Integrating Computer Vision, Smart Glasses, Multimodal Artificial Intelligence, Edge Computing and Digital Twins, with Applications in Water and Wastewater Infrastructure/ By: Dr. Hossein Ataei Far

Abstract

The convergence of artificial intelligence (AI), computer vision (CV), smart glasses, augmented reality (AR), multimodal AI, edge computing and Digital Twin technologies is creating significant opportunities to transform industrial inspection and equipment condition assessment. Although these technologies have demonstrated individual capabilities in manufacturing, infrastructure inspection and industrial maintenance, their integration into a unified, reliable and engineering-oriented inspection ecosystem remains an important technological and research challenge [1–4].

This article examines the complementary contributions of these technologies to intelligent industrial inspection, drawing on six international industrial and research initiatives: Airbus Helicopters and TeamViewer, Clorox and Vuzix, the European Twinspect project, Tech Mahindra's augmented-reality inspection solution, Fraunhofer's Glass@Service initiative and Optelos' AI-enabled infrastructure inspection platform [5–10]. These initiatives provide practical examples of wearable inspection, remote assistance, computer vision, automated defect identification and digital asset representation.

Building on this assessment, the article proposes an integrated seven-layer architecture connecting physical infrastructure, wearable sensing, computer vision, multimodal AI, edge intelligence, Digital Twins and enterprise asset-management systems. Its practical application is examined through the inspection and condition assessment of industrial equipment in municipal water and wastewater treatment plants. A centrifugal pump is used as the principal illustrative case study to demonstrate how these technologies can operate together within a coherent engineering workflow.

The article also establishes the foundation for a structured validation framework to evaluate the technical, operational and economic performance of integrated inspection systems. Particular attention is given to distinguishing independently validated research findings from supplier-reported commercial results, documented project capabilities and proposed future developments.

The central argument is that the greatest opportunity does not lie in deploying individual technologies independently, but in integrating them into an interoperable, secure and human-supervised system capable of converting inspection observations into traceable engineering information and actionable maintenance decisions. The proposed architecture

provides a foundation for future research, industrial benchmarking and pilot implementation in water and wastewater infrastructure.

Keywords: Artificial Intelligence; Industrial Inspection; Computer Vision; Smart Glasses; Multimodal AI; Digital Twin; Edge Computing; Augmented Reality; Predictive Maintenance; Asset Management; Equipment Condition Assessment; Centrifugal Pumps; Water and Wastewater Infrastructure.

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1. Introduction

Industrial inspection is fundamental to equipment reliability, operational safety, product quality, infrastructure performance and sustainable asset management. Conventional inspection practices frequently depend on manual observations, paper-based documentation, separate measurement instruments and the experience of individual technicians and engineers.

Although these methods remain essential, they can introduce several operational limitations:

- Time-consuming inspection and documentation procedures.
- Inconsistent interpretation of equipment abnormalities.
- Limited access to historical inspection records during fieldwork.
- Delays in obtaining specialist technical support.
- Fragmented information across operational, engineering and maintenance systems.
- Difficulties connecting observed defects with equipment history and deterioration trends.
- Limited opportunities for systematic analysis of accumulated inspection data.

These challenges are particularly relevant to infrastructure-intensive sectors such as municipal water and wastewater treatment, where large numbers of mechanical, electrical and process assets must operate reliably under demanding environmental and operational conditions.

Effective asset management requires organisations to consider asset performance, risk, lifecycle value and the quality of information supporting management decisions. The ISO 55000 series provides an internationally recognised foundation for these principles, while ISO 55001 establishes requirements for an asset-management system [11–13].

Recent developments in artificial intelligence and industrial digitalisation provide opportunities to address some of the limitations of conventional inspection practices [1,2].

The integration of computer vision, wearable technologies, multimodal AI and Digital Twins could enable an engineer inspecting industrial equipment to capture its physical condition, automatically identify its components, retrieve relevant technical information, compare current observations with historical records and document findings directly within an asset-management system [1–4].

A more advanced system could combine these observations with vibration, temperature, pressure, flow and electrical measurements to support a more comprehensive condition assessment. Structured reliability and maintenance information can further strengthen the relationship between inspection observations and asset performance [15].

The fundamental opportunity is therefore to move beyond digital inspection documentation towards intelligent, context-aware and evidence-based inspection. However, successful implementation requires more than the availability of advanced AI models or wearable devices. It requires reliable data acquisition, appropriate engineering interpretation, interoperability, cybersecurity, human validation and measurable operational benefits.

1.1 The Centrifugal Pump as a Central Engineering Case Study

To establish a consistent engineering context throughout the article, the intelligent inspection of a centrifugal pump in a municipal wastewater treatment plant is adopted as the principal illustrative application.

Centrifugal pumps are widely used in wastewater collection, transfer, treatment and sludge-handling processes. Their operational condition can be affected by several interacting mechanical, hydraulic, electrical and environmental factors.

Relevant inspection observations and measurements may include:

- Corrosion and deterioration of external surfaces.
- Leakage around mechanical seals and associated connections.
- Damage to protective coatings and insulation.
- Abnormal vibration and bearing-related symptoms.
- Excessive operating temperature.
- Abnormal noise and changes in operating behaviour.
- Motor condition and electrical performance.
- Changes in suction and discharge pressure.
- Changes in flow rate and operating efficiency.
- Evidence of misalignment or abnormal mechanical movement.

Conventional inspection may identify some of these conditions through visual observation and separate measurement instruments. However, the information is often recorded in different formats and may not be immediately available to the engineer conducting the inspection.

An integrated AI-enabled inspection system could connect these information sources. For example, an engineer wearing smart glasses could inspect a centrifugal pump while the system identifies the equipment, retrieves its technical specifications, displays the relevant inspection procedure and captures images of its external condition.

Computer vision could identify visible abnormalities, such as corrosion, leakage indications or damaged protective coatings. Multimodal AI could then compare the observations with historical inspection records, equipment manuals and available operational measurements.

The Digital Twin could associate these findings with the corresponding pump, its components, maintenance history and operating information. Following engineering review, validated findings could be transferred to the organization's computerized maintenance management system (CMMS) or enterprise asset-management (EAM) platform.

This example provides a consistent practical reference for examining the contribution of each enabling technology.

It is important to distinguish between detecting a visible abnormality and establishing its engineering significance. For example, detecting corrosion on a pump casing does not independently establish the remaining wall thickness, corrosion rate, structural integrity or probability of failure. Such conclusions require appropriate measurements, engineering assessment and, where necessary, additional inspection techniques.

The role of AI is therefore to strengthen inspection, information retrieval, anomaly screening and decision support—not to replace qualified engineering judgement.

1.2 Research Questions

This article addresses four principal questions:

1. How can computer vision, smart glasses, multimodal AI, edge computing and Digital Twins be integrated into a coherent industrial inspection architecture?
2. What can be learned from existing international industrial and research implementations, and how strong is the evidence supporting their reported capabilities and results?

3. How can the proposed architecture be implemented and objectively evaluated under real industrial operating conditions?
4. What technical, operational, organisational and economic considerations should guide its application in municipal water and wastewater infrastructure?

1.3 Research Objectives and Principal Contributions

The principal objective is to establish a technically credible and practically implementable framework for integrating emerging digital technologies into industrial inspection and equipment condition assessment.

The article aims to:

1. Examine the technological foundations of AI-enabled industrial inspection.
2. Evaluate relevant international industrial and research initiatives.
3. Identify technological capabilities, limitations and integration gaps.
4. Develop a proposed seven-layer architecture for intelligent inspection.
5. Demonstrate the architecture through a centrifugal-pump inspection scenario.
6. Establish a methodology for technical, operational and economic validation.
7. Identify implementation requirements for municipal water and wastewater infrastructure.

The distinction between the technological foundations and the proposed architecture is important. The article examines six principal technological capabilities in the following section. These capabilities are subsequently organised into seven functional layers to describe how an integrated inspection system could operate.

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2. Technological Foundations of Integrated Industrial Inspection

An effective AI-enabled inspection programme should be understood as an interconnected architecture rather than a collection of independent applications.

Six technological capabilities are particularly important:

1. Computer vision.
2. Smart glasses.
3. Augmented reality.
4. Multimodal artificial intelligence.
5. Edge computing.
6. Digital Twin technologies.

Robotics and Physical AI represent an additional development pathway that can extend inspection capabilities beyond conventional human-operated workflows.

The following sections examine these technologies and their relevance to the centrifugal-pump inspection scenario.

2.1 Computer Vision: Automated Visual Recognition and Defect Detection

Computer vision enables machines to interpret images and video captured through cameras, drones, mobile devices and smart glasses.

In industrial inspection, computer vision can support:

- Equipment and component identification.
- Detection of visible corrosion, cracks, leakage and surface deterioration.
- Recognition of damaged insulation and protective coatings.
- Identification of missing or incorrectly installed components.
- Reading equipment nameplates and serial numbers through optical character recognition (OCR).
- Detection of abnormal visual conditions.
- Comparison of inspection images over time.
- Visual localization and classification of potential defects.

Modern object-detection architectures, including YOLO-based models, can identify and classify objects in images or video streams. More advanced approaches can incorporate image segmentation, object tracking, anomaly detection and visual change analysis [2]. Research on the integration of computer vision and Digital Twins also identifies opportunities for industrial monitoring, defect detection, process optimisation, safety and maintenance [1].

Application to centrifugal-pump inspection

A camera mounted on smart glasses could capture images of a centrifugal pump during routine inspection. Computer vision could potentially identify:

- Pump casing and associated components.
- Motor and coupling arrangements.
- Visible corrosion.
- Leakage indications around the mechanical seal.
- Damaged protective coatings.
- Missing or displaced external components.
- Equipment labels and identification numbers.

The system could associate detected observations with the corresponding equipment and inspection location.

Where historical photographs are available, image-comparison techniques could help identify visible changes between successive inspections.

Nevertheless, identifying an object or detecting a visible anomaly does not automatically establish its engineering significance.

For example, detecting corrosion on a pump casing does not determine the remaining wall thickness, corrosion rate, structural integrity or probability of failure. Similarly, identifying a possible leakage indication does not establish its cause or severity.

Computer vision should therefore be regarded as a visual inspection and anomaly-screening capability that supports, rather than replaces, engineering assessment.

2.2 Smart Glasses: Connecting Field Personnel with Digital Information

Smart glasses provide a wearable interface through which technicians and engineers can access information while maintaining their attention on the equipment being inspected.

Their principal capabilities may include:

- Hands-free image and video capture.
- Voice-controlled interaction.
- Display of inspection instructions and equipment information.
- Access to digital maintenance procedures.
- Remote expert assistance.
- Real-time communication and documentation.
- Integration with inspection and enterprise information systems.
- Contextual visual guidance when combined with augmented reality.

Research has examined the use of smart glasses in industrial quality-control applications, including their integration with image-recognition systems for real-time inspection [2].

Application to centrifugal-pump inspection

An engineer approaching a pump could use smart glasses to:

1. Capture the pump's nameplate and equipment identifier.
2. Retrieve the relevant asset record.
3. Access the pump's technical specifications.
4. Display the inspection checklist.
5. Capture images and video without holding a separate device.
6. Record voice notes describing observed conditions.
7. Request remote assistance from a specialist.
8. Submit inspection observations for subsequent engineering review.

The wearable interface can reduce the need to alternate continuously between the equipment, a handheld device and paper-based documentation.
However, practical deployment depends on several factors, including ergonomics, worker acceptance, battery life, camera performance, industrial environmental conditions, network connectivity and compatibility with existing information systems.
Smart glasses should be understood as a means of improving access to information and supporting field activities, rather than as an independent diagnostic technology.

2.3 Augmented Reality: Contextualizing Engineering Information

Augmented reality enhances the physical environment by overlaying digital information onto the user's view of real objects.
Unlike virtual reality, which replaces the user's perception of the physical environment with a virtual one, AR supplements the real environment with contextual digital information.
In industrial maintenance and inspection, AR can provide:

- Component identification.
- Visual inspection instructions.
- Equipment specifications.
- Maintenance procedures.
- Safety information.
- Measurement locations.
- Assembly and disassembly guidance.
- Remote expert annotations.
- Contextual technical visualization.

Systematic research reviews have examined AR applications in maintenance, identifying potential benefits as well as limitations involving tracking, hardware, usability and human–computer interaction [3,4].

Application to centrifugal-pump inspection

During pump inspection, an AR interface could display:

- The pump and motor identification.
- The location of relevant components.
- Mechanical-seal inspection instructions.
- Bearing inspection points.
- Coupling and alignment information.
- Recommended measurement locations.
- Applicable safety instructions.

- Previous inspection observations.

For example, when the engineer views the pump through the smart-glasses display, the system could overlay component labels and indicate the locations where temperature or vibration measurements should be collected.

This could improve the consistency of inspection procedures and support less experienced personnel.

However, the accuracy of AR information depends on reliable spatial registration between digital content and the physical equipment.

Incorrect component identification, poor tracking or misaligned visual overlays could introduce confusion or operational risk. AR content must therefore be validated against the equipment configuration and approved technical documentation.

2.4 Multimodal Artificial Intelligence: Interpreting Visual, Verbal and Operational Information

Multimodal AI represents an important development beyond conventional image-recognition systems.

Instead of processing images independently, multimodal models can combine different information sources, including:

- Images and video.
- Spoken questions and voice commands.
- Text-based inspection procedures.
- Equipment manuals and technical specifications.
- Historical maintenance records.
- Sensor measurements.
- Operational and environmental data.

The integration of computer vision and Digital Twins provides a relevant foundation for exploring more context-sensitive industrial AI applications. Recent research has also identified the combination of Digital Twins and vision-language models as a potential future development direction [1].

This creates opportunities for more natural interaction between engineers and inspection systems.

Application to centrifugal-pump inspection

An engineer could ask:

"Is this pump showing any visible signs of deterioration compared with its previous inspection?"

An integrated multimodal AI assistant could potentially:

1. Identify the pump through its visual characteristics or asset identifier.
2. Retrieve previous inspection photographs.
3. Compare current and historical visual observations.
4. Identify potentially new or developing abnormalities.
5. Retrieve relevant maintenance records.
6. Present applicable inspection procedures.
7. Identify additional measurements that may be required.
8. Prepare a preliminary inspection report for engineering review.

The system could also correlate visual observations with available vibration, temperature, pressure, flow and electrical measurements.

For example, a visual observation of possible seal leakage could be considered alongside maintenance history and operating conditions. The AI system could identify relevant information and indicate whether further investigation is appropriate.

However, correlation does not automatically establish causation. A model should not infer a mechanical failure solely from the coexistence of a visual anomaly and an abnormal sensor reading.

AI-generated conclusions must remain traceable to their supporting evidence. Engineering recommendations should not be accepted solely because a language model produces a convincing explanation.

The system should distinguish between:

- Directly observed facts.
- Computer-vision detections.
- Retrieved historical information.
- AI-generated interpretations.
- Engineering recommendations.
- Decisions approved by qualified personnel.

This separation is essential for technical traceability, accountability and safe industrial application.

2.5 Edge Computing: Enabling Responsive and Reliable Inspection

Industrial inspection systems can generate substantial quantities of image, video and sensor data.

Transmitting all this information to remote cloud infrastructure can introduce latency, bandwidth limitations, connectivity dependencies and data-security concerns.

Edge computing addresses these challenges by processing selected information close to the point of data collection.

Potential applications include:

- Real-time equipment identification.
- Local object detection and anomaly screening.
- Image-quality assessment.
- Initial defect classification.
- Data filtering and compression.
- Offline inspection support.
- Selective transmission of relevant information to central systems.

Application to centrifugal-pump inspection

A practical system could perform initial visual processing on an industrial computer, embedded processor or edge device.

For example:

1. Images captured by smart glasses are transferred to a nearby processing device.
2. The edge system identifies the pump and checks image quality.
3. Computer vision performs initial component recognition and anomaly screening.
4. Relevant observations are stored locally with timestamps and equipment identifiers.
5. Selected information is transmitted to central systems when connectivity is available.

More computationally demanding multimodal analysis and historical-data processing could take place on secure central infrastructure.

The appropriate balance between edge and cloud processing depends on operational requirements, connectivity, cybersecurity, computational resources and data-governance arrangements.

A hybrid architecture is therefore likely to be more practical than relying exclusively on either local or cloud-based processing.

2.6 Digital Twins: Connecting Inspection Findings with Asset History

Digital Twins provide digital representations of physical assets, processes or systems, supported by relevant engineering, operational and lifecycle information.

The integration of computer vision and Digital Twins is an important area of industrial research, with applications in monitoring, defect detection, process optimisation and maintenance [1].

For industrial inspection, a Digital Twin can connect:

- Asset identification and technical specifications.
- Equipment geometry and component structure.
- Design and operating parameters.
- Inspection history.
- Maintenance interventions.
- Condition-monitoring measurements.
- Detected defects and their locations.
- Operational performance.
- Deterioration and lifecycle information.

The distinction between a conventional three-dimensional model and a Digital Twin is important.

A 3D model may represent the physical geometry of an asset. A Digital Twin should additionally maintain meaningful relationships with the physical asset through relevant data, updates and operational context.

The ISO 23247 series provides a framework for Digital Twins in manufacturing. Its concepts can inform industrial Digital Twin architecture, although it should not be interpreted as a complete sector-specific standard for municipal wastewater infrastructure [16].

Application to centrifugal-pump inspection

A Digital Twin of a centrifugal pump could connect its physical configuration with:

- Manufacturer and equipment information.
- Pump and motor specifications.
- Component identification.
- Operating conditions.
- Historical inspection photographs.
- Maintenance and repair records.
- Vibration measurements.
- Bearing and motor temperatures.
- Suction and discharge pressure.
- Flow measurements.
- Previous inspection findings.

When computer vision identifies a possible defect, the observation could be associated with the relevant pump component and location.

For example, an image showing a possible corrosion anomaly could be linked to the corresponding casing area, inspection date and previous observations.
The engineer could then compare the current finding with historical information and determine whether additional inspection or measurement is necessary.
This provides a more structured basis for condition assessment and lifecycle decision-making.
Nevertheless, the reliability of the Digital Twin depends on the quality, completeness, consistency and timeliness of the underlying data. An incomplete or incorrectly updated digital representation may create misleading conclusions.

2.7 Robotics and Physical AI: Extending Inspection Beyond Human Accessibility

The integration of inspection technologies with robotics provides another important development pathway.
Mobile robots, autonomous inspection platforms, drones and quadruped robots can access locations that may be difficult, hazardous or inefficient for personnel to inspect.
Potential applications include:

- Inspection of pipelines and confined industrial spaces.
- Monitoring of large tanks and storage facilities.
- Inspection of bridges and other infrastructure.
- Thermal and visual inspection of electrical installations.
- Autonomous monitoring of industrial facilities.
- Inspection of hazardous or difficult-to-access equipment.

When combined with computer vision, multimodal AI and Digital Twins, robotic platforms could eventually perform more complex inspection activities, interpret their surroundings and communicate findings through natural language.
In a wastewater treatment plant, for example, a mobile robotic platform could support routine visual monitoring of selected areas, while drones could assist with inspection of elevated structures or difficult-to-access infrastructure.
Such applications require additional attention to navigation, obstacle avoidance, functional safety, communication reliability, environmental suitability and human supervision. Machinery risk assessment and risk-reduction principles are relevant when considering the safe integration of robotic inspection systems [19].
Robotics and Physical AI should therefore be regarded as an extension of the integrated inspection ecosystem rather than a substitute for the six foundational capabilities discussed above.

2.8 Relationship Between the Six Foundational Technologies

The six principal technologies perform different but complementary functions.

Computer Vision

Primary function: Interprets images and identifies visual patterns **Application to centrifugal-pump inspection:** Detects visible corrosion, leakage indications, damaged coatings and components

Smart Glasses

Primary function: Provides a wearable interface for field personnel **Application to centrifugal-pump inspection:** Captures images, records observations and provides hands-free access to information

Augmented Reality

Primary function: Overlays contextual digital information onto the physical environment **Application to centrifugal-pump inspection:** Displays component labels, inspection instructions and measurement locations

Multimodal AI

Primary function: Combines visual, textual, verbal and operational information **Application to centrifugal-pump inspection:** Interprets observations alongside manuals, maintenance history and sensor measurements

Edge Computing

Primary function: Processes information close to the point of data acquisition **Application to centrifugal-pump inspection:** Supports local image processing, responsive operation and selective data transmission

Digital Twin

Primary function: Connects physical assets with engineering, operational and lifecycle information **Application to centrifugal-pump inspection:** Associates inspection findings with pump components, specifications and historical records

These technologies should not be treated as interchangeable.

Smart glasses provide the wearable interface, while augmented reality provides contextual digital visualization. Computer vision interprets visual information, whereas multimodal AI combines different information sources to support more comprehensive interpretation. Edge computing provides local processing capabilities, while the Digital Twin connects inspection observations with the wider engineering and asset-management context. Their integration creates the technological foundation for the proposed seven-layer architecture.

Importantly, the six technologies described in this section represent **foundational capabilities**, not six architectural layers. The seven-layer architecture developed later in the article describes how these capabilities can be organised into an integrated industrial inspection system.

The proposed architecture comprises:

1. Physical Infrastructure and Equipment.
2. Wearable Sensing and Data Acquisition.
3. Computer Vision and Visual Intelligence.
4. Multimodal AI and Engineering Interpretation.
5. Edge Computing and Data Processing.
6. Digital Twin and Asset Intelligence.
7. Enterprise Asset Management and Maintenance Decision Support.

This distinction provides a clear transition from the examination of individual technologies to the design of an integrated, operationally meaningful inspection framework.

References

A. Scientific Literature

[1] Faqeer, H. A., & Khajavi, S. H. (2025). Digital Twin and Computer Vision Combination for Manufacturing and Operations: A Systematic Literature Review. *Applied Sciences*, 15(18), 10157.
https://doi.org/10.3390/app151810157

[2] Silva, J., Coelho, P., Saraiva, L., Vaz, P., Martins, P., & López-Rivero, A. (2024). Validating the Use of Smart Glasses in Industrial Quality Control: A Case Study. *Applied Sciences*, 14(5), 1850.
https://doi.org/10.3390/app14051850

[3] Palmarini, R., Erkoyuncu, J. A., Roy, R., & Torabmostaedi, H. (2018). A systematic review of augmented reality applications in maintenance. *Robotics and Computer-Integrated Manufacturing*, 49, 215–228.
https://doi.org/10.1016/j.rcim.2017.06.002

[4] del Amo, I. F., Erkoyuncu, J. A., Roy, R., Palmarini, R., & Onoufriou, D. (2018). A systematic review of Augmented Reality content-related techniques for knowledge transfer in maintenance applications. *Computers in Industry*, 103, 47–71.
https://doi.org/10.1016/j.compind.2018.08.007

B. Industrial and Research Project Sources

[5] TeamViewer. *Paperless Inspection at Airbus Helicopters: TeamViewer Frontline and Smart Glasses Case Study*. Company case study. https://static.teamviewer.com/resources/2022/01/012022-1_TeamViewer_Case_Study_Airbus_xInspect_EN.pdf

[6] Vuzix. *Clorox: Smart Glasses for Remote Audits, Maintenance and Worker Support*. Company case study. https://net4connect.com/wp-content/uploads/2023/03/vuzix-case-study-auditing-clorox-one.pdf

[7] European Commission. *Twinspect: First Fast and Automated AI-Based Inspection to Increase Operational Safety of Large Critical Infrastructure*. CORDIS, Grant Agreement No. 190140847. Project period: 1 December 2023–30 November 2025. https://cordis.europa.eu/project/id/190140847

[8] Tech Mahindra. *Transforming Rig Site Inspection and Maintenance with Augmented Reality*. Company case study. https://insights.techmahindra.com/assets/augmented-reality-case-study.pdf

[9] Fraunhofer FEP. *Glass@Service: Smart Glasses for Industrial Applications*. Fraunhofer project description. https://www.fep.fraunhofer.de/en/Geschaeftsfelder/Mikrodisplays_und_Sensorik/glass-at-service.html

[10] Optelos. *Automate Transmission Line Inspections: Computer Vision AI and Geospatial Inspection Workflow*. Company case study. https://optelos.com/power-utilities/automate-transmission-line-inspections/

C. International Standards

[11] ISO 55000:2024. *Asset management — Vocabulary, overview and principles*. International Organization for Standardization.

[12] ISO 55001:2024. *Asset management — Asset management system — Requirements*. International Organization for Standardization.

[13] ISO 55002:2018. *Asset management — Management systems — Guidelines for the application of ISO 55001*. International Organization for Standardization.

[14] ISO 55013:2024. *Asset management — Guidance on the management of data assets*. International Organization for Standardization.

[15] ISO 14224:2016. *Petroleum, petrochemical and natural gas industries — Collection and exchange of reliability and maintenance data for equipment*. International Organization for Standardization.

[16] ISO 23247 series. *Automation systems and integration — Digital Twin framework for manufacturing*. International Organization for Standardization.
[17] ISO/IEC 42001:2023. *Information technology — Artificial intelligence — Management system*. International Organization for Standardization and International Electrotechnical Commission.
[18] IEC 62443 series. *Industrial communication networks — Network and system security*. International Electrotechnical Commission.
[19] ISO 12100:2010. *Safety of machinery — General principles for design — Risk assessment and risk reduction*. International Organization for Standardization.