		

3.6. Consultation and communication

→ Who should be consulted before measures are implemented or changed?
→ How will the information on the risk and controls be communicated?

3.7. Indicators, records and reporting

Response template. Indicators, records and reporting.

Element	Response
Main indicator	
Indicator target	
Record/evidence	

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Element	Response
Person responsible for the record	
Report to whom?	
Reporting frequency	daily / weekly / monthly / quarterly / after an occurrence / other

4. Technical justification

Write a brief justification of 300 to 500 words explaining the relationship between the context, the framework, responsibilities, the priority risk, measures, evidence and continual improvement.

Guidance:

The justification should address:

- → how the proposed framework enables risks to be managed in an organised manner;
- → how responsibilities, authority and communication have been allocated;
- → how workers and other interested parties are consulted or informed;
- → how the priority risk has been translated into concrete treatment measures;
- → which indicators and records make it possible to monitor the effectiveness of the measures;
- → how the proposal contributes to continual improvement.

Where applicable, the justification should relate the proposal to risk management principles, particularly integration, adaptation to context, participation, reliable information, human and cultural factors, and continual improvement.

Reference may also be made to ISO 31000 as guidance for structuring risk management and to ISO 45001 as a framework for demonstrating, in an auditable manner, that OSH risks are identified, assessed, controlled, monitored and improved.

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SAFETY TRAINING WITH
REAL IMMERSIVITY FOR MINING

CHAPTER 5

Safety Management: Investigation of Occupational Accidents

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Chapter 5 – Safety Management: Investigation of Occupational Accidents

Quick chapter map

Pedagogical table. Quick chapter map.

Section	Pedagogical function
1. Before you begin	Guide the trainee towards an investigation focused on learning and prevention.
2. Learning pathway	Structure the pathway from concepts through to reporting, lessons learned and return to work.
3. Fundamental concepts	Distinguish incident, occupational accident, near miss, hazard, risk and risk analysis.
4. Causation models	Interpret accidents as the result of interactions between human, technical and organisational factors.
5. Occurrence investigation	Apply the stages of notification, initial response, scene protection, data collection and interviews.
6. Investigation and analysis methods	Use the 5 Whys, Ishikawa and cause classification.
7. Recommendations, actions and monitoring	Define verifiable actions, responsibilities and evidence.
8. Communication, lessons learned and return to work	Turn conclusions into organisational learning and prevention of recurrence.

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5.1. Before you begin

5.1.1. Background

Occupational accident investigation is an essential tool for improving occupational safety and health conditions. Its purpose is not to look for someone to blame, but to understand what happened, why it happened and what measures must be implemented to prevent similar situations from recurring.

This chapter addresses the concepts of incident, accident and near miss, together with the main stages of an effective investigation. Particular attention is also given to human factors, immediate and underlying causes, the definition of corrective actions and communication of the results.

Accident investigation should be understood as an integral part of the OSH management system, contributing to prevention, continual improvement and compliance with applicable legal obligations.

? KEY QUESTION	How can accidents, incidents and near misses be investigated without seeking to assign blame, while identifying systemic causes and actions that prevent recurrence?

5.1.2. Learning objectives

1. Distinguish incidents, accidents and near misses and understand their relevance to OSH prevention.
2. Recognise the importance of human factors in accidents, relating personal, occupational and organisational factors to unsafe acts and unsafe conditions.
3. Identify the main stages of an accident investigation, from initial notification to communication of the results.
4. Analyse immediate, underlying and organisational causes, avoiding superficial conclusions focused solely on individual behaviour.
5. Propose effective recommendations and corrective actions that address the causes identified and prevent recurrence.
6. Understand the legal framework and international good practice applicable to the investigation and reporting of occupational accidents.

5.1.3. Competences to be developed

- Record an occurrence using objective and sufficient information.
- Preserve evidence and collect data through observation, interviews and documents.
- Apply simple methods, such as the 5 Whys and Ishikawa, without reducing the analysis to individual blame.
- Distinguish unsafe acts, unsafe conditions, active failures and latent failures.
- Prepare recommendations, an action plan, communication of lessons learned and monitoring arrangements.

5.1.4. Key concepts

Pedagogical table. Key concepts.

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Concept	Operational definition for this chapter
Incident	A work-related occurrence that reveals a failure, with or without harm.
Occupational accident	An occurrence that causes injury, damage, loss or other impact in the context of work activity.
Near miss	An occurrence that causes no actual harm but has the potential to cause injury, property damage or environmental impact.
Active failure	An action or condition close to the event and generally visible at the time of the occurrence.
Latent failure	An organisational, technical or management condition that remained in the system and contributed to the occurrence.
Immediate, underlying and organisational cause	Levels of explanation that help avoid superficial conclusions focused only on individual behaviour.
Corrective/preventive action	A measure defined to eliminate a cause, reduce risk and prevent recurrence.

5.2. Learning pathway

Pedagogical table. Learning pathway.

Stage	What the trainee does	Resources
LEARN	Reads the essential concepts in chapter 5 and identifies the technical terminology associated with occupational accident investigation.	Core chapter text, table of key concepts, summary tables and examples.
OBSERVE	Analyses examples, figures, tables, practical cases and organisational or operational situations associated with the topic.	Figures, tables, practical examples and a case study.
DECIDE	Classifies situations, identifies priorities, selects criteria and chooses technically justified answers.	Guiding questions, decision criteria, matrices and decision-making exercises.
APPLY	Produces a simple application tool: map, matrix, checklist, plan, record, indicator or improvement proposal.	Templates, worksheets and completed examples.
REFLECT	Records learning, limitations, evidence used and possible improvements to professional practice.	Reflection and final summary; where applicable, a digital portfolio or the platform's forum.

▣ GUIDANCE FOR INDEPENDENT USE

When the chapter is used outside the platform, the trainee should retain completed exercises, filled-in worksheets, reflection records, group outputs and evidence of application. These materials may be used as evidence of learning and as a basis for classroom discussion or continuous assessment.

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5.3. Incident, accident and near miss: relationship between the concepts

5.3.1. Incident

A work-related event that could have caused, or did cause, harm to people, equipment, facilities, the environment or continuity of operations. It includes occurrences both with and without injury.

5.3.2. Occupational accident

An occurrence taking place at the workplace and during working time that causes bodily injury, functional impairment, illness, reduced capacity for work or earning capacity, or death [17]. It is subject to a specific legal framework.

5.3.3. Near miss

An occurrence that caused no injury or damage but had the potential to do so. It should be analysed because it reveals weaknesses in the controls.

5.3.4. Hazard

A source with the potential to cause injury or ill health.

5.3.5. Risk

The combination of the likelihood of an occurrence and the severity of its consequences.

5.3.6. Risk analysis

An initial systematic approach to a safety problem. It helps identify factors within the Human-Machine-Environment system.

5.3.7. Distinction between concepts

The distinction between these concepts is important because not every incident is legally classified as an occupational accident, but all incidents can provide relevant information for the prevention of occupational risks.

Accidents and incidents can give rise to different types of consequences. These may affect the worker directly through injury, illness or incapacity, but may also affect the organisation through property damage, production stoppages, additional costs, loss of confidence or harm to its institutional image.

The investigation should therefore consider not only the immediate consequence, but also the event's potential severity. An incident without injury may reveal a serious weakness in the prevention system and justify analysis as thorough as that undertaken for an accident involving harm [18].

5.3.8. Why investigate all occurrences

The absence of harm does not mean the absence of risk. A preventive organisation does not wait for a serious injury before learning. The following should be investigated or, at minimum, analysed to a depth proportionate to the risk:

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- accidents involving injury;
- near misses;
- dangerous occurrences;
- property damage;
- operational failures;
- situations with a high potential severity.

Occurrence investigation helps identify weaknesses in safety barriers, planning, training, supervision, maintenance, communication and risk assessment. In this way, the organisation learns before more serious consequences arise.

5.3.9. The role of human factors in accidents

Human factors influence how people perceive risks, make decisions and perform tasks. In an accident investigation, human behaviour must be analysed in the context in which it occurred, taking account of working conditions, task organisation, training received, equipment available and existing pressures.

Attributing an accident solely to "human error" is normally insufficient. Error should be viewed as a starting point for the investigation, not as its final conclusion. The essential question is why that action occurred in that context. Human factors should therefore be analysed together with technical, organisational and environmental factors, avoiding simplistic conclusions focused only on the worker.

5.4. Causation models

Causation models help organise the explanation of an occurrence. Their development shows a move away from linear, individual explanations towards systemic, multifactorial and organisational explanations (Figure 24).

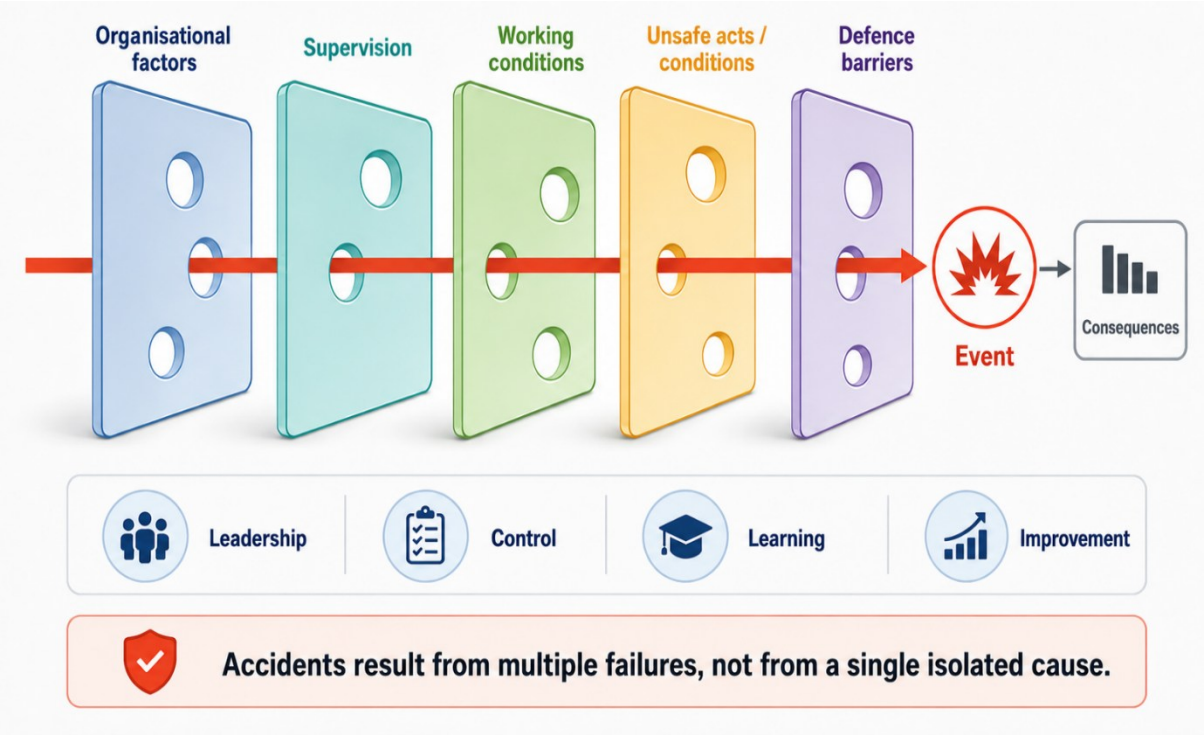

Figure 24. Causation model applied to the investigation of occupational accidents.

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5.4.1. Heinrich's sequential model: a critical reading

Heinrich's sequential model suggests that removing one element from the sequence could prevent the accident. Although it has historical and educational value, it should be used with caution.

- It may focus the explanation too heavily on individual behaviour.
- It may oversimplify complex accidents.
- It does not adequately explain organisational, design, maintenance or supervision factors.
- It should be interpreted in the light of current causation models.

5.4.2. Current models: interaction of factors

Current models understand accidents as the result of interaction between technical, human, organisational and environmental factors (Figure 25). The key principle is that accidents rarely have a single cause.

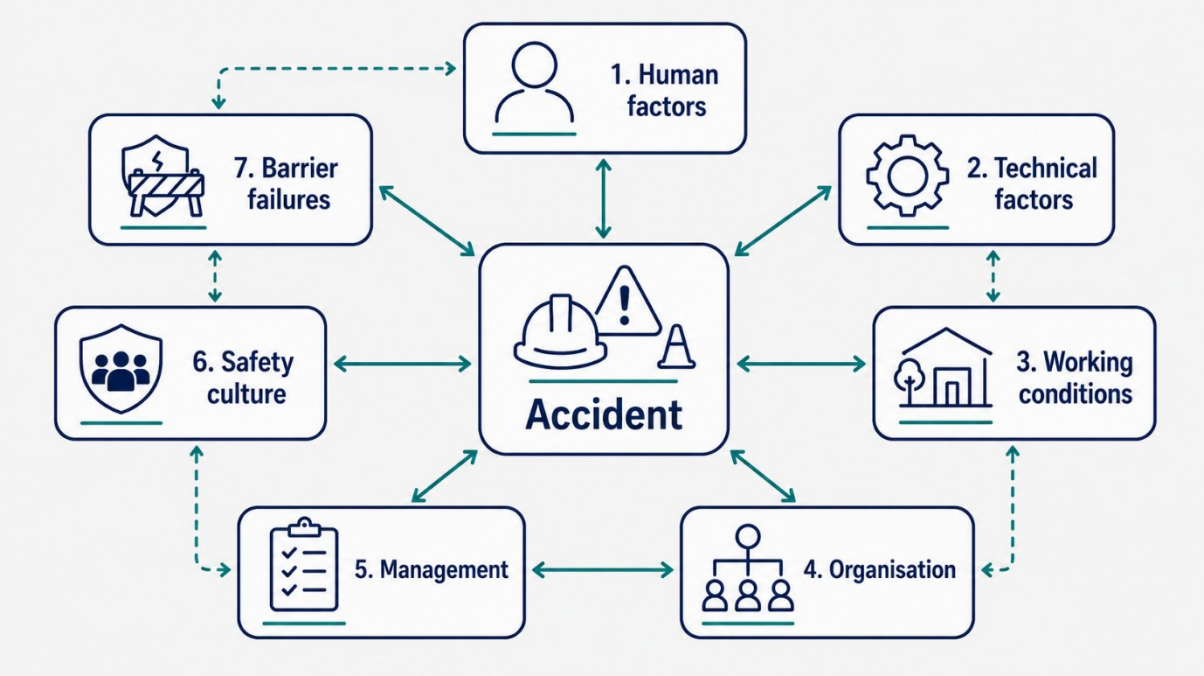

Figure 25. Current causation models: interaction of factors.

5.4.3. Active and latent failures

Current models distinguish active failures, which occur close to the time of the accident, from latent failures, which were present in the system before the occurrence. This distinction makes it possible to identify not only the visible error, but also the conditions that made it likely or acceptable in the real work context (Table 41).

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Table 41. Active and latent failures.

Type of failure	Characteristics	Examples
Active failures	Occur close to the time of the accident and are often visible	Technical failure; human error; lapses or slips; error due to lack of knowledge; deficient application of rules; violation of safety rules
Latent failures	Are present in the system before the accident and create the conditions for its occurrence	Workstation design; task organisation; maintenance; machine guarding; training or personnel selection; supervision and communication

5.4.4. Unsafe acts and unsafe conditions

Even when an unsafe act is identified, the investigation should ask what conditions made that action likely or acceptable in the real work context. Table 42 provides some examples.

Table 42. Examples of unsafe acts and conditions.

Unsafe acts	Unsafe conditions
Removing safety guards	Slippery floor
Not using PPE	Unguarded machine
Using tools incorrectly	Lack of signage
Ignoring a procedure	Poor lighting
Operating equipment without authorisation	Poorly maintained equipment

5.5. Occurrence investigation

The investigation should follow a structured process. The depth of each stage depends on the severity, complexity and potential for recurrence of the occurrence. Not all occurrences require the same level of detail, but all should be recorded, analysed and addressed appropriately in relation to the risk.

NOTE	**Accident investigation does not seek someone to blame;** it seeks to understand the system that allowed the occurrence and to define measures that prevent recurrence.

5.5.1. Stages of occupational accident investigation

The investigation follows a structured sequence from notification through to monitoring of the results. A structured process ensures an appropriate response, preservation of evidence, systematic collection of information and the production of verifiable actions. Table 43 describes the objectives and key considerations at each stage.

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Table 43. Stages of the accident investigation process.

Stage	What should happen	Points requiring attention
1. Notification	Activate internal procedures, begin the formal record and comply with legal obligations.	Fatal accidents in Portugal must be reported to the Authority for Working Conditions (ACT) within the following 24 hours.
2. Initial response	Protect people, provide assistance and control additional hazards.	Saving lives takes priority over preserving evidence.
3. Scene protection	Preserve relevant conditions and evidence.	Equipment, tools, guards, signage, floor, lighting, substances, photographs, videos and measurements.
4. Data collection	Characterise the occurrence, task and context.	Date, time, location, task, materials, environment, work organisation, training and history.
5. Interviews	Collect perceptions and facts from several sources.	Use open questions, avoid value judgements and confirm facts through several sources.
6. Timeline	Construct a sequence covering before, during and after the occurrence.	Separate facts, interpretations and assumptions.
7. Causal analysis	Integrate evidence and identify barrier failures.	Analyse immediate, underlying and organisational causes.
8. Recommendations	Define measures linked to the causes identified.	Avoid vague recommendations such as “take more care”.
9. Action plan	Assign responsibilities, deadlines, resources and effectiveness criteria.	The plan must enable follow-up and verification.
10. Monitoring	Verify implementation and effectiveness of the measures.	Confirm that the risk has been reduced and no new risks have been created.
11. Results	Document conclusions, actions and learning.	Communicate lessons learned and review procedures, training and risk assessment.

5.5.2. Data collection and interviews

Data collection should combine physical evidence, documentation, procedures, risk assessments, maintenance and training records, actual working conditions and interviews. The investigation is more robust when facts are confirmed through different sources.

- Physical evidence: position of equipment, tools, guards, signage, lighting, substances, photographs and measurements.
- Documents: procedures, risk assessments, maintenance, training and inspection records, and the history of similar occurrences.
- People to interview: injured worker, witnesses, colleagues, line managers and supervisors, OSH professional, maintenance personnel, occupational physician and worker representatives.

Interviews should be conducted in a calm environment, preferably individually, with the aim of understanding the facts rather than assigning blame. The interviewer should use open questions, avoid interruptions, record answers faithfully and distinguish observed facts from opinions and interpretations. Whenever possible, the information collected should be corroborated using documents, records, photographs, measurements or other testimony.

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✓ GOOD PRACTICE	Avoid value judgements, use open questions, interview promptly and confirm facts through several sources.

5.5.3. Quick investigation checklist

Table 44 lists the most important points to consider when investigating an accident.

Table 44. Quick investigation checklist.

Check	Notes
☐ People protected and immediate hazards controlled	
☐ Scene preserved where possible	
☐ Physical evidence recorded	
☐ Witnesses identified and interviewed promptly	
☐ Documents, procedures and records collected	
☐ Factual timeline constructed	
☐ Causes analysed at several levels	
☐ Actions linked to specific causes	
☐ Responsibilities, deadlines and effectiveness criteria defined	

5.5.4. Applicable legislation

5.5.4.1. Incidents covered by law

Legally recognised occupational accidents are those that meet the criteria set out in the applicable legislation, particularly in relation to workplace, working time, connection with the professional activity and the existence of injury, illness, incapacity or death. In Portugal, Law No. 98/2009 establishes the compensation regime for occupational accidents and occupational diseases [17].

When a serious or fatal accident occurs, reporting obligations to the competent authorities must be fulfilled and internal investigation, recording and follow-up mechanisms must be activated.

5.5.4.2. Incidents not covered by law

Not all incidents qualify as occupational accidents for legal or compensation purposes. Nevertheless, incidents without injury, near misses, property damage and operational failures should be treated as prevention opportunities.

The absence of harm does not mean the absence of risk. Many situations without serious consequences result only from favourable circumstances or random factors. Their analysis therefore helps anticipate and prevent future accidents.

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5.5.4.3. Benefits for injured workers

Compensation for occupational accidents may include benefits in kind and cash benefits, such as medical, surgical, pharmaceutical and hospital care, rehabilitation, compensation payments, pensions or other support provided for in the applicable legislation. In Portugal, Law No. 98/2009 also covers vocational rehabilitation and reintegration [17].

5.5.5. International good practice

International good practice recommends that accident investigation go beyond describing the event. It should seek to identify immediate causes, underlying causes and management-system failures, and propose suitable preventive measures (Table 45). The International Labour Organization emphasises that an effective investigation should establish what happened, identify causes and define measures to prevent recurrence.

Table 45. Distinction between immediate, underlying and organisational causes.

Type of cause	Guiding question	Example
Immediate cause	What happened at the time?	Wet floor; absence of signage
Underlying cause	Why was this possible?	Failure to report; incomplete procedure
Organisational cause	What weakness in the system allowed the situation?	Incomplete risk assessment; insufficient supervision

5.6. Investigation and analysis methods

The choice of method depends on the severity of the accident, the complexity of the occurrence, the number of factors involved, the availability of data, the purpose of the analysis and the resources available. A practical rule is to use simple methods for simple events and structured methods for complex or serious events. However, no method should replace evidence collection. The method organises the analysis; it does not “create” causes without facts. Table 46 outlines the most common methods used in accident investigation and analysis.

Table 46. Accident investigation and analysis methods.

Method	Main use	Advantages	Limitations / precautions	When to use
5 Whys	Explore successive causes starting from an occurrence	Simple, quick and useful for less complex events.	May remain superficial if answers are not based on evidence	Simple events or initial analysis
5W2H	Structure information and action plans: what, why, where, when, who, how and how much	Helps organise facts and responsibilities	Does not replace causal analysis where several causes are involved	Structuring facts and an action plan
Ishikawa	Explore potential causes by category	Useful for multiple causes: method, people, machine, material, environment, measurement and organisation	Hypotheses must be validated using data	Multiple potential causes

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Method	Main use	Advantages	Limitations / precautions	When to use
Cause tree	Reconstruct the sequence of facts and deviations from normal operation	Avoids explanations focused on one cause and integrates human, technical and organisational factors	More demanding in terms of time, information and analytical competence	Serious or complex accidents, or events involving several failed barriers

5.6.1. Example application of the 5 Whys

1. **Why did the person fall?** The floor was wet.
2. **Why was the floor wet?** There was an unmarked water leak.
3. **Why was the leak not marked?** There was no clear reporting procedure.
4. **Why was there no procedure?** The situation had not been considered in the risk assessment.
5. **Why had it not been considered?** The risk assessment had not taken account of repeated occurrences in that area.

5.6.2. Typical Ishikawa categories

1. **Method**: procedures, instructions and rules.
2. **People**: training, experience, fatigue and motivation.
3. **Machine**: maintenance, guarding and technical condition.
4. **Material**: substances, tools and suppliers.
5. **Environment**: noise, lighting, temperature and space.
6. **Measurement**: inspections, instruments and control criteria.
7. **Organisation**: supervision, communication and planning.

5.7. Recommendations, actions and monitoring

5.7.1. Recommendations

Recommendations should be fact-based, linked to the causes identified, clear and specific, proportionate to the risk, feasible and verifiable. They should avoid vague wording such as “be more careful”, “pay more attention” or “comply with the rules”.

5.7.2. Corrective and preventive actions

Actions may be intended either to prevent an incident from recurring or to prevent a potential incident from occurring in the future. Table 47 describes both types of action.

Table 47. Preventive and corrective actions.

Type of action	Purpose	Example wording
Corrective action	Eliminates the cause of a nonconformity or incident that has already occurred. **Objective: prevent recurrence.**	Correct the source of the water leak, install temporary signage and revise the reporting procedure.

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Type of action	Purpose	Example wording
Preventive action	Eliminates the cause of a potential nonconformity or incident. **Objective: prevent a future occurrence.**	Review risk assessments for areas with a history of near misses and install physical barriers where necessary.

Measures should prioritise elimination of the hazard, substitution and engineering controls. PPE should be treated as the final barrier, not as the main solution where more effective alternatives are available.

5.7.3. Action plan

An action plan should include the elements described in Table 48.

Table 48. Minimum elements of an action plan.

Element	Description
Defined action	Clear description of the measure to be implemented and the associated cause
Responsible person	Person or function responsible for ensuring implementation
Deadline	Final date for implementation and verification
Resources	Human, technical, financial or training resources required
Priority	Urgency classification based on the risk
Completion indicator	Objective evidence that the action has been implemented
Effectiveness criterion	Criterion confirming whether the measure eliminated or reduced the cause
Verification date	Defined time for assessing implementation and effectiveness

The action plan should not merely list measures. For each action, it should be clear which cause it is intended to address, who is responsible for implementation, the deadline, the resources required, the evidence demonstrating completion and how effectiveness will be verified. An action should only be considered complete once it has been implemented and there is evidence that it has helped reduce the risk.

5.7.4. Monitoring

Monitoring confirms whether the action was implemented on time, whether it reduced the risk or eliminated the cause, whether it created any new risks, whether workers understood it and whether the risk assessment needs to be revised. Table 49 lists the key points to monitor after the measures have been implemented.

Table 49. Monitoring questions.

Check	Notes
☐ Was the action implemented on time?	
☐ Did it reduce the risk or eliminate the cause?	
☐ Did it avoid creating new risks?	

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Check	Notes
☐ Was it understood by workers?	
☐ Does the risk assessment need to be revised?	
☐ Did the measure solve the problem or only the symptom?	

5.7.5. Integration of investigation findings into risk management

Accident investigations should generate organisational learning. The final report should therefore not be limited to describing the event or identifying unsafe behaviour. It should explain the immediate, underlying and organisational causes, identify barriers that failed or were absent, propose verifiable actions, and ensure that the findings are incorporated into risk assessment, procedures, training and monitoring of the OSH management system.

Whenever an investigation reveals unidentified hazards, ineffective controls, outdated procedures, training failures or deficiencies in supervision, the risk assessment must be reviewed. This review should be documented and should lead to measures proportionate to the level of risk identified.

5.8. Communication, lessons learned and return to work

5.8.1. Final report and results

The final report should include identification of the occurrence and a factual description, consequences, evidence collected, the analysis method used, immediate, underlying and organisational causes, defined actions, responsible persons, deadlines and the follow-up plan.

5.8.2. Communication and learning

An investigation only creates value when it generates learning. Communication may include a team meeting, a safety alert, updated procedures, review of the risk assessment, specific training, sharing of lessons learned and communication with external bodies where applicable.

Lessons learned should be communicated clearly and objectively to the relevant teams, without undue exposure of the worker involved. Communication should focus on the facts, identified causes, failed barriers and measures implemented. Where applicable, these lessons should be used to review procedures, update risk assessments, adjust training content and improve OSH performance indicators.

5.8.3. Reporting and classification system

All unforeseen situations should be recorded and classified. The system should provide for reporting, classification, investigation, cause analysis, an action plan, communication and follow-up.

- personal injury accident;
- property-damage accident;
- near miss;
- environmental occurrence;
- nonconformity;

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- hazardous situation.

5.8.4. Return to work and rehabilitation

Compensation for occupational accidents includes rehabilitation and vocational reintegration, as indicated in the chapter with reference to Portuguese Law No. 98/2009 [17]. Return to work should consider physical and psychological follow-up, temporary adaptation of duties, fitness assessment, communication with occupational health services, progressive reintegration and monitoring of the return-to-work process.

5.9. Guided practical case

Situation: a worker suffers a same-level fall in an area with a wet floor during a maintenance operation.

Available information: slippery surface and no signage; poor lighting; task carried out at the end of the shift; worker with limited experience of the task; history of near misses in the work area.

1. What evidence should be collected immediately?
2. Who should be interviewed?
3. What are the immediate, underlying and organisational causes?
4. Which analysis method would be most appropriate?
5. What corrective and preventive actions should be proposed?
6. How should the effectiveness of the actions be verified?

5.9.1. Evidence to be collected

- photographs of the location, floor, lighting and signage;
- cleaning and maintenance records;
- task risk assessment;
- maintenance procedures;
- training records;
- near-miss history.

5.9.2. Persons to be interviewed

- worker involved;
- colleagues present;
- immediate supervisor;
- maintenance team;
- person responsible for cleaning or signage;
- OSH professional.

5.9.3. Possible causes and failures identified

The analysis identifies immediate causes and factors that must be addressed to prevent recurrence (Table 50).

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Table 50. Practical case: possible causes and elements identified.

Level of cause	Possible factors
Immediate causes	Wet/slippery floor; absence of signage; insufficient lighting
Underlying causes	Failure to report the hazardous condition; incomplete maintenance procedure; insufficient training; limited supervision at the end of the shift
Latent failures	Incomplete risk assessment; insufficient learning from near misses; absence of barriers or area control

5.9.4. Appropriate methods and actions

For this case, the 5 Whys method can help reach deeper causes. An Ishikawa diagram may be useful to organise causes into categories such as method, people, machine/material, environment, measurement and organisation. The resulting measures are summarised in Table 51.

Table 51. Practical case: possible resulting measures.

Corrective/preventive action	Purpose
Correct the source of the wet floor and strengthen cleaning	Eliminate or reduce the unsafe condition
Install temporary and permanent signage	Control the risk until permanent resolution and prevent inadvertent exposure
Improve lighting and review the risk assessment	Address gaps in site control and preventive analysis
Train workers and supervisors	Ensure hazard recognition, reporting and appropriate action
Create a procedure for reporting hazardous conditions	Ensure rapid and traceable communication
Track near misses as warning signals	Transform no-harm events into preventive learning

5.10. Record templates to support investigation

5.10.1. Simplified occurrence record template

Record template. Accident investigation: Incident report.

Field	Completion
Occurrence identification	
Date and time	
Location	
Type of occurrence	
Severity potential	
Task in progress	

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Field	Completion
Persons involved	
Consequences	
Immediate measures taken	
Evidence collected	
Factual description	
Witnesses	
Person responsible for the record	

5.10.2. Simplified action-plan template

Record template. Accident investigation: Simplified action-plan.

Cause	Type of action (corrective/ preventive)	Action	Responsible person	Deadline	Priority	Indicator	Verification

5.10.3. Brief interview guide

- Explain the purpose of the interview: to understand the facts and prevent recurrence, not to find someone to blame.
- Begin with open questions: “Can you describe what happened?”
- Ask for a timeline: “What happened before? And afterwards?”
- Confirm the conditions of the location, task, equipment, signage, lighting, communication and supervision.
- Avoid accusatory or leading questions.
- Cross-check the information against other sources and evidence.

5.11. Final summary

The investigation of accidents, incidents and near misses is an essential tool for prevention and continual improvement. An effective investigation does not seek to assign blame; it seeks to understand the facts, identify immediate, underlying and organisational causes, analyse failed or absent barriers, and define actions proportionate to the risk.

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The value of an investigation depends on its ability to generate change. Findings should therefore be transformed into verifiable actions and incorporated into risk assessment, procedures, training, internal communication and monitoring of the OSH management system. Good investigation means learning from real work in order to prevent further occurrences.

NOTE	An investigation is only effective when it transforms facts into causes, causes into actions, actions into evidence, and evidence into learning.

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Case studies and assessment activities

A. Self-assessment questions

1. What is the main purpose of investigating occupational accidents?

2. Why should accident investigation not seek to assign blame?

3. What is the difference between an incident, an occupational accident and a near miss?

4. Why is it important also to investigate near misses and occurrences without injury?

5. What does it mean to state that "human error" should be a starting point rather than a final conclusion?

6. What is the difference between active failures and latent failures?

7. Give two examples of unsafe acts and two examples of unsafe conditions.

8. What are the main stages of an occupational accident investigation?

9. What types of evidence should be collected during an investigation?

10. Why must corrective action be linked to the identified cause?

B. Multiple-choice questions

1. The main purpose of investigating occupational accidents is to:

A. Identify the worker responsible for the accident.
B. Complete only a documentary formality.
C. Understand what happened, why it happened and what measures are required to prevent recurrence.
D. Replace risk assessment.
E. Avoid internal communication of the results.

2. A near miss is:

A. An occurrence that caused a fatality.
B. An occurrence without injury or damage, but with the potential to cause consequences.
C. An accident that does not need to be recorded.
D. An occurrence of no preventive interest.
E. Property damage unrelated to work.

3. An occupational accident is characterised by:

A. Any hazardous situation without injury.
B. An occurrence unrelated to occupational activity.
C. An occurrence at the place and time of work that results in injury, illness, incapacity or death.
D. An administrative breach without consequence.
E. A communication failure without impact.

4. The absence of harm in an occurrence means that:

A. No risk exists.
B. The occurrence need not be analysed.

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C. A weakness in the prevention system may exist and should be studied.
D. The situation should be ignored.
E. The worker should automatically be held responsible.

5. In accident investigation, "human error" should be understood as:

A. The final cause of the investigation.
B. A sufficient explanation for closing the process.
C. A starting point for understanding the context in which the action occurred.
D. A reason to avoid analysing working conditions.
E. An irrelevant factor.

6. Active failures are:

A. Failures that have remained hidden in the system for a long time.
B. Failures close to the time of the accident and often visible.
C. Exclusively legal failures.
D. Failures unrelated to human behaviour.
E. Failures that occur only at top-management level.

7. An example of a latent failure is:

A. A worker slipping on a wet floor.
B. A lapse during the task.
C. An incomplete risk assessment or insufficient supervision.
D. A tool falling at the time of the accident.
E. A fall immediately after tripping.

8. Which option is a stage in accident investigation?

A. Notification, initial response, data collection, causal analysis and action plan.
B. Only completing and filing a form.
C. Informal communication and closure.
D. Assigning blame and applying a sanction.
E. Interviewing only the injured worker.

9. The 5 Whys method is useful for:

A. Avoiding evidence collection.
B. Progressively exploring the causes of an occurrence.
C. Replacing all investigation stages.
D. Automatically determining legal responsibility.
E. Classifying only fatal accidents.

10. An effective recommendation should be:

A. Vague, such as "take more care".
B. Fact-based, linked to causes, specific, practicable and verifiable.
C. Identical for every accident.
D. Defined without a deadline or responsible person.
E. Focused only on PPE.

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C CORRECT ANSWERS	1. C; 2. B; 3. C; 4. C; 5. C; 6. B; 7. C; 8. A; 9. B; 10. B.

C. Practical cases

Case 1 – Occurrence in a wet area

During a maintenance operation, a worker slipped in an area with a wet floor and suffered a sprain, resulting in one month of temporary absence from work. There was no temporary signage at the location. Lighting was poor and the task was carried out at the end of the shift. Near misses had previously been reported in that area, but the risk assessment had not been changed.

A ACTIVITY	1. Classify the occurrence: accident, incident or near miss. 2. What evidence should be collected? 3. Identify immediate causes. 4. Identify underlying or organisational causes. 5. Propose three corrective/preventive actions.

Case 2 – Forklift occurrence

In a warehouse, a forklift passed very close to a pedestrian worker. There was no contact or injury, but the worker had to move quickly to avoid being struck. The area had no separate routes for pedestrians and mobile equipment.

A ACTIVITY	1. How should the occurrence be classified? 2. Why should it be investigated? 3. Identify one active failure and one latent failure. 4. Who should be interviewed? 5. Propose preventive measures.

Case 3 – Machine occurrence

A worker suffered a cut to the hand while removing jammed material from a machine. The machine guard had been removed several days earlier to make cleaning easier. Maintenance personnel knew about the situation, but production continued because of pressure to meet deadlines.

A ACTIVITY	1. Identify the unsafe act. 2. Identify the unsafe conditions. 3. Identify immediate, underlying and organisational causes. 4. Which analysis method could be used? 5. Propose a simple action plan.

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Case 4 – Applying the 5 Whys

A worker fell after tripping over a hose left in a walkway. The hose was frequently used for cleaning, but there was no designated storage location. The walkway was also used by people and for material transport.

A ACTIVITY

Apply the 5 Whys method and propose two corrective and two preventive actions.

Case 5 – Final report and communication of lessons learned

Following an accident involving projected particles during a cutting operation, the company concluded that the worker had not worn eye protection. However, the investigation also found that the available safety glasses were uncomfortable, scratched, and that use of personal protective equipment (PPE) was not regularly supervised. The task procedure was outdated.

A ACTIVITY

1. Why would it be insufficient to conclude that the sole cause was “failure to use PPE”?
2. What underlying causes may exist?
3. What information should be included in the final report?
4. What actions should be proposed?
5. How should lessons learned be communicated?

Suggested answers

Case 1 – Occurrence in a wet area

PROPOSED ANSWER

1. This is an occupational accident because it occurred in the work context and caused injury to the worker.

2. Evidence to be collected:

- photographs of the floor, lighting and existing or absent signage;
- cleaning and maintenance records;
- task risk assessment;
- maintenance procedure;
- training records;
- near-miss history;
- statements from the worker, colleagues and supervisor.

3. Immediate causes:

- wet/slippery floor;
- absence of signage;
- insufficient lighting.

4. Underlying or organisational causes:

- failure to report or address hazardous conditions;
- incomplete procedure for work in wet areas;

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PROPOSED ANSWER

- outdated risk assessment;
- failure to learn from previous near misses;
- insufficient supervision at the end of the shift.

5. Corrective/preventive actions:

- correct the source of the wet floor and strengthen cleaning;
- install temporary and permanent signage;
- improve lighting;
- review the risk assessment;
- create a hazardous-condition reporting procedure;
- provide specific training on safe movement and reporting.

Case 2 – Forklift occurrence

PROPOSED ANSWER

1. The occurrence should be classified as a near miss because it caused no injury but had the potential to cause a serious accident.

2. It should be investigated because it revealed a weakness in internal traffic controls. Absence of injury does not mean absence of risk.

3. Active failure: the forklift passed too close to the worker.

Latent failures may include absence of physical separation between pedestrian and equipment routes, lack of signage, incomplete risk assessment and insufficient supervision.

4. Persons to interview:

- forklift operator;
- worker involved;
- witnesses;
- immediate supervisor;
- OSH professional;
- warehouse/logistics manager.

5. Preventive measures:

- physically separate pedestrian and forklift routes;
- implement horizontal and vertical signage;
- define priority and traffic rules;
- strengthen training for operators and workers;
- conduct behavioural observations and periodic inspections;
- review the internal-traffic risk assessment.

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Case 3 – Machine occurrence

PROPOSED ANSWER

1. Unsafe act: intervening in the machine to remove jammed material without safe conditions; operating with the guard removed.

2. Unsafe conditions:

- machine without a guard;
- absence of lockout/isolation;
- lack of a safe unjamming procedure;
- production pressure.

3. Immediate causes:

- hand contact with the hazardous area of the machine;
- guard removed.

Underlying causes:

- inadequate cleaning/unjamming procedure;
- maintenance failure;
- insufficient supervision;
- normalisation of unsafe practice.

Organisational causes:

- production prioritised over safety;
- lack of operational control;
- failure in management of change;
- absence of effective stop-work authority.

4. Possible methods:

- 5 Whys, to investigate the root causes in more depth;
- Ishikawa diagram, to organise causes by method, manpower, machinery, materials, environment, measurement and organisation;
- Cause tree, if the accident is serious or complex.

5. Simple action plan:

Response template. Case 3 – Machine occurrence: Simple action plan.

Cause	Action	Responsible person	Deadline	Evidence
Machine without guard	Reinstall the guard and prevent operation without it	Maintenance	Immediate	Intervention record
No procedure	Create a safe unjamming procedure	OSH / Production manager	10 days	Approved procedure
Lack of training	Train workers and supervisors	OSH manager	15 days	Training records
Production pressure	Define a stop-work rule for unsafe conditions	Management / line managers	15 days	Internal communication

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Cause	Action	Responsible person	Deadline	Evidence
Supervision failure	Implement periodic inspections	Production supervisor	Monthly	Checklists

Case 4 – Applying the 5 Whys

PROPOSED ANSWER

1st Why: Why did the worker fall? Because the worker tripped over a hose in the walkway.

2nd Why: Why was there a hose in the walkway? Because it was used for cleaning and left there after the task.

3rd Why: Why was it left there? Because no immediate storage location had been defined.

4th Why: Why was there no defined location? Because the cleaning procedure did not provide for storage and a final area check.

5th Why: Why did the procedure not provide for this? Because the activity risk assessment did not consider interference between cleaning, pedestrian movement and material transport.

Corrective actions:

- remove the hose immediately and define a storage location;
- update the cleaning procedure to include a final area check.

Preventive actions:

- review the risk assessment for the traffic area;
- create periodic inspections for obstructions in walkways and passage areas.

Case 5 – Final report and communication of lessons learned

PROPOSED ANSWER

1. It would be insufficient because “failure to use PPE” only describes visible behaviour. The investigation must determine why the PPE was not used: whether it was unsuitable, uncomfortable, poorly maintained, inadequately supervised, or whether the procedure was unclear.

2. Possible underlying causes:

- uncomfortable or damaged PPE;
- lack of inspection and replacement of safety glasses;
- outdated procedure;
- insufficient supervision;
- incomplete training;
- failure to consult workers on PPE suitability.

3. The final report should include:

- identification of the occurrence;
- factual description of events;

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PROPOSED ANSWER

- consequences;
- evidence collected;
- persons interviewed;
- analysis method used;
- immediate, underlying and organisational causes;
- defined actions;
- responsible persons;
- deadlines;
- effectiveness criteria;
- follow-up plan.

4. Proposed actions:

- replace scratched glasses with suitable eye protection;
- consult workers on PPE comfort and suitability;
- update the task procedure;
- provide practical training on projection hazards;
- implement periodic inspections of PPE use and condition;
- assess engineering controls such as barriers against projected particles.

5. Communication of lessons learned:

- brief team meeting;
- safety alert;
- updated procedure;
- specific training;
- communication of causes and measures without identifying individuals to blame;
- review of the risk assessment;
- follow-up of action effectiveness in the field.

D. Case study

CASE STUDY – PEDREIRA ROCHA VIVA, LTD.

Purpose of the assignment: Analyse a simple case study and apply the essential concepts of occupational accident investigation: classification of the occurrence, information collection, identification of causes, and definition of corrective/preventive actions.

1. Context

Pedreira Rocha Viva, Ltd. extracts, crushes and dispatches aggregates for the construction industry.

The company has occupational safety and health (OSH) procedures, risk assessments and training records, but experiences difficulties in communicating near misses and updating procedures after operational changes.

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For this assignment, the trainee should assume the role of an OSH professional responsible for supporting the internal investigation of an accident.

2. Situation presented

On 12 March at 10:20, an accident occurred in the crushing area. A worker climbed an access platform to check an operational fault in the installation. While moving on the metal stairway, the worker slipped on a step containing dust and small fragments of material, lost balance and fell, sustaining a fractured wrist, as shown in Figure 26.

Figure 26. Scene of the accident on the stairway and access platform leading to the crushing area.

After the accident, it was found that loose material had accumulated on the steps, the handrail showed signs of wear, and there was no recent inspection record for the stairway/platform. The team was under pressure to restart production, and the sole of the worker's safety footwear was worn.

The risk assessment referred generally to the risk of falling but did not define specific measures for cleaning, inspection and maintenance of access routes. There were also informal reports of previous slips in that area, without formal investigation.

3. Work to be developed

Answer the following questions, using the tables as response templates.

3.1. Initial classification of the occurrence

→ Classify the occurrence as an incident, occupational accident or near miss.
→ State whether an internal investigation should be carried out.
→ State what communication should be made and justify it on the basis of the facts presented.
→ Identify two facts from the case that support your answer.

Response template. Initial classification of the occurrence.

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Question	Trainee response
Classification of the occurrence	Example: Occupational accident. The occurrence happened during a maintenance task carried out in the context of occupational activity and caused physical injury requiring medical assistance and absence from work for more than three days.
Internal investigation: yes/no and why	
Communication: what to communicate, to whom and why	
Two facts from the case supporting the response	

3.2 Information to be collected

Identify four items of evidence/data to collect and two persons/functions to interview. Wherever possible, include elements relating to the location, the equipment/stairway, work organisation and the worker.

Response template. Information to be collected.

Evidence/data to collect	Why is it relevant?
Example: work instructions, maintenance procedure and risk assessment applicable to the task.	These make it possible to determine whether the task was planned, whether control measures existed and whether the relevant risk was adequately addressed.
Person/function to interview	**Purpose of the interview**

3.3. Identification of causes

Identify causes at three levels. Avoid answers focused only on the worker's behaviour.

Response template. Identification of causes.

Type of cause	Causes identified	Facts from the case supporting the analysis
Immediate causes		
Underlying causes		
Organisational failures / failed barriers		

3.4. Simple application of the 5 Whys

Select a relevant causal chain and apply the Five Whys method. Begin with the main event: "Why did the worker fall?"

Response template. Simple application of the 5 Whys.

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Question	Answer
1st Why?	
2nd Why?	
3rd Why?	
4th Why?	
5th Why?	

3.5. Corrective/preventive action plan

Propose three actions linked to the causes identified.

Response template. Corrective/preventive action plan

Proposed action	Associated cause	Responsible person	Deadline	How will effectiveness be verified?
Example: create a work instruction for the task, including safe positioning, housekeeping, inspection and the sequence of work.	Absence of a specific procedure and generic risk assessment.	Maintenance manager + OSH professional	30 days	Verify approval of the procedure, observe a task performed according to the instruction, and interview workers.

3.6. Communication and conclusion

→ State two messages or lessons learned that should be communicated internally.
→ Identify one procedure/document that should be reviewed following the investigation.
→ Write a short conclusion of 6–8 lines explaining how the investigation can prevent recurrence of the accident.

Response template. Communication and conclusion.

Question	Trainee response
Two lessons learned	
Procedure/document to be reviewed	
Conclusion	

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STRIM

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CHAPTER 6

Safety Management: Education, Training and Continuous Monitoring

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Chapter 6 – Safety Management: Education, Training and Continuous Monitoring

Quick chapter map

Pedagogical table. Quick chapter map.

Section	Pedagogical function
1. Before you begin	Question training as bureaucracy and introduce it as competence development.
2. Learning pathway	Guide learning from requirements through to workplace application.
3. Role of education and training	Connect policies, procedures, risks and standards with actual safe working practices.
4. Training and competence acquisition	Understand competence as a continual cycle linked to risk and the task.
5. Competences under development	Value experience, practical knowledge and what is already being done well.
6. Learning safety in real work	Distinguish prescribed work from real work, and formal, non-formal, informal and incidental learning.
7. Workplace training and participation	Plan micro-training, toolbox talks, feedback and learning from incidents.
8. Practical application tools	Use a training matrix, a toolbox-talk guide and learning indicators.

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6.1. Before you begin

6.1.1. Background

Education and training play an essential role in integrated and occupational safety and health management systems, as they help transform policies, procedures, risk assessments and normative requirements into actual safe working practices.

In this chapter, training is understood not merely as a formal or documentary obligation, but as a competence-development process. The starting point is that workers are not simply recipients of information: they possess experience, practical know-how and knowledge of real work, all of which should be valued and integrated into learning and prevention processes.

? KEY QUESTION	How can OSH training be transformed from a documentary requirement into a living process for developing competence in real work?

6.1.2. Learning objectives

1. Understand the role of education and training in integrated OSH management systems.
2. Recognise workers' experience as a source of knowledge about real work.
3. Plan simple forms of workplace training suited to the task, the risk and workers' experience.
4. Use daily safety dialogues and toolbox talks as tools for training, communication and participation.
5. Analyse incidents, near misses and errors as learning opportunities, avoiding responses centred solely on individual blame.

6.1.3. Competences to be developed

- Relate training needs to risks, tasks, changes and incidents.
- Plan workplace micro-training with objectives, methods, resources and evidence.
- Value workers' practical knowledge and transform it into collective learning.
- Conduct participatory toolbox talks focused on critical controls.
- Evaluate training effectiveness beyond attendance sheets.

6.1.4. Key concepts

Pedagogical table. Key concepts.

Concept	Operational definition for this chapter
Training	A learning process that takes place throughout a person's life in the various contexts in which they find themselves.
Competence	A body of knowledge and skills that an individual is able to apply in a practical context, particularly when carrying out tasks to achieve the desired results.
Awareness	Understanding the significance of risks, requirements, responsibilities and the consequences of actions, and acting accordingly.
Prescribed work	The way in which the task is envisaged in procedures, rules and instructions.

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Concept	Operational definition for this chapter
Real work	The way in which the task is actually performed under concrete conditions, pressures and unforeseen circumstances.
Toolbox talk	A brief safety dialogue before or during a task, focused on risks, controls and participation.
Training evidence	Evidence of learning or competence, such as workplace observation, practical validation, contributions or an applied improvement.

6.2. Learning pathway

Pedagogical table. Learning pathway.

Stage	What the trainee does	Resources
LEARN	Reads the essential concepts in chapter 6 and identifies technical terminology relating to education and training.	Core chapter text, table of key concepts, summary tables and examples.
OBSERVE	Analyses examples, figures, tables, practical cases and organisational or operational situations relating to the topic.	Figures, tables, practical examples and a case study.
DECIDE	Classifies situations, identifies priorities, chooses criteria and selects technically justified responses.	Guiding questions, decision criteria, matrices and decision-making exercises.
APPLY	Produces a simple application tool: map, matrix, checklist, plan, record, indicator or improvement proposal.	Templates, worksheets and completed examples.
REFLECT	Records learning, limitations, evidence used and possible improvements for professional practice.	Reflection and final summary; where applicable, a digital portfolio or the platform's forum.

▣ GUIDANCE FOR INDEPENDENT USE

When the chapter is used outside the platform, the trainee should retain completed exercises, filled-in worksheets, reflection records, group outputs and evidence of application. These materials may be used as evidence of learning and as a basis for classroom discussion or continuous assessment.

6.3. The role of education and training

The first chapters established the logic of an integrated system: processes, risks, leadership, organisational culture, the environment and continual improvement. Chapters 4 and 5 examined risk management and accident investigation in greater depth. Chapter 6 acts as a bridge between these topics and system documentation, showing how learning and competence enable the formal system to be transformed into safe practice in real work.

6.3.1. From the formal system to learning in real work

Standards help define what must be in place: competence, training, awareness, participation, operational control and documented evidence. However, effective application of these requirements depends on how people learn, interpret risks, apply controls and adapt procedures to the concrete conditions of the activity.

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Table 52 describes the relationship between the main occupational safety and health management-system standards and education and training.

Table 52. Standards relating to occupational safety and health and their relationship with education and training.

Standard	Relationship with education/training	Contribution
ISO 31000 / NP ISO 31000 (Risk management – Guidelines) [7]	Indirect but relevant	Values competence, experience, consultation, learning and awareness in risk management.
ISO/IEC 31010:2019 (Risk management – Risk assessment techniques) [19]	Functional	Some risk-assessment techniques require training, experience or specialist facilitators.
ISO 45001:2018 (Occupational health and safety management systems – Requirements with guidance for use) [4]	Very strong	Integrates competence, training, awareness, worker participation, emergency preparedness, contractors and documented evidence.

6.3.2. ISO 45001 as the central reference

ISO 45001 is particularly relevant when considering OSH training because it links competence to risk control, worker participation, awareness, emergency preparedness, contractor management and documentation [4]. Training does not appear in isolation: it is part of a system that must demonstrate that people have the conditions, knowledge and abilities needed to work safely.

In practice, ISO 45001 requires the organisation to determine the competences needed for roles that affect OSH performance, ensure training or other actions to develop those competences, evaluate the effectiveness of those actions and retain appropriate documented information.

To avoid frequent confusion, it is important to distinguish training, competence and awareness. These three concepts are related but do not mean the same thing: training is one way of developing competence; competence must be demonstrated in real work; and awareness concerns understanding the importance of risks, rules and the consequences of individual and collective action (Table 53).

Table 53. Difference between training, competence and awareness.

Concept	Meaning	OSH example
Training	Learning process that takes place throughout a person's life in the various contexts in which they find themselves (including work contexts). At times, this may take the form of a training course, that is, an organised session designed to impart or develop knowledge and skills.	A session on working at height
Competence	A body of knowledge and skills that an individual is able to apply in a practical context, particularly when carrying out tasks to achieve the desired results.	A worker performs work at height while complying with controls and stop-work criteria
Awareness	An understanding of the importance of the rules, the risks and the consequences of one's actions, and the ability to act accordingly.	A worker understands why an unsafe condition must be reported

An OSH management system should therefore not be limited to recording training activities; it should demonstrate that people are competent, aware of the risks and capable of applying controls in real work.

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6.4. Training and competence acquisition as OSH management-system processes

OSH competence does not simply mean having attended a training activity. A competent person is able to act safely in context, understanding the hazards, applicable controls, the limits of their authority and the situations in which they must stop, seek support or report an unsafe condition.

Competence may result from a combination of several elements:

- formal education and training;
- professional qualifications;
- accumulated experience;
- knowledge of risks and controls;
- ability to apply procedures;
- understanding warning signs;
- ability to respond to anticipated and unforeseen situations;
- participation in simulations, reviewed incidents and safety dialogues.

Within an OSH management system, training must be directly linked to real work and to the risks it is intended to control. Training is meaningful when it helps workers understand why controls are needed, apply procedures, recognise limits, respond to changes and participate in improving the system.

6.4.1. What should training be linked to?

Training should be related to:

- roles and responsibilities;
- hazards, risks and critical tasks;
- legal and normative requirements;
- procedures and operational controls;
- changes to processes, equipment or work organisation;
- workers' previous experience;
- contractors and temporary workers;
- emergency preparedness and response;
- documented evidence and traceability.

6.4.2. Competence as a continual cycle

Competence acquisition does not take place through a single training event. It is a continuous cycle that begins with the identification of training needs, moves on to the definition of learning strategies, application in the workplace, observation of performance, and a review of areas for improvement. Competence should be managed as a cycle: identifying needs, planning learning, developing competences, applying them in the workplace, observing results, and improving (Table 54).

Table 54. Stages in competence acquisition.

Stage	Guiding question	Possible evidence
Identify needs	Which risks, tasks or changes require competence development?	Competence matrix, risk assessment, incident analysis

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Stage	Guiding question	Possible evidence
Plan learning	Which method is best suited to the person, task and risk?	Training plan, induction plan, workplace-training guide
Develop competences	How should explanation, demonstration, practice and feedback be combined?	Session records, observation, simulation, coaching
Apply at work	Can the person perform the task safely in the real context?	Checklists, workplace validation, safety observations
Review and improve	What changed in practice? What remains difficult to apply?	Corrective actions, procedure reviews, lessons learned

6.4.3. Training as a control: potential and limitations

Training may be a necessary control measure, but it should rarely be the only response to a significant risk. Before concluding that "more training is needed", it is necessary to ask whether the system allows the person to work safely. A worker may know the rule and still be unable to apply it if the equipment is unsuitable, the procedure is impracticable, production pressure exists or actual conditions differ from those anticipated.

Training may be needed to:

- understand risks;
- apply procedures;
- use equipment and PPE;
- respond to emergencies;
- report incidents and near misses;
- act in response to changes.

However, when unsafe behaviour, deviation from a procedure or repeated incidents are observed, the response should not automatically be "provide more training". Table 55 presents examples of questions that should be asked before deciding on a training action, helping to distinguish genuine training needs from problems relating to working conditions, organisation, equipment or procedures.

Table 55. Questions to consider before deciding to use training as a control measure.

Observed problem	Question before deciding on training	Possible response in addition to training
Worker does not use PPE	**Is the PPE suitable, comfortable and available?**	Review PPE selection, test alternatives and improve availability
Procedure is not followed	**Is the procedure practicable in real work?**	Review the procedure with workers
Error during a critical task	**Is the task complex, poorly designed or performed under pressure?**	Redesign the task, strengthen supervision and reduce operational pressure
Repeated incident	**Have the causes already been addressed?**	Review controls, maintenance, layout or planning

Training should therefore be combined with technical and organisational measures, supervision, worker participation and improvement of actual working conditions. When used in isolation, it may correct a knowledge gap, but it is unlikely to resolve system failures.

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6.4.4. Training evidence beyond the attendance sheet

An attendance sheet demonstrates participation in a session, but does not in itself prove learning or application. Training evidence (Table 56) should show that the person understood, practised and applied what was learned and, where necessary, was coached or reassessed.

Table 56. Types of training evidence.

Type of evidence	What it demonstrates	Example
Formal training record	Participation, topic, duration and trainer	Training on working at height or hazardous energies
Induction record	Initial integration and knowledge of local rules	Induction of a temporary worker or contractor
Simulation or drill	Ability to respond in a practical situation	Emergency exercise or evacuation drill
Workplace observation	Application of controls in real work	Validation of safe performance of a critical task
Feedback and improvement	Learning, difficulties and adjustments	Record of obstacles to applying a procedure

6.5. Competences as a developing process: moving beyond a deficit approach

A limited approach to training often starts from a deficit assumption: workers do not know, do not comply or need to be corrected. A broader view is therefore proposed: before defining what is missing, it is necessary to recognise what workers already know, what they already do well and what they can teach the organisation.

6.5.1. Competence as the ability to act in context

In OSH, competence should be understood as the ability to act appropriately in a concrete situation. This includes interpreting warning signs, adapting communication, following procedures, recognising when a task should not begin, reporting problems and contributing to the improvement of existing controls.

6.5.2. The worker as a person with multiple experiences

Workers are not merely recipients of training. They are people with professional experience, tacit knowledge, memories of incidents, practical strategies and the ability to identify obstacles that often do not appear in formal procedures. Valuing this experience improves the quality of training and increases the likelihood that controls will be practicable.

6.5.3. Valuing what is already being done well

Training can and should be used to:

- identify existing good practices;
- recognise safe behaviours;
- make practical knowledge visible;
- reinforce effective practices;

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- share experience between workers;
- transform individual good practice into collective learning.

6.6. Learning safety in real work: the meaning of experience and informal learning

Experience alone does not guarantee learning. To generate prevention, it must be discussed, interpreted, compared with procedures and transformed into an improvement in practice.

6.6.1. From experience to learning

A near miss during a maintenance task can generate learning if the team discusses:

- what happened;
- which warning signs were ignored;
- which procedure applied;
- what difficulty existed on site;
- which practice should change;
- which good practice should be reinforced.

Experience becomes learning when there is a concrete situation, observation of what happened, interpretation of the risks, reflection on the action, discussion with others, connection with procedures and a change to or confirmation of practice.

6.6.2. Forms of education and learning

The forms of education and learning that may arise in work-related OSH contexts are described in Table 57.

Table 57. Forms of education and learning.

Form	Characteristics	OSH example
Formal	Planned, structured and with defined objectives	Certified course on working at height
Non-formal	Organised, but more flexible and situated	Toolbox talk, simulation or short session on a specific risk
Informal	Integrated into daily work, often without explicit objectives	Learning from an experienced colleague while performing the task
Incidental	Arises as a consequence of another action or unforeseen event	Learning after resolving an operational failure or near miss

6.6.3. Prescribed work and real work

Not all knowledge relevant to safety is written in procedures. Prescribed work corresponds to the rules, instructions and anticipated sequences; real work corresponds to the concrete conditions of performance, unforeseen circumstances, pressures and decisions made at the time, as described in Table 58.

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APPLICATION EXAMPLE

A procedure may state that specific PPE is mandatory. In real work, that PPE may impair vision, communication or movement. Training should enable this gap to be discussed rather than merely repeating the rule.

Table 58. Prescribed work vs. real work.

Prescribed work	Real work
Procedures, rules and instructions	Concrete conditions of performance
Ideal task sequence	Adjustments, unforeseen events and pressures
Formal control	Decisions made at the time
What the organisation anticipates	What the worker encounters
Risk described on paper	Risk experienced in the concrete situation

PRACTICAL QUESTION

For training:

"Which part of this procedure is most difficult to apply on site, and why?"

6.6.4. Experience: resource and risk

Experience helps people anticipate risks, recognise weak signals, make rapid decisions, support less experienced colleagues and understand actual task difficulties. However, it can become problematic when it leads to the normalisation of shortcuts, underestimation of risks or resistance to new controls (see Table 59).

Table 59. Experience: resource and risk.

Experience helps to...	Experience may become problematic when...
Anticipate risks and recognise weak signals	The belief arises that "I have always done it this way"
Make rapid decisions	There is resistance to new controls
Support less experienced colleagues	Risks are underestimated
Understand actual task difficulties	Shortcuts come to be regarded as normal
Identify good practices	There is difficulty in relearning

6.7. Workplace training

Workplace training brings learning closer to the actual risk. It is not limited to "learning by doing"; it means learning by doing, observing, asking questions, correcting and reflecting. The workplace is therefore not merely where training is applied, but also where learning is produced.

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6.7.1. How do people learn in the workplace?

- observation of the task;
- guided practice;
- support from experienced colleagues;
- problem-solving;
- interaction with teams;
- immediate feedback;
- adaptation to change;
- incident analysis;
- reflection on concrete situations.

6.7.2. Dimensions of workplace learning

The dimensions of workplace learning can be summarised as follows (Table 60).

Table 60. Dimensions of workplace learning.

Dimension	Practical application
Demonstration	Show how to perform the task safely at the location where it takes place
Explanation of risks	Relate the task to concrete hazards and applicable controls
Observation of performance	Check how the task is actually performed
Immediate correction	Intervene without humiliating the person and explain the reason for the correction
Questions about decisions	Understand the worker's reasoning and the obstacles encountered
Post-task feedback	Recognise good practices and identify improvements
Recording difficulties	Transform obstacles into information for improving the procedure

6.7.3. When should workplace training be used?

Situations in which workplace training may be used can be summarised as follows (Table 61).

Table 61. Situations in which workplace training may be used.

Situation	Appropriate training response
New worker	Induction, close support and frequent feedback
Experienced worker undertaking a new task	Recognise previous experience and address critical differences
Worker following an incident	Non-punitive learning and review of actual conditions
Change of equipment	Practical demonstration and supervised training
Change of procedure	Explain the reason, provide guided practice and validate applicability
Critical task	Observation, demonstration, simulation and stop-work criteria

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6.7.4. How to plan workplace micro-training

Workplace micro-training should produce understanding, not merely repetition. It should start from a concrete task, observe how the work is actually performed, discuss the risks with workers and end with feedback and a record of the learning achieved.

Table 62 presents a simple guide for planning and conducting workplace micro-training.

Table 62. Guide for planning workplace micro-training.

Stage	Guiding question	Possible evidence
Select a critical task	Which task has the greatest risk, variability or need for control?	Record of the selected task
Identify hazards and controls	Which hazards exist and which controls must be applied?	Risk assessment, procedure or checklist
Explore the worker's experience	Which difficulties, good practices or adaptations does the worker already know?	Conversation notes or record of contributions
Observe actual performance	How is the task carried out on site?	Workplace observation checklist
Discuss risks and decisions	Which decisions are made during the task, and why?	Record of questions and answers
Demonstrate or reinforce safe practice	Which control must be applied and what is its purpose?	Demonstration, practical validation or photograph of the control
Identify obstacles	What makes it difficult to apply the defined procedure or control?	Record of obstacles or deviations identified
Give immediate feedback	What was done well and what should be improved?	Feedback record
Confirm understanding	Can the person explain the reason for the controls and the stop-work criteria?	Verification questions or oral validation
Record learning	Which improvements, questions or needs were identified?	Micro-training record or action plan
Review the need for improvement	Do the procedure, equipment, PPE or organisation of the task need adjustment?	Corrective action, procedure review or improvement request

6.7.5. Role of line managers, supervisors and experienced workers

The role of line managers, supervisors and experienced workers can be summarised as follows (Table 63).

Table 63. Role of line managers, supervisors and experienced workers.

Line managers and supervisors	Experienced workers
Create time for learning	Demonstrate safe practices
Observe without assigning blame	Explain warning signs
Give feedback and reinforce good practices	Support new workers
Escalate systemic problems	Share strategies and actual difficulties

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6.8. Participation and training in OSH management systems

Participation transforms training from the simple transmission of information into the collective construction of safety. Workers can contribute by identifying hazards, validating procedures, testing control measures, selecting PPE, reporting near misses, suggesting improvements, sharing good practice and supporting new colleagues.

6.8.1. Communication, consultation and participatory training

Table 64 presents the main characteristics of communication, consultation and participatory worker training within an occupational safety and health management system.

Table 64. Communication, consultation and participatory training.

Communication	Consultation	Participatory training
Transmits information	Collects contributions	Builds understanding
May be one-way	Requires listening	Values experience
Ensures everyone is informed	Improves decisions	Develops competence
Example: safety alert	**Example: selection of PPE**	**Example: task discussion**

6.8.2. Human factors: beyond individual error

Error should be analysed as part of the system, not merely as an individual failure. Before concluding that there was "human error", it is important to ask why that action made sense in that context. The answer may lie in factors such as fatigue, production pressure, insufficient communication, limited supervision, unsuitable equipment, an impracticable procedure, a culture of silence, normalisation of deviations, interference between teams, or the presence of new and contracted workers.

6.8.3. Incidents and near misses as learning opportunities

An incident can generate learning when it makes it possible to:

- understand what happened;
- identify immediate and underlying causes;
- listen to the workers involved;
- review actual working conditions;
- update procedures;
- reinforce or redesign competences;
- share lessons learned;
- avoid blame.

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6.8.4. Toolbox talks and daily safety briefings

A toolbox talk should not be limited to reminding workers of rules. It can function simultaneously as training, communication, consultation and learning when it starts from the specific work planned for the day.

Useful questions for a daily safety briefing:

- What risks do we face today?
- What has changed since yesterday?
- What near misses have we observed?
- Which part of the procedure is difficult to apply?
- Which good practice should we maintain?
- What support is required?
- What conditions prevent the task from being carried out safely?

APPLICATION EXAMPLE

Toolbox talk – movement of mobile equipment
- What vehicle movements are planned today?
- Are there areas with reduced visibility?
- Are there pedestrians in the area?
- Which routes are restricted?
- Which right-of-way rule applies?
- What circumstances require the task to be stopped?

6.8.5. Feedback that develops competence

Feedback is not merely correction. It is a tool for developing competence, recognising good practice, listening to obstacles, strengthening confidence, improving procedures and promoting shared responsibility. Table 65 summarises the key points concerning good practice and what should be avoided when giving feedback.

Table 65. Good practice and what to avoid when giving feedback.

Good feedback should...	Avoid...
Recognise good practice	Humiliating or blaming
Correct respectfully	Reducing the problem to individual failure
Explain why controls are needed	Repeating rules without linking them to the risk
Listen to obstacles to implementation	Ignoring actual working conditions
Value experience	Undervaluing practical knowledge

6.9. Implications for OSH management

Integrating training into the OSH management system requires the organisation to treat learning as part of prevention. This means that training plans should arise from risk assessment, incident analysis, organisational changes and observation of real work. It also means that records should demonstrate not

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only that training took place, but that it contributed to improving competence and controlling risks. These points are summarised in Table 66.

Table 66. Implications of training and learning for the main elements of the OSH management system.

System element	Implication for training and learning
Risk assessment	Identify critical tasks and the associated competence needs
Operational control	Ensure that workers understand and apply controls
Management of change	Train and support workers before changing equipment, procedures or work organisation
Participation	Include workers in validating procedures and measures
Incident investigation	Turn events into lessons learned and a review of competences
Documentation	Record useful evidence for traceability, learning and improvement
Management review	Use competence indicators to support decisions and prioritise resources

6.10. Practical application tools

6.10.1. Simple OSH training-planning matrix

The following is an example of a simple matrix for planning training within an occupational safety and health management system (Table 67).

Table 67. Simple OSH training-planning matrix.

Task/Risk	Required competence	Learning method	Responsible person	Evidence
Critical task	Know the hazards, controls and stop-work criteria	Demonstration + workplace observation	Line manager / OSH professional	Validation checklist and feedback
New equipment	Operate safely and recognise faults	Supervised practice	Maintenance manager / supervisor	Training and observation record
Emergency	Respond in accordance with the plan	Simulation or practical exercise	Emergency team	Drill report
Contractor	Know local rules and interfaces	Induction and initial supervision	Contract manager / OSH	Induction and authorisation record

6.10.2. Guide for a participatory toolbox talk

1. Start with the specific task planned for the day.
2. Identify relevant changes, interfaces, and weather or operational conditions.
3. Ask which risks the team anticipates.
4. Remind the team of critical controls and stop-work criteria.
5. Listen to difficulties in applying procedures.
6. Record suggestions, obstacles or near misses.
7. Close with clear responsibilities and immediate actions.

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6.10.3. Possible indicators

Table 68 describes examples of indicators that may be defined for training and learning.

Table 68. Examples of training and learning indicators.

Indicator	Unit	Frequency	Purpose
Workers with valid critical training	%	Monthly / quarterly	Monitor formal coverage of critical requirements
Workers validated in the workplace	%	Quarterly	Verify practical application of competence
Toolbox talks with recorded contributions	No. / month	Monthly	Assess participation and situated learning
Near misses analysed with lessons learned	No. / quarter	Quarterly	Measure learning from experience
Training actions triggered by incidents or changes	No.	Quarterly	Link learning to real events and management of change
Obstacles to applying procedures identified and addressed	No. / % addressed	Monthly / quarterly	Prevent training from concealing systemic problems

6.11. Final summary and reflection questions

Chapter 6 leads to the following conclusions:

- ISO 45001 requires competence, training, awareness, participation and evidence;
- competences develop over time, through experience and work;
- workers possess practical knowledge that should be recognised;
- workplace training brings learning closer to actual risk;
- incidents and near misses should generate learning, not blame;
- safety briefings and feedback make training more participatory and effective.

REFLECT

Questions for individual or group reflection

1. In your organisation, is training treated as a documentary requirement or as a learning process?
2. Which critical competences should be observed in the workplace rather than merely recorded in a classroom?
3. Which forms of workers' practical knowledge could be valued more?
4. Which recent incidents or near misses could have been transformed into collective learning?
5. Which evidence would be most useful in demonstrating the actual application of competence?

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Case studies and assessment activities

A. Self-assessment questions

1. What is the role of education and training in an integrated occupational safety and health (OSH) management system?

2. Why should training not be understood merely as a documentary obligation?

3. How can workers' experience contribute to improving risk prevention?

4. What is the difference between training, competence and awareness?

5. Why should OSH competence be demonstrated in real work?

6. Which types of evidence can demonstrate learning more effectively than a simple attendance sheet?

7. Why should training rarely be the only control measure for a significant risk?

8. How can incidents and near misses be used as learning opportunities?

9. What are the advantages of toolbox talks and daily safety briefings?

10. How can feedback contribute to developing OSH competence?

B. Multiple-choice questions

1. OSH training should primarily be understood as:

A. A bureaucratic requirement for audit compliance.
B. A process for developing competence for safe work.
C. An activity exclusively for the human resources department.
D. A one-off action unrelated to risks.
E. An obligation only for new workers.

2. Under the logic of ISO 45001, the organisation should:

A. Only archive attendance sheets.
B. Ensure that everyone receives the same training, regardless of their role.
C. Determine the necessary competences, provide training or other actions, evaluate effectiveness and retain documented evidence.
D. Replace worker participation with written procedures.
E. Avoid workplace training.

3. OSH competence means:

A. Having attended a training session.
B. Being able to repeat safety rules.
C. Demonstrated ability to apply knowledge and act safely in the actual context.
D. Having many years of service.
E. Following orders without question.

4. Awareness refers to:

A. Knowing only the names of procedures.

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B. Understanding the significance of risks, rules, and the consequences of individual and collective action.
C. Attending mandatory formal training.
D. Performing tasks without supervision.
E. Memorising all legal requirements.

5. Before concluding that "more training is needed" in response to unsafe behaviour, one should ask:

A. Who should be disciplined?
B. Whether the worker has already been replaced.
C. Whether the system enables the person to work safely.
D. Whether the attendance sheet has been signed.
E. Whether the procedure is sufficiently long.

6. Workplace training is characterised by:

A. Learning only through theoretical classes.
B. Learning by doing, observing, asking questions, correcting and reflecting.
C. Replacing all written procedures.
D. Eliminating the need for supervision.
E. Applying only to office work.

7. Prescribed work means:

A. Actual conditions, unforeseen events and decisions made at the time.
B. Procedures, rules, instructions and the ideal sequence of the task.
C. Informal strategies used by workers.
D. The operational pressures of the day.
E. Adaptations made during execution.

8. Workers' experience may become problematic when it:

A. Helps recognise weak signals.
B. Supports less experienced colleagues.
C. Makes it possible to anticipate risks.
D. Leads to normalising shortcuts and the idea that "I have always done it this way".
E. Identifies good practice.

9. A participatory toolbox talk should:

A. Be limited to repeating general rules.
B. Start from the specific work planned for the day and involve the team in identifying risks and controls.
C. Be held only after a serious accident.
D. Avoid asking workers questions.
E. Replace formal risk assessment.

10. Good OSH feedback should:

A. Humiliate the worker to prevent the error from recurring.
B. Reduce the problem to individual failure.
C. Recognise good practice, correct respectfully and explain why controls are needed.
D. Ignore obstacles encountered in real work.

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E. Repeat rules without linking them to the risk.

C CORRECT ANSWERS	1. B; 2. C; 3. C; 4. B; 5. C; 6. B; 7. B; 8. D; 9. B; 10. C.

C. Exercises

Exercise 1 – Training as a control

In a company, several workers do not use a particular item of PPE correctly. The line manager proposes repeating the mandatory training on PPE use.

A ACTIVITY	State three questions that should be asked before deciding that the solution is simply to "provide more training".

Exercise 2 – Evidence of competence

An organisation has several training attendance sheets but cannot demonstrate whether workers apply the controls in the workplace.

A ACTIVITY	Identify four types of evidence that could better demonstrate the actual application of competence.

Exercise 3 – Incident as learning

A near miss occurred during a maintenance task. The line manager's first reaction was to state that there had been "human error".

A ACTIVITY	Explain how this near miss could be transformed into a learning opportunity.

Exercise 4 – Planning micro-training

A company has introduced new equipment into a critical task.

A ACTIVITY	Propose a short workplace micro-training plan with at least five stages.

Exercise 5 – Participatory toolbox talk

Before the start of a shift, a team will work in an area where mobile equipment and pedestrians are present.

A ACTIVITY	Draft six questions that could be used in a participatory toolbox talk.

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Suggested answers

Exercise 1 – Training as a control

PROPOSED ANSWER

Before deciding, questions should include, for example:

- Is the PPE suitable for the task and the risk?
- Is the PPE available, in good condition and in the correct size?
- Is the PPE comfortable and does it allow work to be carried out safely without restricting vision, communication or movement?

Training may be necessary, but it may also be necessary to review PPE selection, test alternatives, improve availability or adjust the procedure.

Exercise 2 – Evidence of competence

PROPOSED ANSWER

1. A workplace observation checklist.
2. Practical validation of the safe performance of a critical task.
3. A simulation or practical-drill record.
4. A record of feedback, difficulties encountered and improvement actions.

This evidence demonstrates not only participation, but also understanding, practice, application and improvement.

Exercise 3 – Incident as learning

PROPOSED ANSWER

The near miss should be analysed without immediate blame. The team should discuss what happened, which signals were overlooked, which procedure applied, which difficulties existed in the field, which actual conditions influenced the action, and which practice should change or be reinforced. The workers involved should also be heard, working conditions reviewed, and procedures or competences updated where necessary.

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Exercise 4 – Planning micro-training

PROPOSED ANSWER

1. Select the critical task associated with the new equipment.
2. Identify the applicable hazards, risks and controls.
3. Explain the reason for the change and the stop-work criteria.
4. Demonstrate safe use of the equipment in the workplace.
5. Allow guided and supervised practice.
6. Observe actual performance.
7. Give immediate feedback.
8. Record questions, difficulties, competence validation and improvement needs.

Exercise 5 – Participatory toolbox talk

PROPOSED ANSWER

1. What mobile-equipment movements are planned today?
2. Are there areas with reduced visibility?
3. Will pedestrians be present in the traffic area?
4. Which routes are restricted or altered?
5. Which right-of-way and communication rules should be applied?
6. In which situations should the task be stopped?

These questions help link training to the specific work of the day, promoting communication, consultation, participation and learning.

D. Case study

CASE STUDY – PLANNING WORKPLACE MICRO-TRAINING

Purpose of the assignment: Apply the content of Chapter 6 through the planning of workplace micro-training.

1. Context of the assignment

The proposal should begin with a specific Occupational Safety and Health situation and should value the worker's experience, observation of real work, discussion of safe practice and immediate feedback.

2. Instructions

→ The micro-training should be short, situated and linked to a real or simulated task.
→ The conversation with the worker should not be conducted as a test, but as an exploration of existing experience and knowledge.
→ Observation should make it possible to understand how the task is actually performed, including adaptations, difficulties and obstacles.
→ Feedback should recognise good practice, discuss aspects for improvement and avoid blame.

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→ The proposal should show how training contributes to improving practice, the procedure or the organisation of work.

All points in the following section should be addressed, using the tables as response templates. Responses should be clear, objective, organised and justified on the basis of the facts of the case and the concepts covered in the chapter.

The assignment should not present only generic training. It should show how a short workplace intervention can value the worker's experience, bring training closer to real work and transform practice into an opportunity for learning and improvement.

3. Work to be developed

i. Situation justifying the micro-training

Briefly explain what prompted the need for this micro-training.

Response template. Micro-training justification.

Question	Response
What was observed or identified?	Example: Some dumper operators were observed travelling at high speed around a low-visibility bend near the crushing area. A near miss between a dumper and a light vehicle was also recorded in this area.
How was this situation identified?	Example: Observation / near miss / incident / conversation with workers / audit / task change / arrival of a new worker / other
What is the problem, difficulty or opportunity for improvement?	
Who is involved?	Example: Dumper operator, wheel-loader operator, quarry-face supervisor, external drivers, pedestrians and OSH professional.
What may happen if this problem is not resolved?	
What are the main hazards identified, associated risks and possible consequences?	Examples: Hazards: large mobile equipment, presence of pedestrians/external drivers, and dusty or low-visibility routes. Risks: collision, being struck by a vehicle, and loss of control/overturning. Consequences: serious injury, fatality, property damage and operational stoppage.
What is the objective of the micro-training?	Example: Develop the dumper operator's ability to recognise critical traffic areas, adjust speed to actual quarry conditions, communicate by radio before entering risk areas, and know when to stop or request assistance.

ii. Selected critical task

Identify a task to be addressed in the micro-training.

Response template. Selected critical task.

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Element	Response
Organisation/sector	Example: Extractive industry – open-pit quarry.
Selected critical task	Example: Dumper travel and manoeuvring between the quarry face, loading area and unloading/crushing area.
Location where the task is carried out	Example: Internal quarry roads, quarry face, loading area and crushing area.
Target worker for the micro-training	Example: Dumper operator.
Other workers involved	Example: Wheel-loader operator, quarry-face supervisor, pedestrians, external drivers and OSH professional.
Equipment, tools, materials or substances used	Example: Dumper, wheel loader, communication radio, traffic-management plan, signage, internal roads, high-visibility vest, safety helmet, safety footwear and seat belt.
Why is this task critical for OSH?	Example: It involves large mobile equipment, travel on uneven roads, interaction with pedestrians and other vehicles, reduced visibility, and risks of collision, being struck, overturning and falling material.

iii. Exploratory conversation with the worker

Before demonstrating or correcting the practice, seek to understand how the worker performs the task, what experience they have, which risks they recognise and which difficulties they encounter. Answer at least 5 of the 9 exploratory questions below.

Response template. Exploratory conversation with the worker.

Exploratory question	Response / aspects identified
How do you normally perform this task?	
Why do you normally perform it in this way?	
Which hazards or risks do you identify in this task?	
How do you know whether you are carrying out the task safely?	
Which difficulties do you encounter when performing the task?	
In which situations should you stop or ask for help?	
How would you explain the correct and safe way to perform this task to a new colleague?	
Which good practices already exist and should be maintained?	
What could be improved in this task?	

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iv. Observation of actual performance

State what you would observe while the task is being performed. The observation is expected to reveal the situation that gives rise to the micro-training.

Response template. Observation of actual performance.

Aspect to observe	What to look for during observation
Task preparation	
Checking equipment/tools	
How the task is performed	
Use of controls and PPE	
Communication with colleagues or the supervisor	
Adaptations made by the worker	
Difficulties or obstacles observed	

v. Discussion or demonstration of safe practice

Explain how safe practice will be addressed in the workplace.

Response template. Discussion or demonstration of safe practice.

Question	Response
Which safe practice will be discussed or demonstrated?	
Who will facilitate or demonstrate?	
Which aspects of the worker's experience will be valued?	
Which procedure, rule or control will be explained?	
How will the reason for the safe practice be explained?	

vi. Support and feedback

Explain how the worker will be supported and what type of feedback will be given during performance of the same task, following the discussion or demonstration of the safe practice.

Response template. Support during performance of the same task after the safe discussion or demonstration.

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Stage	How will it be done?
Before starting the task	
During performance	
When a difficulty or deviation arises	
At the end of the task	

Response template. Feedback during performance of the same task after the safe discussion or demonstration.

Type of feedback	What will be said or discussed?
Good practices observed	
Aspects for improvement	
Risks requiring greater attention	
Difficulties reported by the worker	
Worker suggestions	

vii. Obstacles to applying safe practice

Identify difficulties that may prevent or hinder the application of safe practice. Select two or three obstacles.

Response template. Obstacles to applying safe practice.

Obstacle identified	How can it be discussed or overcome?
Lack of time	
Missing or unsuitable equipment	
Procedure difficult to apply	
Insufficient communication	
Production pressure	
Lack of support from the supervisor or team	
Other obstacle	

viii. Final summary

In 8 to 10 lines, explain how this micro-training:

→ responds to the situation identified;
→ values what the worker already knows;
→ brings training closer to real work;

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- → contributes to developing OSH competence;
- → helps workers understand risks more clearly;
- → identifies learning, suggestions or improvements for the task, procedure or organisation of work.

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STRIM

SAFETY TRAINING WITH
REAL IMMERSIVITY FOR MINING

CHAPTER 7

Safety Management: Documentation

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Chapter 7 – Safety Management: Documentation

Quick chapter map

Pedagogical table. Quick chapter map.

Section	Pedagogical function
1. Before you begin	Clarify documentation as a management tool rather than an end in itself.
2. Learning pathway	Guide learning from documents and records through to document control and improvement.
3. Documentation in the OSH management system	Relate policies, responsibilities, processes, risks, audits and improvement.
4. Documented information: maintain and retain	Distinguish documents that guide action from records that provide evidence of results.
5. ISO 45001 and ILO-OSH 2001 frameworks	Understand requirements and good practice for appropriate, participative documentation.
6. Essential documents and records	Select the information needed to control risks and demonstrate that the system is operating.
7. Document life cycle and control	Manage creation, approval, distribution, review, archiving, retention and disposal.
8. Common errors and verification checklist	Identify bureaucracy, outdated versions, unhelpful records and lack of accessibility.

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7.1. Before you begin

7.1.1. Background

Mandatory documentation in the context of ISO 45001, Occupational health and safety management systems – Requirements with guidance for use [4], demonstrates the organisation's commitment to providing safe and healthy workplaces, preventing injury and occupational ill health. It supports compliance with legal and normative requirements and promotes continual improvement in performance.

The general principles governing documented information within the IMS were presented in **section 2.5**. This chapter explores their application to the OSH management system in greater depth, focusing on operational usefulness, evidence, version control and the prevention of unnecessary bureaucracy.

The management-system documentation should support the processes addressed in the previous chapters: risk management, accident investigation, training, participation, operational control, audits and continual improvement.

Documented information – the term used by the standard to refer to documents and records – should be regarded as a management tool rather than merely as bureaucracy. It helps ensure that processes are carried out consistently and that the organisation has evidence of conformity to present during audits.

? KEY QUESTION	How can OSH documentation help control risks, guide work and demonstrate results, rather than merely increasing bureaucracy?

7.1.2. Learning objectives

1. Distinguish documents from records within documented information.
2. Identify essential documentation in an OSH management system.
3. Recognise document-control requirements, including version, approval, access, retention and disposal.
4. Assess whether a document is useful, proportionate to the risk and applicable to real work.
5. Identify common document-management errors and propose improvements.

7.1.3. Competences to be developed

- Classify documented information as a document to be maintained or a record to be retained.
- Select essential documents for controlling OSH risks.
- Construct simple records that demonstrate implementation, verification and effectiveness.
- Assess documents in terms of usefulness, clarity, currency and accessibility.
- Propose improvements involving simplification, integration, version control and removal of duplication.

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7.1.4. Key concepts

Pedagogical table. Key concepts.

Concept	Operational definition for this chapter
Documented information	Information that must be maintained or retained to support the management system and demonstrate conformity.
Maintain documented information	Keep documents that guide action, such as policies, procedures, instructions and plans.
Retain documented information	Preserve records that provide evidence of what was done and of the results achieved.
Document	Information used to guide, control or communicate a way of working.
Record	Evidence of an activity performed, a decision taken, a result achieved or a check carried out.
Document control	Management of version, approval, access, distribution, retention, protection, updating and disposal.
Useful documentation	Documentation that is simple, current, accessible, proportionate to the risk and applicable to real work.

7.2. Learning pathway

Pedagogical table. Learning pathway.

Stage	What the trainee does	Resources
LEARN	Reads the essential concepts in chapter 7 and identifies the technical terminology associated with documentation.	Core chapter text, table of key concepts, summary tables and examples.
OBSERVE	Analyses examples, figures, tables, practical cases and organisational or operational situations associated with the topic.	Figures, tables, practical examples and a case study.
DECIDE	Classifies situations, identifies priorities, chooses criteria and selects technically justified responses.	Guiding questions, decision criteria, matrices and decision-making exercises.
APPLY	Produces a simple application tool: map, matrix, checklist, plan, record, indicator or improvement proposal.	Templates, worksheets and completed examples.
REFLECT	Records learning, limitations, evidence used and possible improvements to professional practice.	Reflection and final summary; where applicable, a digital portfolio or the platform's forum.

▣ GUIDANCE FOR INDEPENDENT USE

When the chapter is used outside the platform, the trainee should retain completed exercises, filled-in worksheets, reflection records, group outputs and evidence of application. These materials may be used as evidence of learning and as a basis for classroom discussion or continuous assessment.

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7.3. Documentation within an OSH management system

An OSH management system organises policies, responsibilities, processes, resources, evaluation and improvement in order to prevent injuries, occupational diseases, incidents and control failures. Documentation supports this system but does not replace it: useful documents help people work safely; documents with no practical value merely increase bureaucracy. Table 69 summarises the fundamental aspects of occupational safety and health documentation according to ISO 45001 [4] and the Guidelines on Occupational Safety and Health Management Systems (ILO-OSH 2001 [20]).

Table 69. Characteristics of occupational safety and health documentation according to ISO 45001 and the ILO-OSH 2001 guidelines.

Dimension	ISO 45001:2018 [4]	ILO-OSH 2001 [20]
Nature	Requirements standard for OSH management systems, also used in certification contexts	Voluntary guidelines of the International Labour Organization; they do not replace national law and do not require certification
Management logic	A structure based on the Plan-Do-Check-Act cycle, integrating context, leadership, planning, operation, evaluation and improvement	A model with five elements: policy; organising; planning and implementation; evaluation; and action for improvement
Documentation	Uses the concept of documented information: maintain necessary information and retain evidence of results	Recommends documentation suited to the size and nature of the organisation, which is clear, reviewed, communicated and accessible
Participation	Places emphasis on leadership, consultation and worker participation	Treats worker participation as an essential element of the OSH system

? KEY QUESTION

Does this document help someone work more safely, control a risk, meet a requirement or demonstrate a decision?

If the answer is no, the document should be removed, simplified or integrated into another document.

7.4. Documented information: maintain and retain

In the ISO 45001 approach, the term documented information covers two complementary uses: maintaining and retaining information (Table 70). In simple terms, maintaining documented information means making available documents that guide action; retaining documented information means preserving records that demonstrate what was done and with what result.

? GUIDING QUESTION

Does this information effectively control the risk and make it possible to demonstrate the result?

If the answer is no, the document should be simplified, integrated into another process or removed.

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Table 70. Documented information according to ISO 45001.

Use	Practical question	Examples
Maintain	What information is needed to guide and control the activity?	OSH policy, procedures, operational criteria, work instructions and emergency plans
Retain	What evidence proves that the activity was performed and that the system operated?	Training, inspection, audit, incident, calibration, drill and management-review records

✓ **PRACTICAL RULE**

"Maintain" documented information means having documents that guide action, such as procedures, instructions or plans.

"Retain" documented information means preserving evidence of what was done, such as records of training, inspections, measurements, audits or incident investigations.

7.5. Documentation according to ISO 45001 and ILO-OSH 2001

The ILO-OSH 2001 guidelines reinforce a practical interpretation: document management should support prevention, worker participation, performance evaluation and continual improvement [20]. For teaching purposes, they may be read as a map showing how the OSH system operates (Table 71).

Table 71. Documentation according to ILO-OSH 2001 [20].

ILO-OSH 2001 element	Documentary implication	Example for an organisation
Policy	The policy should be written, clear, dated, communicated and reviewed	OSH policy signed by management and made available to workers and interested parties
Organising	Responsibilities, competence, training, communication and participation should be defined and evidenced	Responsibility matrix, training plan, consultation minutes and internal communications
Planning and implementation	The initial review, objectives, hazards, risks, controls, changes, emergencies, purchasing and contractors require criteria and evidence	Risk assessment, action plans, safe-purchasing criteria and contractor procedure
Evaluation	Monitoring, incident investigation, audits and management review should generate traceable records	Inspection reports, accident-investigation reports, internal audit reports and management-review minutes
Action for improvement	Corrective/preventive actions and continual improvement should be planned, implemented, checked and documented	Nonconformity record with root cause, responsible person, deadline, closure evidence and effectiveness verification

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NOTE	**Comparison point** ISO 45001 specifies requirements for an OSH management system; ILO-OSH 2001 provides voluntary and practical guidance. Both converge on one idea: documentation should help prevent risks, demonstrate conformity and improve performance.

7.6. Essential documents in an OSH management system

The documented set should be proportionate to the risk, the complexity of the organisation and applicable legal requirements. A simple rule is to document anything which, if forgotten, changed without control or poorly communicated, could increase risk.

Table 72 presents examples of essential documents in an OSH management system, indicating their purpose and how they may be applied in practice.

Table 72. Essential documents in an OSH system.

Essential document	Purpose	Example of application
Scope of the OSH management system	Defines the limits, activities, locations and processes covered by the system	Identification of units, facilities, workers, contractors and activities included in the system
OSH policy	Defines the organisation's commitments, principles and overall direction regarding OSH	Communication of the policy to workers, contractors and interested parties
Roles, responsibilities and authorities	Clarifies who decides, implements, monitors, consults and reports within the OSH system	Responsibility matrix, organisation chart, job descriptions and consultation/participation channels
Hazard-identification and risk-assessment methodology	Defines how hazards are identified, risks assessed, controls determined and results reviewed	Application to critical tasks, equipment, hazardous substances, changes and contractor activities
Legal and other requirements	Identifies legal, normative, contractual or internal obligations applicable to OSH	Legal register, compliance evaluation and action plan for unmet requirements
OSH objectives and action plans	Translate priorities into targets, responsibilities, deadlines, resources and indicators	Reduction of accidents, improvement of training, contractor control or reduction of exposure to hazardous agents
Operational-control criteria	Define how critical tasks are to be performed safely	Work instructions, PPE/collective-protection rules, permits to work, energy isolation and stop-work criteria
Emergency plan	Defines preparedness and response to critical situations	Fire, spill, evacuation, first aid, rescue or critical-equipment failure
Contractor and purchasing management	Defines OSH requirements applicable to third parties, suppliers and procurement	Contractor induction, work authorisations, supplier evaluation and safe-purchasing specifications
Audit, incident and improvement procedures	Define how the system is checked, failures investigated and corrective actions implemented	Internal audits, accident investigation, nonconformity records and verification of action effectiveness

Not all documents require the same level of detail. The higher the risk, task complexity, worker turnover or legal requirement, the greater the level of formalisation and document control should be.

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✓ **PRACTICAL RULE**

The higher the risk, complexity or need to demonstrate conformity, the greater the level of document control should be.

The aim is not to document everything, but to document what is necessary to control risks and demonstrate results.

7.7. Essential records: evidence that the system works

Records are objective evidence. They should be identifiable, traceable, protected and retained for the period defined by the organisation or by legislation. Good records answer four questions: what was done, by whom, when and with what result?

A good record does not merely demonstrate that an activity was carried out. It should also enable the organisation to identify trends, repeat good practice, correct deviations and check whether implemented actions were effective.

The main types of record within an OSH management system can be summarised as follows (Table 73):

Table 73. Types of record within an OSH management system.

Type of record	Expected evidence
Competence and training	Attendance, content, assessments, qualifications and future needs
Communication, consultation and participation	Meeting records, critical communications, suggestions and responses to workers
Monitoring and measurement	Inspections, occupational/environmental measurements, calibrations, equipment checks and legal-compliance checks
Incidents, accidents and nonconformities	Investigation reports, causes, corrective actions, responsible persons, deadlines and effectiveness verification
Internal audits	Programme, plan, criteria, findings, conclusions and action plan
Management review	Decisions, approved resources, priorities, changes and improvement opportunities
Emergencies	Drills, evaluation of results, response times, detected failures and implemented improvements
Contractors and purchasing	Selection criteria, communicated OSH requirements, authorisations, induction and performance monitoring

7.8. Document life cycle and document control

A safety document needs an owner, a version, controlled access and a final disposition. The life cycle of a document can be summarised in eight stages: creation, technical review, approval, availability, use, updating, archiving/retention and controlled disposal. Traceability should exist at every stage. Without this cycle, the risk of using obsolete or incomplete information increases.

For this cycle to operate, each document should contain, or be associated with, minimum control elements. These make it possible to identify the current version, determine who is responsible for updating it and prevent the use of obsolete information. Table 74 summarises the main document-control elements.

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Table 74. Minimum document-control elements.

Control element	Purpose
Code or identifier	Avoid confusion between similar documents and facilitate traceability
Title	Clearly indicate the document's content and purpose
Version/revision	Ensure that the current version is used
Issue or revision date	Show when the document was created or updated
Responsible person/document owner	Define who keeps the document current and ensures its review
Approver	Confirm that the document was validated before use
Access location	Ensure that the document is available at the point of use
Change history	Record significant changes between versions
Document status	Distinguish documents that are current, under review or obsolete
Retention period, where applicable	Define how long the information must be preserved

With these elements defined, the document life cycle can be organised into the following stages:

1. Identify the need: determine which risk, requirement or process justifies the document.
2. Define the owner: assign responsibility for updating and reviewing it.
3. Draft: define purpose, users, controlled risks and format.
4. Technically review: confirm consistency with risks, legislation and real practice.
5. Approve: ensure formal responsibility and an authorised version.
6. Distribute: make it available at the point of use, in the appropriate format and language.
7. Use and retain evidence: apply it during operations and keep the associated records.
8. Review, update or withdraw: control changes, remove obsolete versions and define retention/disposal.

7.9. Common errors and how to avoid them

Table 75 presents common errors and ways of addressing them when defining, implementing and maintaining documents required within an OSH management system.

Table 75. Common errors concerning documentation in OSH.

Common error	Risk created	How to avoid it
Excessive paperwork	Workers stop consulting lengthy or repetitive documents	Use short workflows, simple templates and operational language
Wrong versions	Outdated criteria are applied and control is lost	Publish only the current version; block or remove obsolete copies
Incomplete records	The organisation cannot demonstrate conformity or learn from failures	Define minimum fields: date, responsible person, location, result, decision and evidence

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Common error	Risk created	How to avoid it
Invisible documents	Real practice diverges from the documented system	Ensure access at the workplace and train users
Documentation not linked to risk	Bureaucracy has no preventive effect	Begin by analysing critical processes and relevant hazards
Actions not closed out	Problems recur and the system does not improve	Use an action record containing cause, deadline, responsible person, verification and effectiveness
Documents created only for audit	The documented system does not represent real work	Involve workers and line managers/supervisors in drafting and reviewing documents used for critical tasks

In addition to these errors, it is important to distinguish excessive documentation from useful documentation. Table 76 gives simple examples showing how documented information can be simplified without losing control, traceability or preventive value.

Table 76. Examples of excessive documentation and useful documentation.

Excessive documentation	Useful documentation
A long, technical procedure rarely consulted by workers	A short, visual instruction available at the workplace
Several different forms for the same inspection	A single checklist with essential fields and a link to the action plan
A training record containing only attendance signatures	A record containing the topic, participants, questions, assessment and practical validation where applicable
An action plan with no responsible person, deadline or verification	An action plan containing the cause, measure, responsible person, deadline, evidence and effectiveness verification
Duplicate documents for quality, environment and OSH	An integrated procedure that avoids repetition and clarifies common requirements
Paper copies with no version control	Controlled access to the current version and removal of obsolete copies

Document simplification does not mean absence of control. It means retaining only the information that is necessary, clear, accessible and useful for controlling risks and demonstrating results.

7.10. Quick verification checklist

Use this checklist to assess whether OSH documentation is useful and controlled:

☐ Does the document have a clear purpose and is it linked to a risk, legal requirement or critical process?

☐ Has the document been tested or validated with the workers who use it?

☐ Is there a responsible person/document owner?

☐ Is the current version identifiable and accessible at the point of use?

☐ Are there criteria for review, approval, retention and disposal?

☐ Do records make it possible to trace the date, responsible person, location, decision and result?

☐ Do workers know the relevant information and have an opportunity to participate?

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☐ Do incidents, audits and inspections feed into corrective action and improvement?

☐ Is the documentation simple enough to be used in real work?

☐ Is documentation reviewed after incidents, process changes, audits or relevant legal changes?

7.11. Final summary

Documentation adds value only when it is linked to risk, real work and continual improvement. An effective document system should be simple, current, accessible, understood by its users and capable of demonstrating that risks are controlled in practice.

- Documentation should support the OSH system, not replace it.
- Documents guide action; records demonstrate results.
- Documented information should be clear, controlled, accessible, reviewed and proportionate to risk.
- ILO-OSH 2001 reinforces the integration of policy, organising, planning, evaluation and improvement.
- Good document management turns safety into practice that can be verified, repeated and improved.

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Case studies and assessment activities

A. Self-assessment questions

1. What is the role of documentation in an Occupational Safety and Health management system?

2. Why should documentation be regarded as a management tool rather than merely as bureaucracy?

3. What is the difference between documents and records within documented information?

4. What does “maintain documented information” mean under the ISO 45001 approach?

5. What does “retain documented information” mean in an OSH management system?

6. What characteristics should useful documentation proportionate to risk have?

7. Which types of document are essential in an OSH management system?

8. Which questions should good OSH records answer?

9. Why is it important to control versions, approvals, access and obsolete documents?

10. What are the main risks of documentation that is excessive, incomplete or disconnected from real work?

B. Multiple-choice questions

1. Within ISO 45001, mandatory documentation mainly demonstrates:

A. Only the completion of administrative tasks.
B. The organisation's commitment to providing safe and healthy workplaces.
C. The replacement of risk assessment by forms.
D. The existence of lengthy and technical documents.
E. The exclusive responsibility of the OSH professional.

2. Documented information includes:

A. Only written procedures.
B. Only training records.
C. Documents and records used to guide action and demonstrate results.
D. Only documents required by an external auditor.
E. Only policies signed by management.

3. “Maintain documented information” means:

A. Preserve evidence of completed activities.
B. Make available documents that guide and control the activity.
C. Remove old documents without a record.
D. Archive every document on paper.
E. Keep only statutory records.

4. “Retain documented information” means:

A. Preserve records that demonstrate what was done and with what result.
B. Create work instructions for every task.
C. Keep procedures available at the workplace.

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D. Prevent workers from accessing documents.
E. Replace audits with forms.

5. An essential document in an OSH system should be created particularly when:

A. The organisation wishes to increase the number of forms.
B. A risk, requirement or critical process requires guidance, control or evidence.
C. Workers should not participate in the process.
D. The document has no practical application.
E. Many similar documents already exist.

6. Which of the following is an OSH record?

A. OSH policy.
B. Emergency plan.
C. Audit procedure.
D. Accident-investigation report.
E. Work instruction.

7. Good records should answer four main questions:

A. How much did it cost, who approved it, who printed it and where was it stored?
B. What was done, by whom, when and with what result?
C. Who made the error, who was punished, who signed and who archived it?
D. How many pages does it contain, who read it, who copied it and who disposed of it?
E. What is the version, title, colour and format?

8. A minimum document-control element is:

A. Number of pages.
B. Cover colour.
C. Version or revision.
D. Name of the external auditor.
E. Number of uncontrolled printed copies.

9. Using the wrong document versions may cause:

A. Greater worker participation.
B. Application of outdated criteria and loss of control.
C. Automatic system improvement.
D. Reduction of document-related risks.
E. Removal of the need for auditing.

10. Document simplification means:

A. Removing all document control.
B. Keeping only information that is necessary, clear, accessible and useful for controlling risks and demonstrating results.
C. Reducing worker participation.
D. Replacing records with verbal communication.
E. Creating generic documents not linked to risk.

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C CORRECT ANSWERS	1. B; 2. C; 3. B; 4. A; 5. B; 6. D; 7. B; 8. C; 9. B; 10. B.

C. Exercises

Exercise 1 – Documents or records?

An organisation has the following items: OSH policy, inspection report, emergency procedure, training record, responsibility matrix and internal-audit report.

A ACTIVITY	Classify each item as a document or a record.

Exercise 2 – Assessing document usefulness

An organisation has a 30-page procedure for a critical task. Workers rarely consult it and use informal instructions passed on by colleagues.

A ACTIVITY	Identify three problems and propose three improvements.

Exercise 3 – Version control

During an audit, it is found that some workers are using an old instruction on hazardous-energy isolation. The updated version is available only on the central server.

A ACTIVITY	State the risks associated with this situation and propose corrective actions.

Exercise 4 – Creating a useful record

After a safety inspection, the organisation records only “inspection completed” and the responsible person's signature.

A ACTIVITY	State which minimum fields should be included in a more useful inspection record.

Exercise 5 – Excessive documentation

An organisation has several different forms for similar inspections, duplicated documents for quality, environment and OSH, and action plans with no responsible person or deadline.

A ACTIVITY	Propose a document-simplification strategy that does not result in loss of control.

Suggested answers

Exercise 1 – Documents or records?

PROPOSED ANSWER
OSH policy – **Document**.

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PROPOSED ANSWER

Inspection report – **Record**.

Emergency procedure – **Document**.

Training record – **Record**.

Responsibility matrix – **Document**.

Internal-audit report – **Record.**

Documents guide action; records demonstrate that an activity was performed and with what result.

Exercise 2 – Assessing document usefulness

PROPOSED ANSWER

Possible problems:

1. The procedure is too long and insufficiently operational.
2. The document is not adapted to real work.
3. Real practice may diverge from the documented system.

Possible improvements:

1. Create a short, visual instruction available at the workplace.
2. Review the procedure with worker participation.
3. Ensure that the current version is accessible and that workers are trained in its application.

Exercise 3 – Version control

PROPOSED ANSWER

Risks:

- Application of outdated criteria.
- Loss of document control.
- Increased risk during a critical task.
- Audit nonconformity.

Corrective actions:

- Remove or block obsolete copies.
- Ensure access to the current version at the point of use.
- Communicate the change to workers.
- Record the update, approval, review date and change history.
- Check that workers understand and apply the current version.

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Exercise 4 – Creating a useful record

PROPOSED ANSWER

An inspection record should include at least:

- Inspection date.
- Location or area inspected.
- Person responsible for the inspection.
- Criteria or items checked.
- Observed results.
- Identified nonconformities or deviations.
- Proposed corrective actions.
- Person responsible for each action.
- Completion deadline.
- Closure evidence and effectiveness verification.

The record therefore supports traceability, learning and improvement.

Exercise 5 – Excessive documentation

PROPOSED ANSWER

The strategy may include:

- Integrate common quality, environmental and OSH documents where possible.
- Create a single checklist for similar inspections.
- Define essential form fields: date, location, responsible person, result, decision and evidence.
- Review duplicated documents and remove versions with no useful purpose.
- Ensure that action plans include the cause, measure, responsible person, deadline, evidence and effectiveness verification.
- Retain only documentation that is necessary, clear, accessible and linked to risk control.

D. Case study

CASE STUDY – DEVELOPING AN OCCUPATIONAL SAFETY AND HEALTH POLICY

Purpose of the assignment: Design an Occupational Safety and Health Policy suited to the reality of a specific organisation, demonstrating an understanding of:

→ the relationship between the OSH policy and the organisation's context;
→ the importance of identifying the main risks and opportunities;
→ the minimum commitments required by ISO 45001;
→ the need to involve workers and interested parties;
→ the role of the policy in guiding objectives, practices and continual improvement.

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1. Assignment context

In this individual assignment, each trainee should prepare an Occupational Safety and Health (OSH) Policy for their company, institution or another organisation that they know sufficiently well.

The policy should be based on the principles of NP ISO 45001:2019, particularly the requirement relating to the OSH Policy, which states that top management must establish a policy appropriate to the organisation's purpose, size and context and to the nature of its OSH risks and opportunities. The standard also states that the policy must include commitments relating to safe and healthy working conditions, legal compliance, elimination of hazards, reduction of risks, continual improvement, and consultation and participation of workers.

2. Work to be developed

Part I – Characterisation and justification of the organisation

Before presenting the policy, provide a brief description of the selected organisation, explaining its context and justifying the choices made when formulating the policy.

1. General identification of the organisation

Respond in approximately 5-8 lines, identifying the chosen organisation, its sector of activity, location, approximate size and main activities.

2. Brief description of the organisation's context

Respond in approximately 8-12 lines, describing the main internal and external factors that may influence occupational safety and health management, such as the type of activity, working conditions, number of workers, service providers, legal requirements, safety culture, available resources and exposure to specific risks.

3. Main OSH hazards and risks

Respond in approximately 8-12 lines, identifying the main OSH hazards and risks associated with the organisation's activity. Where applicable, consider physical, chemical, biological, mechanical, electrical, ergonomic and psychosocial risks, as well as risks associated with equipment, traffic, emergencies, work at height and other relevant situations.

4. Relevant interested parties

Respond in approximately 5-8 lines, identifying the main interested parties that may affect or be affected by OSH management, such as workers, top management, line managers and supervisors, worker representatives, service providers, customers, authorities, suppliers, visitors or the surrounding community.

5. Justification of the proposed policy

Respond in approximately 8-12 lines, explaining how the proposed policy was formulated in the light of the organisation's reality, its main hazards and risks, the needs of interested parties and the commitments set out in ISO 45001.

Part II – Occupational Safety and Health Policy

Draft the Occupational Safety and Health Policy in approximately 15-25 lines.

Guidance: the policy should be clear, institutional and appropriate to the selected organisation. As a minimum, it should include commitments concerning the prevention of injury and ill health, legal

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compliance, elimination of hazards and reduction of risks, definition of OSH objectives, continual improvement, consultation and participation of workers, internal communication, and availability to interested parties where appropriate.

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SAFETY TRAINING WITH
REAL IMMERSIVITY FOR MINING

CHAPTER 8

Final Assignment

Simplified Diagnosis of an Integrated Management System

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Chapter 8 – Final Assignment

Simplified diagnosis of an integrated management system

8.1. Background

The purpose of this work is to apply, in a real context or a context closely approximating reality, the content of the previous chapters.

The proposal brings together the fundamentals of Integrated Management Systems (IMSs), the integration of quality, environment and safety, the organisational context, leadership, worker participation, document management, risk management, incident and accident investigation, and safety training.

The conceptual basis is drawn from the seven chapters: chapter 1 presents the logic of integrated management systems, the relationship between quality, environment and safety, the PDCA cycle and risk-based thinking; chapter 2 develops the organisational context, interested parties, leadership, culture, communication, documentation, audits and continual improvement; chapter 3 addresses environmental management, environmental aspects and impacts, environmental performance and continual improvement; and chapters 4 to 7 develop the safety management framework, risk management, accident investigation, training and OSH documentation.

8.2. Work topic

Practical analysis of an organisation in the light of Quality, Environment and Safety Management Systems, with a focus on Occupational Safety and Health.

The trainee must choose a real organisation, preferably in industry, mining, construction, technical services, logistics, healthcare, education, catering, maintenance, a laboratory, a workshop, or another activity involving relevant risks.

The assignment may be completed through one of the following routes:

Option A – Company visit

The trainee visits an organisation, observes a workstation or process and gathers information through observation and, where possible, an informal discussion with workers or responsible personnel.

Option B – Interview with a worker or responsible person for the organisation

The trainee conducts a structured interview with a worker, team leader, safety technician, environmental manager, quality manager, manager or another professional with knowledge of the activity.

Both options must address the same main questions. The only difference is the method used to collect information.

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8.3. Learning objectives

1. Characterise a real organisation or activity according to the logic of an Integrated Management System.
2. Identify processes, interested parties and the main quality, environmental and safety requirements.
3. Recognise hazards, occupational risks, environmental aspects and existing control measures.
4. Analyse how the organisation documents, communicates, trains, monitors and improves its safety practices.
5. Critically assess the relationship between the formal system and real work practice.
6. Propose simple, realistic and justified improvements, giving priority to the prevention of occupational risks.

8.4. Mandatory report structure

1. Identification of the organisation or activity

The trainee must present:

- sector of activity;
- approximate size of the organisation or team;
- main products, services or processes;
- role of the person interviewed, where applicable;
- brief description of the location, task or process analysed;
- limitations affecting the collection of information.

Where confidentiality applies, the name of the company may be omitted. The trainee may use a fictitious designation, for example “Company A”, “Workshop B” or “Quarry C”.

2. Framework as an Integrated Management System

The trainee must explain whether the organisation appears to have an integrated or separate approach to quality, environment and safety.

Guiding questions:

- Are there common policies, rules or procedures for quality, environment and safety?
- Does the company appear to manage these subjects in an integrated manner, or does each area operate separately?
- Is there evidence of the PDCA cycle: plan, do, check and improve?
- Are there objectives or indicators relating to safety, quality or the environment?
- Who monitors these subjects?

NOTE	This section relates particularly to chapters 1 and 2, which distinguish integration from the mere coexistence of systems and emphasise the importance of context, leadership, communication, documented information and continual improvement.

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3. Context, interested parties and requirements

The trainee must identify at least:

- Internal issues: human resources, equipment, facilities, shifts, competence, safety culture, work organisation, maintenance and critical processes.
- External issues: legislation, customers, suppliers, the community, the surrounding environment, regulatory authorities, the market, and climatic or technological conditions.
- Relevant interested parties: workers, management, customers, suppliers, regulatory authorities, the local community, contractors, visitors or others.

Guiding questions:

- Which interested parties influence or are influenced by the activity?
- What are their main needs and expectations?
- Which legal, normative or internal requirements appear relevant?
- Is worker safety considered in the organisation's decisions?

4. Identification of hazards, risks and safety controls

This is the central part of the assignment.

The trainee must select a task, workstation or process and identify:

- hazards present;
- possible consequences;
- persons exposed;
- existing prevention and protection measures;
- qualitative risk assessment;
- proposed improvements.

Examples of hazards: falls; movement of loads; machinery and equipment; noise; dust; chemicals; electricity; vehicles; tools; physical effort; heat stress; lone working; emergencies; communication failures.

Suggested table:

Task/activity	Hazard	Possible consequence	Who is exposed	Existing controls	Proposed improvements

The trainee must demonstrate that risk management is not limited to identifying hazards, but turns the assessment into decisions, responsibilities, control measures, monitoring and documented evidence, as discussed in chapter 4.

5. Environmental aspects associated with the activity

Although the main focus is safety, the trainee must identify at least three environmental aspects associated with the activity analysed.

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Examples of environmental aspects: water consumption; energy consumption; waste generation; atmospheric emissions; dust; environmental noise; effluent; spills; use of chemicals; visual impact; land occupation.

Suggested table:

Environmental aspect	Possible impact	Existing measures	Possible improvements

NOTE	This section links to chapter 3, which distinguishes environmental aspects from environmental impacts and highlights the importance of monitoring, operational control and continual improvement in environmental performance.

6. Training, competence and worker participation

The trainee must analyse how the organisation prepares people to work safely.

Guiding questions:

- What induction or continuing training is provided?
- Is specific training provided for higher-risk tasks?
- Do workers know what to do in an emergency?
- Are toolbox talks, safety conversations, meetings or workplace instructions used?
- Is workers' experience valued?
- Do workers participate in identifying hazards or improving procedures?
- Is there evidence of training beyond a simple attendance sheet?

NOTE	Chapter 6 emphasises that training should be understood as the development of competence in the real work context, rather than merely as a formal or documentary obligation.

7. Incidents, near misses and organisational learning

The trainee should seek to understand whether the organisation learns from occurrences.

Guiding questions:

- Does the company record accidents, incidents or near misses?
- Are workers encouraged to report hazardous situations?
- When an accident occurs, does the organisation look for someone to blame or for causes?
- Are immediate causes, underlying causes and organisational factors analysed?
- Are corrective actions monitored through to closure?
- Are lessons learned communicated to workers?

Where the interviewee cannot discuss actual accidents, the trainee may ask about a hypothetical situation or a minor occurrence, without names or personal data.

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i NOTE	Chapter 5 emphasises that accident investigation should establish what happened, why it happened and what measures must be implemented to prevent recurrence, while avoiding conclusions centred solely on individual blame.

8. Documentation and evidence

The trainee must identify which documents or records exist or would be expected.

Examples of documents:
Safety policy; risk assessment; procedures; work instructions; emergency plan; PPE rules; training plan; maintenance plan; responsibility matrix; inspection plan.
Examples of records:
Training records; inspection records; maintenance records; accident reports; PPE issue records; audits; emergency drills; measurements of noise, dust or chemical agents; meeting minutes; corrective actions.

Central question: Does the documentation genuinely help to control risk, or does it exist only to meet formal requirements?

i NOTE	This analysis links to chapter 7, which presents documented information as a management tool rather than bureaucracy, distinguishing documents that guide activities from records that provide evidence of results.

9. Critical diagnosis

The trainee must present a critical appraisal of the situation observed or reported. The analysis may be organised into three blocks:

- **Strengths**: examples of good practice, effective controls, worker involvement, useful documentation, visible leadership and adequate training.
- **Weaknesses**: poorly controlled risks, lack of training, outdated documentation, insufficient communication, absence of records, or measures dependent solely on individual behaviour.
- **Opportunities for improvement**: simple, realistic actions proportionate to the organisation.

10. Proposed improvement plan

The trainee must propose three to five improvement actions, giving priority to safety.

Examples of improvement actions:
Review the risk assessment for a task; create an inspection checklist; improve signage; strengthen training for a critical task; implement a weekly toolbox talk; create a simple near-miss record; review the emergency procedure; improve housekeeping; control document versions; create a responsibility matrix; improve communication of risks to contractors.

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Suggested table:

Problem identified	Proposed action	Suggested person responsible	Suggested deadline	Evidence of implementation

✓ GOOD PRACTICE	Avoid vague recommendations such as “take more care” or “provide more training” without explaining the risk, task or evidence to which they relate.

8.5. Alternatives for completion

Option A – Company visit

During the visit, the trainee must directly observe a task, workstation or process.

Minimum mandatory information

- description of the location visited;
- one photograph or simple diagram, only where authorised;
- identification of at least five hazards;
- identification of at least three environmental aspects;
- identification of documents or records observed or mentioned;
- a brief discussion with a worker or person responsible, where possible;
- an improvement proposal.

Ethical and safety precautions

The trainee must not interfere with operations, photograph people without permission, collect confidential data, or disregard any rules of the company visited.

Option B – Interview with a worker or responsible person

Possible interviewee profile

- operational worker;
- team leader;
- safety technician;
- environmental manager;
- quality manager;
- maintenance manager;
- manager;
- worker experienced in a high-risk task.

Minimum interview guide

1. What is the company’s main activity?
2. What is your role?
3. What are the main safety risks in your work?
4. What measures are in place to control those risks?

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5. What training have you received to perform the work safely?
6. Do workers participate in identifying hazards or improving conditions?
7. Which documents or records are used in day-to-day work?
8. Has an accident, incident or near miss occurred? How was it dealt with?
9. Which environmental aspects are most relevant to the activity?
10. Which improvement do you consider most important for strengthening safety?

The trainee must include a summary of the interview in the report, without identifying the interviewee by name unless express permission has been given.

8.6. Final deliverable

The trainee must submit an individual report with the following structure:

1. Cover page
2. Introduction
3. Characterisation of the organisation or activity
4. Methodology: visit or interview
5. Framework as an Integrated Management System
6. Context and interested parties
7. Safety risk analysis
8. Environmental aspects
9. Training, participation and communication
10. Incidents, near misses and learning
11. Documentation and evidence
12. Critical diagnosis
13. Improvement plan
14. Conclusion
15. Appendices, where applicable

Suggested length: **8 to 12 pages**, excluding appendices.

8.7. Assessment criteria

Assessment criteria table – Final Assignment.

Criterion	Weight
Characterisation of the organisation, process and methodology	10%
Application of IMS concepts, context and interested parties	15%
Identification and analysis of safety risks	25%
Integration of environmental and quality aspects	10%
Analysis of training, participation, documentation and evidence	15%
Critical ability and connection with real practice	15%
Quality of improvement proposals	10%

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8.8. Completion template

Final Assignment – Simplified Diagnosis of an Integrated Management System

Field	Information
Assignment prepared by:	[Full name]
Company / organisation analysed	[Real name or fictitious designation]
Data collection method	☐ Option A: company visit ☐ Option B: interview
Date of visit / interview	[dd/mm/yyyy]

INSTRUCTION (DELETE AFTER COMPLETION):

All green text must be deleted before the assignment is submitted. Always read the instructions for each section first.

How to use this template

This document standardises responses to the individual assignment. The trainee must replace the fields in square brackets with information collected through a company visit or an interview with a worker or responsible person.

The report must be objective, evidence-based and centred on the relationship between the management system, real work, risk prevention and continual improvement. Occupational safety and health should receive the greatest attention, without excluding quality and the environment.

Selecting the method

Method	When to use it	Expected evidence
Option A – Company visit	When the trainee is able to observe a location, process, task or workstation.	Description of the location, observation of hazards and environmental aspects, documents/records and, where authorised, photographs or a simple diagram.
Option B – Interview	When it is not possible to visit the company but it is possible to interview a worker, line manager, technician or responsible person.	Interview summary, answers to the guiding questions and a critical analysis based on the experience reported.

Suggested contents

1. Introduction
2. Characterisation of the organisation or activity
3. Data collection methodology

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4. Framework as an Integrated Management System
5. Context, interested parties and requirements
6. Safety risk analysis
7. Environmental aspects
8. Training, competence, communication and participation
9. Incidents, near misses and learning
10. Documentation and evidence
11. Critical diagnosis
12. Improvement plan
13. Conclusion
14. Appendices

Recommended length: 8 to 12 pages, excluding appendices. The trainee should prioritise critical analysis and evidence, avoiding generic descriptions that are not linked to the situation observed or reported.

1. Introduction

[Briefly present the purpose of the assignment, the method selected and the relevance of the analysis to Quality, Environment and Safety Management Systems, with greater emphasis on Occupational Safety and Health.]

1.1. Specific objectives of the assignment

- Characterise the organisation or activity analysed.
- Identify relevant processes, interested parties and requirements.
- Analyse hazards, risks and safety control measures.
- Identify environmental aspects and associated control measures.
- Assess training, participation, documentation, incidents and continual improvement.
- Propose realistic improvement actions proportionate to the context.

2. Characterisation of the organisation or activity

Response template. Final Assignment: Characterisation of the organisation or activity

Element	Trainee response
Sector of activity	[Complete]
Approximate size	[Number of workers, shifts, teams or other available information]
Main products / services	[Complete]
Process, task or workstation analysed	[Complete]
General location	[Town/region, if not confidential]
Role of the person interviewed	[Complete only where applicable]
Limitations affecting data collection	[For example: partial access, confidentiality, inability to observe certain tasks]

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2.1. Brief description of the activity analysed

[In 1 to 3 paragraphs, describe the process/task/workstation analysed: what is done, by whom, using which equipment and materials, in what work environment, and the main stages involved.]

3. Data collection methodology

Selected method: ☐ **Company visit** ☐ **Interview**

3.1. Sources of information used

Response template. Final Assignment: Sources of information used.

Source	Select	Notes / details
Direct observation of the workplace	☐	[Complete]
Interview with worker/responsible person	☐	[Enter role, without name where necessary]
Documents or records consulted	☐	[For example: risk assessment, instructions, training records]
Authorised photographs, diagram or sketch	☐	[State whether used]
Other sources	☐	[Complete]

3.2. Summary of the visit or interview

[Describe the date, approximate duration, person(s) involved, location analysed and main subjects addressed. Do not include sensitive personal data.]

4. Framework as an integrated management system

[Analyse whether the organisation appears to manage quality, environment and safety in an integrated, separate or informal manner. Refer to evidence of policies, objectives, processes, responsibilities, indicators, audits, meetings or improvement actions.]

Response template. Final Assignment: Framework as an integrated management system.

Analysis question	Evidence collected	Critical comment
Is there a policy or commitment covering quality, environment and safety?	[Complete]	[Complete]
Are objectives or indicators monitored?	[Complete]	[Complete]
Does management demonstrate leadership and commitment?	[Complete]	[Complete]
Are quality, environmental and safety functions integrated or separate?	[Complete]	[Complete]
Are there signs of continual improvement or the PDCA cycle?	[Complete]	[Complete]

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5. Context, interested parties and requirements

5.1 Internal and external issues

Response template. Final Assignment: Internal and external issues.

Type	Issue identified	Impact on the QES IMS
Internal	[For example: competence, equipment, culture, shifts, maintenance]	[Complete]
Internal	[Complete]	[Complete]
External	[For example: legislation, customers, suppliers, community, climate]	[Complete]
External	[Complete]	[Complete]

5.2. Interested parties

Response template. Final Assignment: Interested parties.

Interested party	Needs / expectations	Requirements or implications
Workers	[Complete]	[Complete]
Management / directors	[Complete]	[Complete]
Customers	[Complete]	[Complete]
Suppliers / contractors	[Complete]	[Complete]
Regulatory authorities	[Complete]	[Complete]
Community / neighbours	[Complete]	[Complete]

6. Safety risk analysis

[Select a task, workstation or process. Identify hazards, consequences, persons exposed, existing controls and proposed improvements. Avoid vague recommendations such as “be more careful”.]

6.1. Task or process selected

[Describe the task/process: main stages, equipment, persons involved and conditions under which it is carried out.]

6.2. Table of hazards, risks and controls

Response template. Final Assignment: Table of hazards, risks and controls.

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Task/activity	Hazard	Possible consequence	Persons exposed	Existing controls	Proposed improvements
[Complete]	[Complete]	[Complete]	[Complete]	[Complete]	[Complete]
[Complete]	[Complete]	[Complete]	[Complete]	[Complete]	[Complete]
[Complete]	[Complete]	[Complete]	[Complete]	[Complete]	[Complete]
[Complete]	[Complete]	[Complete]	[Complete]	[Complete]	[Complete]
[Complete]	[Complete]	[Complete]	[Complete]	[Complete]	[Complete]

6.3. Qualitative assessment of priority risks

Response template. Final Assignment: Qualitative assessment of priority risks.

Priority risk	Reason for priority	Most important control measure	Suggested person responsible
[Complete]	[Complete]	[Complete]	[Complete]
[Complete]	[Complete]	[Complete]	[Complete]
[Complete]	[Complete]	[Complete]	[Complete]

7. Environmental aspects associated with the activity

[Identify at least three environmental aspects associated with the activity analysed, together with their impacts, controls and improvements.]

Response template. Final Assignment: Environmental aspects associated with the activity.

Environmental aspect	Possible impact	Existing measures	Possible improvements
[For example: energy consumption]	[Complete]	[Complete]	[Complete]
[For example: waste generation]	[Complete]	[Complete]	[Complete]
[For example: dust, noise, effluent, water or chemicals]	[Complete]	[Complete]	[Complete]

8. Training, competence, communication and participation

Response template. Final Assignment: Training, competence, communication and participation.

Question	Response / evidence	Critical comment
What induction or continuing training is provided?	[Complete]	[Complete]

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Question	Response / evidence	Critical comment
Is specific training provided for higher-risk tasks?	[Complete]	[Complete]
Are toolbox talks, meetings or safety dialogues used?	[Complete]	[Complete]
Do workers participate in identifying hazards and improvements?	[Complete]	[Complete]
Is there evidence of competence beyond an attendance sheet?	[Complete]	[Complete]

9. Incidents, near misses and learning

[Analyse how the organisation records, investigates and learns from accidents, incidents or near misses. Where no actual data are available, use a hypothetical situation described by the interviewee.]

Response template. Final Assignment: Incidents, near misses and learning.

Subject	Evidence collected	Trainee analysis
Recording of accidents/incidents/near misses	[Complete]	[Complete]
Investigation method	[Complete]	[Complete]
Identification of immediate and organisational causes	[Complete]	[Complete]
Definition and follow-up of corrective actions	[Complete]	[Complete]
Communication of lessons learned	[Complete]	[Complete]

10. Documentation and evidence

[Identify documents that guide the activity and records demonstrating that something was carried out. Assess whether the documentation effectively controls risk or is merely formal.]

Response template. Final Assignment: Documentation and evidence.

Type of documented information	Exists? Yes/No/Unknown	Example or evidence	Comment on usefulness
OSH / QES policy	[Complete]	[Complete]	[Complete]
Risk assessment	[Complete]	[Complete]	[Complete]
Procedures / work instructions	[Complete]	[Complete]	[Complete]
Emergency plan / drills	[Complete]	[Complete]	[Complete]
Training records	[Complete]	[Complete]	[Complete]

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Type of documented information	Exists? Yes/No/Unknown	Example or evidence	Comment on usefulness
Inspection / maintenance records	[Complete]	[Complete]	[Complete]
Incident reports / corrective actions	[Complete]	[Complete]	[Complete]

11. Critical diagnosis

Response template. Final Assignment: Critical diagnosis.

Dimension	Main conclusions
Strengths	[Identify good practices observed or reported.]
Weaknesses	[Identify gaps, poorly controlled risks, absence of evidence or implementation difficulties.]
Opportunities for improvement	[Identify realistic improvements proportionate to the context.]

11.1. Critical summary

[Write 2 to 4 paragraphs interpreting the coherence between the formal system and real practice. Comment on leadership, participation, documentation, training, risk and continual improvement.]

12. Proposed improvement plan

[Propose 3 to 5 specific and realistic improvement actions linked to identified problems. Each action must include a suggested person responsible, a deadline and evidence of implementation.]

Response template. Final Assignment: Proposed improvement plan.

Problem identified	Proposed action	Suggested person responsible	Suggested deadline	Evidence of implementation / effectiveness
[Complete]	[Complete]	[Complete]	[Complete]	[Complete]
[Complete]	[Complete]	[Complete]	[Complete]	[Complete]
[Complete]	[Complete]	[Complete]	[Complete]	[Complete]
[Complete]	[Complete]	[Complete]	[Complete]	[Complete]
[Complete]	[Complete]	[Complete]	[Complete]	[Complete]

13. Conclusion

[Summarise the main findings of the diagnosis: what the organisation does well, the most relevant risks or gaps, and which improvement would have the greatest preventive impact. Briefly state what the trainee learned from the visit or interview.]

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14. Appendices

[Include only authorised and relevant appendices, for example: completed interview guide, observation checklist, photographs without identifiable persons, workstation diagram, list of documents consulted or a supplementary risk table.]

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Appendix A – Interview guide

Use this guide when the selected method is an interview. Adapt the questions to the interviewee's role and the company's sector.

1. What is the company's main activity?

Response: [Complete]

2. What is your role and how long have you worked in this activity?

Response: [Complete]

3. What are the main safety risks in your work?

Response: [Complete]

4. What measures are in place to control those risks?

Response: [Complete]

5. What training have you received to perform the work safely?

Response: [Complete]

6. Do workers participate in identifying hazards or improving conditions?

Response: [Complete]

7. Which documents or records are used in day-to-day work?

Response: [Complete]

8. Has an accident, incident or near miss occurred? How was it dealt with?

Response: [Complete]

9. Which environmental aspects are most relevant to the activity?

Response: [Complete]

10. Which improvement do you consider most important for strengthening safety?

Response: [Complete]

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Appendix B – Observation checklist for a visit

Use this guide when the selected method is a company visit.

Record template. Observation checklist for a visit.

Observation item	Yes	No	N/A	Notes
Is the location clean, tidy and arranged for safe movement?	☐	☐	☐	[Complete]
Are the main hazards signposted?	☐	☐	☐	[Complete]
Is suitable PPE available and used?	☐	☐	☐	[Complete]
Do machinery/equipment have guards and visible evidence of maintenance?	☐	☐	☐	[Complete]
Are instructions or procedures accessible at the point of use?	☐	☐	☐	[Complete]
Are emergency arrangements identified?	☐	☐	☐	[Complete]
Are communication or participation practices observable?	☐	☐	☐	[Complete]
Are relevant environmental aspects controlled?	☐	☐	☐	[Complete]
Are records or other evidence available for consultation?	☐	☐	☐	[Complete]

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