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ARTICLE

# ARTIFICIAL INTELLIGENCE IN BUSINESS PROCESS MANAGEMENT: CHALLENGES, OPPORTUNITIES AND STRATEGIES FOR ALIGNMENT WITH ISO 42001

## Inteligência Artificial no Gerenciamento de Processos de Negócio: Desafios, Oportunidades e Estratégias para Alinhamento à ISO 42001

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**ABSTRACT | Purpose:** This study aims to analyze the main challenges, opportunities, and strategies for aligning Artificial Intelligence (AI)-based Business Process Management (BPM) practices with the ISO/IEC 42001 standard. It seeks to understand how organizations can integrate principles of AI governance, risk management, and explainability into BPM to ensure responsible, transparent, and auditable automation of business processes. **Methodology:** The research adopts a qualitative approach through an integrative literature review structured according to the PRISMA protocol. Searches were conducted in the Scopus and Web of Science databases, covering the period from 2015 to 2025, resulting in a final corpus of 22 articles. The analyzed studies address topics such as Explainable AI (XAI), process mining, algorithmic governance, compliance, and semantic data management. The content analysis followed Bardin's (2008) method, organizing the findings into three dimensions: challenges, opportunities, and strategies. **Findings:** The results indicate that the alignment between BPM and ISO/IEC 42001 involves three main axes: (i) governance and transparency, (ii) data and semantic infrastructure, and (iii) sociotechnical adoption factors. The concept of "dual transparency" (technical and operational) and a layered compliance architecture (design-time, run-time, and post-hoc) are highlighted, supported by process mining, human oversight, and explainable interfaces. **Theoretical And Practical Implications:** The study presents a theoretical and operational framework that connects BPM to ISO/IEC 42001, guiding organizations on how to embed AI governance principles in process design, monitoring, and continuous improvement. For practitioners, it provides practical guidance to strengthen auditability, reduce algorithmic risks, and enhance corporate responsibility in digital environments. **Originality And Value:** This paper is among the first to integrate BPM and the ISO/IEC 42001 standard, proposing a systematic interpretation of AI management requirements within organizational contexts. It advances the debate on algorithmic governance by showing how process-oriented methodologies can operationalize ethical, transparent, and compliant AI systems.

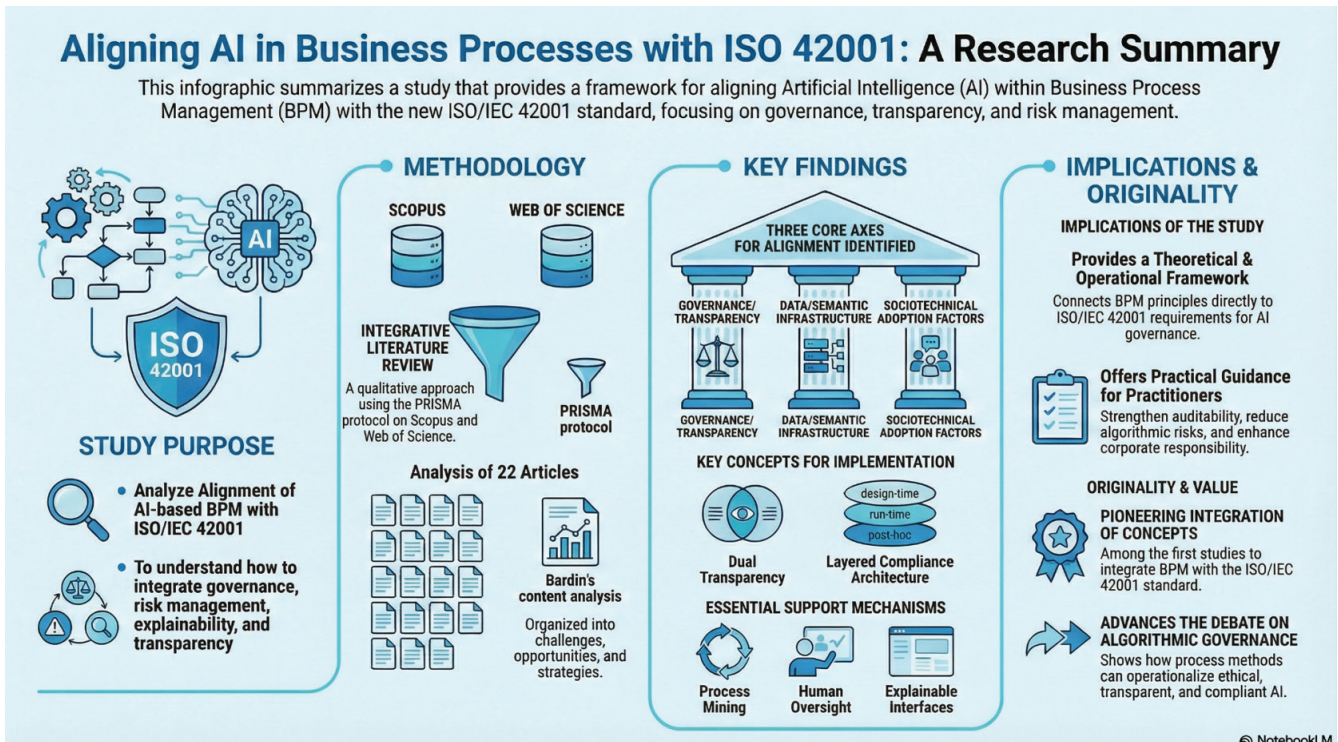
**Keywords |** Artificial Intelligence; Business Process Management; ISO/IEC 42001; Algorithmic Governance; Explainability.





**RESUMO | Propósito:** Este estudo tem como objetivo analisar os principais desafios, oportunidades e estratégias de alinhamento entre as práticas de *Business Process Management* (BPM) mediadas por Inteligência Artificial (IA) e os requisitos da norma ISO/IEC 42001, buscando compreender como as organizações podem integrar princípios de governança, gestão de riscos e explicabilidade ao BPM para assegurar uma automação responsável, transparente e auditável dos processos de negócio. **Metodologia:** A pesquisa adota uma abordagem qualitativa por meio de uma revisão integrativa da literatura estruturada segundo o protocolo PRISMA, com buscas realizadas nas bases Scopus e Web of Science, cobrindo o período de 2015 a 2025 e resultando em um corpus final de 22 artigos que discutem Explainable AI (XAI), mineração de processos, governança algorítmica, conformidade e gestão semântica de dados; a análise de conteúdo seguiu o método de Bardin (2008). **Resultados:** Os achados indicam que o alinhamento entre BPM e ISO/IEC 42001 envolve três eixos centrais relacionados à governança e transparência, infraestrutura de dados e semântica e fatores sociotécnicos de adoção, destacando a noção de dupla transparência técnica e operacional e a proposta de uma arquitetura de conformidade em camadas composta por momentos de design-time, run-time e post-hoc apoiada por mineração de processos, supervisão humana e interfaces explicáveis. **Implicações teóricas e práticas:** O estudo apresenta um framework teórico e operacional que orienta organizações sobre a incorporação de princípios de governança da IA no desenho, monitoramento e melhoria contínua de processos, contribuindo para fortalecer a auditabilidade, reduzir riscos algorítmicos e aprimorar a responsabilidade corporativa. **Originalidade e valor:** O artigo é um dos primeiros a integrar BPM e a ISO/IEC 42001, avançando o debate sobre governança algorítmica ao demonstrar como metodologias orientadas a processos podem apoiar o desenvolvimento de sistemas de IA éticos, transparentes e alinhados à conformidade regulatória.

**Palavras-chave |** Inteligência Artificial; Business Process Management; ISO/IEC 42001; Governança Algorítmica; Explicabilidade.





## 1 INTRODUCTION

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The emergence of Artificial Intelligence (AI) as a driving force for organizational transformation profoundly redefines how companies design, operate, and evaluate their business processes. In recent years, the rapid evolution of machine learning, deep learning, natural language processing, and autonomous systems has led to the creation of sophisticated models capable of performing tasks previously exclusive to humans (Benraouane, 2024). In the context of Business Process Management (BPM), these technologies have been incorporated to promote intelligent automation, predictive optimization, and large-scale personalization (Khazieva et al., 2024; Ricciardi Celsi & Zomaya, 2025).

However, despite the exponential growth of studies on the potential of AI in BPM, there is a lack of consolidated guidelines to ensure that intelligent systems operate in compliance with governance, transparency, traceability, and organizational accountability requirements (Biroğul et al., 2025; McIntosh et al., 2024). The introduction of the ISO/IEC 42001 standard represents a milestone in this scenario, establishing international normative parameters for AI system management, covering the entire algorithm life cycle—from design and implementation to continuous monitoring and decommissioning.

Despite this normative advancement, there remains a significant difficulty in effectively and pragmatically aligning AI-driven BPM practices with the complex and interdependent requirements of ISO 42001. This challenge is not merely operational but also conceptual, methodological, and cultural, manifesting in the absence of integrated governance models, the lack of standardized metrics to assess algorithmic transparency, and regulatory uncertainty caused by overlapping frameworks (e.g., AI Act, GDPR, Data Act, and DORA) (Botunac et al., 2024). Rybalko (2024) emphasizes that AI should be understood as a construct of human intellect that mirrors rationality and creativity, expanding the boundaries of knowledge and challenging the very notion of rational cognition. Complementarily, Silva and Janes (2023) reinforce that the global expansion of AI requires the development of regulatory frameworks that balance innovation and responsibility, especially in contexts of accelerated technological adoption. Thus, the literature has converged toward the normative advancement of AI governance.

In parallel, BPM has been consolidated over the past decades as an interdisciplinary field that integrates strategic management, process engineering, and information systems. Its historical evolution encompasses the development of frameworks such as Business Process Model and Notation (BPMN), Six Sigma, and Lean Management, along with the progressive adoption of digital workflows (Campos & Carreiro, 2024). However, the advent of AI-based solutions marks a qualitative shift in this trajectory by enabling unprecedented predictive, adaptive, and automation capabilities (Biroğul et al., 2025).

At the same time, the global regulatory landscape has become increasingly restrictive, reflecting social concerns regarding algorithmic bias, lack of explainability, and risks to privacy and fundamental rights (McIntosh et al., 2024). In this environment, organizations face growing pressure to demonstrate that their AI systems are auditable, reliable, and aligned with internationally recognized standards. ISO/IEC 42001 thus emerges as the first specific standard



for AI management systems, offering a comprehensive framework encompassing governance principles, risk assessment, and mitigation of adverse impacts (Benraouane, 2024).

The convergence between BPM and ISO 42001 is beginning to be explored in studies on risk management and digital compliance (Campos & Carreiro, 2024). McIntosh et al. (2024) analyze how frameworks such as COBIT and ISO 42001 can be integrated to mitigate risks in the commercialization of large language models. Campos and Carreiro (2024) highlight that organizations constantly face tensions between innovation and compliance, particularly in regulated sectors. Although some studies address AI integration into BPM (Khazieva et al., 2024) and others focus on AI governance under ISO 42001 (Benraouane, 2024), few approaches systematically reconcile BPM practices with the normative and governance requirements of ISO 42001—especially regarding the simultaneous operationalization of process performance metrics and algorithmic compliance indicators.

To address this research gap, this study poses three research questions:

- **RQ1:** What are the main challenges in aligning AI-driven BPM practices with ISO/IEC 42001?
- **RQ2:** What opportunities arise from adopting ISO 42001 in AI-mediated business processes?
- **RQ3:** What strategies have been proposed to integrate ISO 42001 requirements into AI practices in BPM?

To answer these questions, this paper adopts an integrative literature review (Snyder, 2019) aimed at identifying, categorizing, and critically analyzing the challenges, opportunities, and strategies associated with aligning AI-enabled BPM practices with ISO 42001. The article contributes by proposing an integrative framework that connects AI-driven BPM practices with the governance, risk, and explainability requirements of ISO/IEC 42001. This approach provides a conceptual and operational foundation for translating normative principles into auditable process management practices, promoting transparency, compliance, and organizational learning in intelligent systems. Given the technical nature of the topic, a theoretical framework was developed to support the analysis on solid conceptual grounds.

## 2 THEORETICAL FRAMEWORK

Recent literature on AI has evolved beyond a purely technical view, incorporating philosophical, epistemological, and sociotechnical dimensions that help to understand how intelligent systems interact with organizational processes. Rybalko (2024) discusses the evolution of AI from a constructivist perspective, arguing that AI reflects the human capacity to design and create, and that its development requires understanding the brain as a dynamic system of reasoning and learning. This view broadens the understanding of AI as a cognitive artifact that coevolves with social and technological systems, reinforcing the need for integrated approaches between natural and artificial cognition. Joska Junior et al. (2023) analyzes the practical application of AI in technology-based companies, showing how its adoption is linked to strengthening organizational efficiency and collective learning through the socialization of knowledge. The study highlights that the internalization of intelligent tools depends both on technological infrastructure and on



organizational culture and employee engagement, indicating that AI becomes a driver of innovation when combined with collaborative practices and knowledge management.

From this perspective, literature converges on the recognition that the organizational value generated by AI depends on its alignment with ethical, governance, and continuous learning principles. These findings are consistent with contemporary approaches that emphasize the integration of algorithmic governance, process management, and social responsibility. Banerjee et al. (2023), for instance, emphasizes the role of international standards such as ISO/IEC 42001 in structuring transparent, auditable, and human-centered AI management systems. Collectively, these studies reinforce the importance of understanding AI not merely as automation technology but as a cognitive and ethical infrastructure that redefines the boundaries of business process management, based on principles of explainability, traceability, and dynamic compliance.

## 2.1 Overview of ISO/IEC 42001

ISO/IEC 42001:2023 is the first international standard to establish requirements for an Artificial Intelligence Management System (AIMS), focusing on demonstrable governance, risk management, and the safe and responsible operation of AI systems throughout their entire life cycle. Unlike technical guides or codes of conduct, it is a certifiable management standard built on the ISO high-level structure, which facilitates integration with existing systems such as ISO 9001 (quality) and ISO/IEC 27001 (information security), as well as IT and cybersecurity frameworks (Benraouane, 2024; Gueorguiev, 2024; McIntosh et al., 2024).

In terms of scope, ISO/IEC 42001 is both technology-agnostic and sector-agnostic. It does not prescribe algorithms, specific techniques, or single metrics. Instead, it defines what an organization must establish to plan, operate, monitor, and improve the management of its AI systems proportionally to the associated risk. This process-oriented and risk-based approach makes it suitable for diverse contexts such as financial services, healthcare, automotive industries, and public administration, while requiring evidence that the management system operates effectively in practice (Biroğul et al., 2025; Nelson & Lin, 2025; Ranjbar et al., 2024).

The structure follows the PDCA logic and the process-based approach. In the Plan phase, the organization identifies risks and stakeholders, sets objectives, defines controls and acceptance criteria, allocates resources and competencies, and plans impact and risk assessments. In the Do phase (Operation), it implements controls throughout the AI life cycle, from design to decommissioning, covering requirements for data, models, suppliers, change management, human oversight, explainability, and incident management. In the Check phase (Performance Evaluation), it monitors and audits the effectiveness of controls, measures indicators, and conducts reviews. Finally, in the Act phase (Improvement), it corrects deviations, addresses nonconformities, and updates processes and controls (Benraouane, 2024; Gueorguiev, 2024). This cadence is particularly suitable for integrating ISO/IEC 42001 into BPM and project management routines, as it allows for deliverables to be aligned with process and project milestones (Bogucka et al., 2024).



From an operational perspective, four key layers stand out. The first is governance: the standard requires clear roles and responsibilities such as Data Owner, Model Owner, and Process Owner, decision-making forums, and documentation that ensures accountability, including aspects such as human oversight, change management, and applied ethics (Biroğul et al., 2025; Ricciardi Celsi & Zomaya, 2025). The second is risk and impact management, which involves structured AI Impact Assessment (AIA) reports detailing purpose, context, data, risks, mitigation, and monitoring plans, helping to translate principles into evidence of due diligence (Benraouane, 2024; Bogucka et al., 2024). The third is life cycle operation, with controls across design-time, run-time, and post-hoc phases, defining process rules and semantics for pre-validation and maintaining ongoing audits enabled by process mining, supported by metrics such as precision, recall, latency, false alarm rate, and explanation stability (McIntosh et al., 2024; Weimer et al., 2025; Yatagha et al., 2024). The fourth is supporting infrastructure, encompassing data governance, competencies, and knowledge management, all essential to ensure traceability and reproducibility (Benraouane, 2024; Khazieva et al., 2024).

Three key considerations help to calibrate expectations. First, ISO/IEC 42001 is process-oriented: it certifies the management system, not the AI technology itself. A technically excellent model, if not embedded in processes with defined roles, metrics, and documentation, fails to meet the standard. Conversely, a compliant AIMS may require replacing models that are not explainable or controllable enough for their level of risk (Benraouane, 2024). Second, the standard assumes risk proportionality: the level of control and evidence must scale with criticality, impact, and exposure, which makes prioritization and assessment escalation strategies essential (Weimer et al., 2025). Third, ISO/IEC 42001 does not replace sector-specific regulations; instead, it organizes and makes them auditable through compliance matrices linking each obligation to process controls and evidence (Botunac et al., 2024; McIntosh et al., 2024).

In summary, ISO/IEC 42001 provides the guiding framework for transforming AI practices within BPM through process-anchored explainability, log governance, and human oversight, all supported by a system designed to be planned, executed, verified, and improved. By adopting this structure, organizations move beyond isolated initiatives and begin to demonstrate, through evidence, that their AI systems are responsible, auditable, and aligned with internationally recognized standards.

## **2.2 Business Process Management (BPM)**

Business Process Management (BPM) is the discipline that organizes an enterprise by processes, meaning the cross-functional activity flows that deliver value to customers and stakeholders. It operates through a continuous life cycle that models, executes, monitors, and improves these flows to enhance performance, compliance, and organizational learning. In practice, BPM combines three dimensions: management, which includes process governance, roles such as process owner, indicators, and targets; engineering, which includes process discovery, analysis, redesign, and implementation of rules; and technology, which includes workflow engines, system integration, process mining, automation, and analytics. This configuration explains why BPM often acts as the



connective tissue linking strategy, operations, and governance (Campos & Carreiro, 2024; Moreira & Dallavalle, 2024).

The BPM life cycle typically follows a structured sequence: process identification and discovery through documentation or data, modeling using standards such as BPMN, analysis of bottlenecks, risks, and rules, redesign and prioritization of changes, implementation in systems, roles, and procedures, execution and monitoring through event collection and performance indicators, and finally optimization based on evidence. In data-intensive domains, this cycle is increasingly data-driven, with process mining extracting models and metrics from real event logs, thereby narrowing the gap between the designed and the actual process (Dallagassa et al., 2022; Shafei et al., 2024).

From a sociotechnical perspective, BPM is not merely diagrammatic but represents organizational change. The adoption of intelligent automation and predictive monitoring requires role-based competencies, feedback design, and explicit human oversight within workflows, factors that directly influence solution acceptance and effectiveness (Mayr et al., 2024; Wang et al., 2025). For this reason, the integration between BPM and ISO/IEC 42001 is natural, since BPM provides the process architecture and control points where the standard demands evidence, while ISO/IEC 42001 provides the management system grammar including roles, risk and impact assessment, documentation, monitoring, and improvement, which turns technical mechanisms into auditable governance evidence (Elkhawaga et al., 2024; Grohs et al., 2025; Sun et al., 2024).

For BPM, the main implication is that ISO/IEC 42001 functions as a governance grammar to be embedded into processes. This materializes in direct mappings: critical processes gain associated AI system inventories, BPMN models incorporate compliance rules and metadata, process indicators are expanded with control KPIs, tasks and roles include human oversight and review channels, and the continuous improvement cycle consolidates process audits and AIA reviews to adjust thresholds, explanations, and response plans (Benraouane, 2024; Biroğul et al., 2025). In organizations with a PMO, this configuration translates into project baselines and deliverables: AIA and risk matrices in the planning phase, explainability criteria, control SLAs, and test plans during execution, audit dashboards and effectiveness reports during monitoring, and controlled decommissioning in the closing phase (Bogucka et al., 2024; Gueorguiev, 2024).

In summary, BPM serves as the operational vehicle for embedding responsible AI into organizational processes. It identifies where to insert controls and explanations, how to measure their effectiveness, and who is accountable for decisions and exceptions. By aligning the BPM life cycle with the AIMS structure of ISO/IEC 42001, organizations can plan, execute, verify, and improve AI within the natural workflow of operations, balancing business value, compliance, and accountability.



**Table 1.** Summary of Convergence between ISO/IEC 42001 and BPM

ISO/IEC 42001	BPM	References
<b>Governance:</b> definition of roles such as Data Owner, Model Owner, and Process Owner, decision-making forums, human oversight, ethics, and accountability	<b>Process governance:</b> roles such as Process Owner, definition of indicators, supervision mechanisms, and decision-making instances	Benraouane (2024); Biroğul et al. (2025); Ricciardi Celsi & Zomaya (2025)
<b>Risk and impact management:</b> AI risk matrix, AI Impact Assessment (AIA) reports, mitigation and monitoring plans	<b>Process analysis and redesign:</b> risk identification, BPMN modeling with compliance rules, prioritization of changes	Benraouane (2024); Bogucka et al. (2024); Ranjbar et al. (2024)
<b>Life cycle operation (PDCA):</b> controls from design to decommissioning, data, model, supplier, audit, and explainability requirements	<b>BPM life cycle:</b> discovery, modeling, execution, monitoring, and optimization, process mining and proactive conformance checking	Gueorguiev (2024a, 2024b, 2025); McIntosh et al. (2024); Weimer et al. (2025)
<b>Performance evaluation:</b> monitoring indicators, recurring audits, review of control effectiveness	<b>Process monitoring and auditing:</b> event log collection, compliance and performance KPIs, audits enabled by process mining	McIntosh et al. (2024); Yatagha et al. (2024); Zerbino et al. (2018)
<b>Continuous improvement:</b> addressing nonconformities, updating controls and processes based on audit results	<b>Process optimization:</b> adjustments based on metrics and feedback, BPM cycle feedback for efficiency and compliance gains	Benraouane (2024); Gueorguiev (2024a)
<b>Support infrastructure:</b> data governance, competencies, and knowledge management	<b>BPM technology and data:</b> workflow engines, process ontologies and glossaries, log management, and process mining	Benraouane (2024); Khazieva et al. (2024); Berti et al. (2024); Bliznak et al. (2024)
<b>Risk proportionality:</b> controls and evidence should scale with process criticality and impact	<b>Prioritization of critical processes:</b> definition of key processes and differentiated levels of monitoring and auditing	Weimer et al. (2025); Botunac et al. (2024)

Source: Authors, based on the literature.

In general, convergence occurs because ISO/IEC 42001 defines what must be managed and evidenced throughout the AI life cycle, while BPM defines how these requirements can be embedded into organizational workflows, ensuring explainability, compliance, and continuous optimization.

### 3 METHODOLOGY

This study followed the methodological principles of the integrative review (Snyder, 2019). The review aimed to identify, organize, and critically analyze the main challenges and opportunities for aligning Business Process Management (BPM) practices mediated by Artificial Intelligence (AI) with the requirements of the ISO/IEC 42001 standard, following the PRISMA guidelines (Moher et al., 2015). The search was conducted in the Scopus and Web of Science databases, recognized for their interdisciplinary coverage and indexing of leading journals in management, production engineering, information science, and information systems (Table 2).

**Table 2.** Search String and Results

Search String	Scopus	WoS
("process mining" OR "business process management") AND ("artificial intelligence" OR "machine learning" OR "deep learning") AND ("transparency" OR "explainability" OR "traceability" OR "governance" OR "risk management" OR "compliance")	21	21

Note: The following filters were applied to both databases: search in abstract, title, and keywords; only articles were included; and publications dated between 2015 and 2025.



The selection process followed the PRISMA flow (Moher et al., 2015), consisting of the following stages:

- **Identification:** 42 records retrieved from automated searches.
- **Screening:** 13 duplicate references removed, resulting in 29 articles for title and abstract screening.
- **Eligibility/Exclusion:** After reviewing titles and abstracts, 7 studies were excluded for being out of scope or lacking a clear connection with BPM, AI, governance, or compliance, leaving 22 articles for full-text review.
- **Final Inclusion:** 22 studies were incorporated into the qualitative analysis.

In summary, the application of the PRISMA protocol ensured methodological rigor, transparency, and reproducibility in the selection process, resulting in a final corpus of 22 studies that provide a solid foundation for analyzing the challenges, opportunities, and strategies for aligning BPM, AI, and the ISO/IEC 42001 requirements.

## 4 RESULTS ANALYSIS

The analysis followed Bardin's (2008) content analysis framework. The corpus of studies was examined considering the research questions. The analytical process followed Bardin's classical structure (pre-analysis, material exploration, and result treatment) guided from the outset by three deductive theoretical categories: challenges, opportunities, and strategies. These were later expanded through inductive subthemes that emerged during the analysis of the selected studies.

### 4.1 Challenges for Alignment

The first set of challenges emerges at the intersection between the literature on explainability applied to predictive process monitoring and the requirements for transparency, traceability, and accountability expected by ISO/IEC 42001. Studies focused on Explainable AI (XAI) in Predictive Process Monitoring (PPM) converge on a central premise: explaining in the BPM context is not merely about generating interpretability artifacts but about situating explanations within the semantics of the process, linking them to tasks, case attributes, roles, and business rules that are meaningful to operators, managers, and auditors.

El-Khawaga et al. (2022) propose an empirical framework for applying XAI in PPM, emphasizing that explanations are more useful when contextualized within process elements and when their stability under data or configuration changes is systematically evaluated. In parallel, the authors explore informational gaps that compromise the reliability of explanations, such as missing logs, semantic heterogeneity, and weak proxies. These make explanations statistically plausible but fragile as decision-making and auditing tools (Elkhawaga et al., 2022). Such discussions resonate with ISO/IEC 42001, which demands verifiable and stakeholder-relevant transparency.

Elkhawaga et al. (2024) advance this debate by "explaining the explanation," developing a method for assessing the reliability of XAI techniques in PPM. They show that explanations differ



in fidelity, stability, and perceived usefulness depending on the model, data, and audience. This implies that no single explanation is sufficient and that standardized quality metrics are required to avoid subjective or rhetorical transparency. These findings echo ISO/IEC 42001's requirement for performance evidence and documented justification in design decisions.

"White-box" and process-model-based approaches offer an alternative that narrows the gap between "how the model works" and "how the process works." Verenich et al. (2019) demonstrate that process-based performance predictions enhance causal understanding and justification, though they require disciplined updates to remain current. Similarly, Maita et al. (2025) propose a framework that uses process models as the backbone of interpretability, improving the legibility of explanations for experts. Both cases emphasize that auditability gains come with maintenance costs, as processes and logs evolve, demanding versioning and revalidation—linking explainability to lifecycle management, a key ISO/IEC 42001 concern.

When deep learning architectures such as recurrent neural networks (RNNs) are introduced, the tension between performance and interpretability intensifies. Hanga et al. (2020) presents a graph-based method to interpret RNNs, showing that intermediate representations capturing temporal and sequential dependencies can reduce opacity. This complements, rather than contradicts, "white-box" approaches, demonstrating that when complexity requires expressive models, interpretive layers grounded in process semantics can restore part of the intelligibility needed for governance.

The second group of challenges involves process data governance and quality—the silent infrastructure upon which explainability, compliance, and auditability depend. Bliznak et al. (2024) systematize contemporary data governance practices and identify recurring gaps in metadata, catalogs, lineage, and data quality metrics. When applied to event logs, these gaps hinder traceability and reproducibility. Cicu (2024) complements this discussion by proposing an "AI Corporate Design" framework that integrates AI governance within corporate governance structures, establishing mandates and clear responsibilities to prevent "ownerless" controls and illegitimate explanations. Combined with Sun et al. (2024), who discuss design-time compliance using multigranular semantic information, it becomes evident that the bottleneck is not only technical but also semantic and organizational. Without living semantic repositories—such as process glossaries, ontologies, and rule catalogs—process-oriented explainability and compliance validation lose traction.

On the technical side, object-centric event logs better capture complex process realities with multiple interacting entities but pose challenges for feature stability and semantic coherence over time (Berti et al., 2024). In sectoral applications, the literature confirms these findings. In healthcare (Dallagassa et al., 2022; Shafei et al., 2024) and public administration (Nai et al., 2025), log enrichment is critical yet costly but essential for detecting contextually meaningful risks. The common denominator is clear: governed semantics link data to rules and processes to evidence.

The third set of challenges concerns dynamic compliance—translating norms and policies into computable, effective rules across design, execution, and audit stages. While process mining has enabled audit automation (Zerbino et al., 2018), regulatory ambiguity, legitimate exceptions, and incomplete data can still lead to misclassifications and reputational risks if not properly governed. Grohs et al. (2025) advance the discussion toward proactive conformance, where deviations are



predicted and mitigated before they occur. However, this introduces the challenge of calibrating sensitivity and precision to avoid alert fatigue or metric gaming, while requiring clear accountability and response protocols. Sun et al. (2024) propose an upstream mitigation path through semantic design validation. This is cost-effective when semantic repositories and modeling discipline exist; otherwise, recurrent audits and predictive conformance loops may serve as transitional mechanisms.

Finally, sociotechnical challenges are evident. Mayr et al. (2024) identify key determinants of intelligent automation adoption, emphasizing digital capability, perceived value, and integration maturity. Wang et al. (2025) explore how fairness perception and legitimacy shape acceptance of AI feedback versus human supervision, demonstrating the importance of feedback clarity and contestation mechanisms. When combined with Fahland et al. (2025), who warn about persuasive but unverifiable outputs from large language models (LLMs), the importance of explicit human oversight, defined review cycles, and traceable accountability becomes a core condition for effective and ethical governance.

## 4.2 Opportunities for Adoption

If challenges define the problem's boundaries, opportunities reveal the available levers for aligning BPM, AI, and ISO/IEC 42001. The first and clearest opportunity lies in process-anchored explainability. El-Khawaga et al. (2022; 2024) and Maita et al. (2025) demonstrate that explanations linked to process elements (activities, case attributes, gateways, roles) enhance both user acceptance and auditability, particularly when coupled with quality metrics. Verenich et al. (2019) reinforce this point by showing that process-based explanations inherently improve legibility and transform transparency into demonstrable evidence, a decisive value within an AI Management System. Together, these studies suggest the need for standardized explanation templates and role-based quality indicators to operationalize ISO/IEC 42001's transparency requirements.

The second opportunity concerns the organization of compliance controls in layers. Grohs et al. (2025) show that predictive compliance reduces nonconformance costs and enables control service agreements, while Sun et al. (2024) demonstrate that design-time compliance is more cost-effective when semantic maturity exists. Zerbino et al. (2018) remind that post-event auditing remains essential for assurance and continuous improvement. Rather than mutually exclusive, these layers form an integrated architecture: design-time for prevention, run-time for supervision, and post-hoc for learning and adaptation.

The third opportunity, present across multiple studies, positions process data governance as the central pillar of alignment. Bliznak et al. (2024) consolidate frameworks for metadata-rich catalogs, explicit data lineage, and quality policies. Cicu (2024) highlights the importance of corporate governance structures that grant legitimacy and ownership over AI governance. Practical applications such as Nai et al. (2025) in public procurement show the direct impact of robust data governance on risk detection and compliance consistency. In healthcare, Dallagassa et al. (2022) and Shafei et al. (2024) show that data governance enhances patient safety and service quality.



Opportunities extend beyond technical design. Mayr et al. (2024) map organizational adoption determinants that guide a pragmatic roadmap: prioritize processes with higher digital readiness, invest in role-based training, minimize integration friction, and secure executive sponsorship through risk and compliance value cases. Wang et al. (2025) highlight the behavioral dimension, showing that feedback design and consequence clarity increase acceptance of AI-driven recommendations. In the background, Moreira and Dallavalle (2024) provide a bibliometric mapping of BPM trends, identifying diffusion opportunities. Building on this, Martino et al. (2025) propose a knowledge-driven BPM framework enhanced by AI, linking explainability to agile knowledge sharing—an organizational practice valued by ISO/IEC 42001 in its focus on continuous improvement and learning.

### **4.3 Strategies for Integration**

From the synthesis of studies, it is possible to outline an implementation grammar that connects ISO/IEC 42001 principles with BPM practice. The first strategic decision concerns defining the type of transparency sought. Combined findings indicate that effective transparency is dual: technical, clarifying how the model produced its output, and operational, explaining how the information should be used within process language (El-Khawaga et al., 2022; Elkhawaga et al., 2024; Hanga et al., 2020; Maita et al., 2025; Verenich et al., 2019). Achieving this dual transparency requires standardizing process-based explanations, evaluating fidelity and stability, and testing their comprehensibility among target audiences. Where LLMs mediate communication, Fahland et al. (2025) recommend using them as conditioned explanatory interfaces anchored in verifiable artifacts such as BPMN models and governed logs, complemented by automatic checks and human review.

The second strategic decision involves placing compliance controls where they are most effective, considering modeling maturity and available semantic governance. The literature suggests a layered approach: formalize vocabulary, rules, and constraints at design time for pre-validation; use predictive process monitoring for proactive conformance during execution; and conduct regular post-execution audits with process mining and independent sampling (Grohs et al., 2025; Sun et al., 2024; Zerbino et al., 2018).

The third strategic decision reaffirms process data governance as a central element. Following Bliznak et al. (2024) and Cicu (2024), alignment requires comprehensive event log catalogs, metadata, lineage from event to metric, quality and access policies, and explicit roles such as Data Owner, Data Steward, and Model Owner. Applied studies (Nai et al., 2025; Dallagassa et al., 2022; Shafei et al., 2024) show that investment in this infrastructure reduces deviations, accelerates audits, and strengthens compliance evidence. Berti et al. (2024) complement this by highlighting the need for semantic curation and versioning in object-centric logs to maintain feature stability over time.

The fourth decision treats the AI life cycle itself as a management object. Maita et al. (2025) and Verenich et al. (2019) propose that models and explanations be versioned, monitored, and retired based on explicit criteria. Berti et al. (2024) add that semantic changes in logs require revalidation of both models and explanatory artifacts. In ISO/IEC 42001 terms, this translates into retraining and



validation plans, drift detection, regression testing for explanations, and replicable documentation of changes.

The fifth decision places the human factor at the core of governance. Mayr et al. (2024) show that adoption depends on controllable organizational variables. Wang et al. (2025) highlight that feedback design and clarity of consequences shape user acceptance. Fahland et al. (2025) warn that textual explanations are insufficient without proof and contestation mechanisms. The resulting strategy involves instituting human review channels, role-based training, and explicit response times for alerts and recommendations, ensuring that the AI management system operates as a sociotechnical arrangement rather than a purely technological layer.

Finally, a transversal strategy identified by Martino et al. (2025) emphasizes knowledge management as an organizational buffer. By linking explainability to agile knowledge sharing, the proposed framework promotes the creation of playbooks, checklists, and repositories that codify lessons learned and accelerate the replication of explainable and auditable controls. Moreira and Dallavalle (2024) contextualize these practices within a field of expanding BPM and intelligent automation, reinforcing the need for internal standards to maintain consistency as new solutions are adopted.

**Table 3.** Identified Challenges, Opportunities, and Strategies

Categories	Challenges	Opportunities	Strategies	References
<b>A priori categories</b>				
Governance	Silos between IT, process, and compliance areas; unclear roles and responsibilities; limited legitimacy and acceptance	Strengthening accountability, trust, and institutional legitimacy	Define Process/Data/Model Owners; establish decision-making forums; explicit human oversight; code of ethics and contestation channels	(Benraouane, 2024; Biroğul et al., 2025; Cicu, 2024; Ricciardi Celsi & Zomaya, 2025; Wang et al., 2025)
Risk and Impact Management	Lack of standardized templates; regulatory overlap; evidence gaps	Structured risk documentation; preventive control portfolio	AI Impact Assessment (AIA) with purpose, context, data, risks, mitigation, and monitoring plan; risk matrix linked to process controls	(Benraouane, 2024; Bogucka et al., 2024; Botunac et al., 2024; McIntosh et al., 2024; Weimer et al., 2025)
Life Cycle Operation (PDCA)	AI/BPM integration; change management; data/model drift; supplier management	Establish traceable controls from design to decommissioning	Apply PDCA to AIMS; control SLAs; design-time compliance rules; runtime monitoring; post-hoc auditing; retraining plans	(Grohs et al., 2025; Gueorguiev, 2024, 2025; Sun et al., 2024; Zerbino et al., 2018)
Performance Evaluation and Auditing	Meaningful transparency KPIs; real-time pipelines; deep model auditability	Continuous auditing; compliance and effectiveness dashboards	KPIs (precision/recall, latency, false alarms, explanation stability); auditable logging; process mining with sampling	(Elkhawaga et al., 2024; McIntosh et al., 2024; Weimer et al., 2025; Zerbino et al., 2018)
Continuous Improvement	Model and explanation versioning; maintenance costs in dynamic processes	Learning loops and playbooks; deviation reduction over time	MLOps + ProcessOps; regression testing for models/explanations; lessons learned and internal standards	(Maita et al., 2025; Martino et al., 2025; Verenich et al., 2019)
Support Infrastructure	Insufficient metadata and lineage; OCEL complexity; interoperability issues	Strong traceability; reuse and analytical quality	Data catalogs and lineage; OCEL; ontologies/glossaries; knowledge repositories and internal standards	(Berti et al., 2024; Bliznak et al., 2024; Dallagassa et al., 2022; Khazieva et al., 2024; Nai et al., 2025; Shafei et al., 2024)
Risk Proportionality	Governance scaling in high-volume/high-velocity processes; control calibration	Layered controls by criticality; focus on high-impact areas	Risk tiering; control SLAs; automated and periodic risk/impact assessments	(Botunac et al., 2024; McIntosh et al., 2024; Weimer et al., 2025)



Categories	Challenges	Opportunities	Strategies	References
<b>A posteriori categories</b>				
Process-Anchored Explainability	Black-box models; non-contextual explanations; instability in interpretability	Increased acceptability and auditability when explanations reference BPMN, tasks, roles, and paths	XAI linked to process elements; white-box models with interpretive layers; fidelity/stability metrics; LLMs as grounded explanatory interfaces	(El-Khawaga et al., 2022; Elkhawaga et al., 2024; Fahland et al., 2025; Hanga et al., 2020; Maita et al., 2025; Verenich et al., 2019)
Layered Dynamic Compliance	Alert fatigue; regulatory ambiguity; legitimate exceptions	Violation prevention; faster response and organizational learning	Semantic design-time compliance; predictive run-time conformance; periodic process mining audits with clear escalation	(Grohs et al., 2025; Sun et al., 2024; Zerbino et al., 2018)
Adoption and Sociotechnical Factors	Resistance, skill gaps, perceived fairness and legitimacy	Greater acceptance and accountability clarity	Role-based training; feedback design (clarity, source, consequences); contestation channels and human-in-the-loop review	(Benraouane, 2024; Cicu, 2024; Mayr et al., 2024; Wang et al., 2025)
Sectoral and Case Applications	Sector-specific semantics; privacy concerns; cost of log enrichment	Improved safety, quality, and risk detection	Log enrichment; domain ontologies; privacy-aware process mining	(Dallagassa et al., 2022; Nai et al., 2025; Ranjbar et al., 2024; Shafei et al., 2024)
Techniques and Engineering	Attribute stability; drift; weak proxies	Better performance with enhanced interpretability	Graph-based feature extraction in OCEL; feature governance; variable recommendation	(Berti et al.,

Source: Authors, based on the literature.

## 5 DISCUSSION

This section interprets the findings considering the literature and the three research questions, highlighting conceptual convergences, tensions, and theoretical advances between AI-enabled Business Process Management (BPM) and the requirements of ISO/IEC 42001.

### 5.1 Convergences

The first convergence lies in governance and the PDCA cycle as the common language linking BPM and ISO 42001. The standard requires the definition of roles, responsibilities, risk and impact assessment, and continuous improvement (Benraouane, 2024; Biroğul et al., 2025), while BPM provides the operational sequencing to materialize these controls (Campos & Carreiro, 2024; Moreira & Dallavalle, 2024). Gueorguiev (2024, 2025) supports the use of the PDCA cycle and process-based approach as a practical bridge to integrate an AI Management System (AIMS) into existing management systems, directly aligning with the layered compliance synthesis identified in this study.

Second, the findings confirm the importance of process-anchored explainability. In XAI applied to PPM, the usefulness of explanations increases when they are grounded in BPMN, tasks, case attributes, and roles (El-khawaga et al., 2022; Elkhawaga et al., 2024; Maita et al., 2025). This aligns with white-box approaches based on process models (Verenich et al., 2019) and interpretability mechanisms for deep neural networks (Hanga et al., 2020). These insights converge with ISO 42001, which demands stakeholder-relevant transparency and evidence of control performance (Benraouane, 2024).



Third, the literature supports the layered compliance architecture that emerged from the analysis: prevention at design time (Sun et al., 2024), predictive conformance monitoring during execution (Grohs et al., 2025), and post-event auditing via process mining (Zerbino et al., 2018). These layers are complementary rather than mutually exclusive, and their implementation should respect process maturity and criticality (consistent with ISO 42001's risk-proportionality principle) (Weimer et al., 2025).

Fourth, the results corroborate prior studies that view process data governance as a value-creating infrastructure rather than a purely technical requirement. Reviews on data governance (Bliznak et al., 2024) and research on object-centric event logs and feature engineering (Berti et al., 2024) emphasize metadata, lineage, ontologies, and data quality as prerequisites for traceability and reproducibility. Sectoral evidence in healthcare and public administration (Dallagassa et al., 2022; Nai et al., 2025; Shafei et al., 2024) confirms that semantic enrichment enhances compliance and analytical value. The sociotechnical dimension also appears as essential: adoption factors (Mayr et al., 2024) and feedback acceptance (Wang et al., 2025) reveal that clear roles, role-based training, and auditable feedback design improve control effectiveness—conditions necessary for operationalizing ISO 42001's governance requirements in daily routines.

## 5.2 Tensions

The first tension concerns the performance–explainability trade-off. While deep models provide high accuracy, their opacity requires interpretive layers or white-box approaches when risk contexts demand strong justifiability (Hanga et al., 2020; Verenich et al., 2019). This synthesis advances the debate by proposing dual transparency: technical (how the model produces results) and operational (how the result should inform process decisions). Literature tends to treat these dimensions separately; combining them as a design criterion strengthens the connection with ISO 42001's auditing principles (Elkhawaga et al., 2024; Maita et al., 2025).

The second tension is semantic. Design-time compliance gains depend on living vocabularies and ontologies (Sun et al., 2024), yet many environments still struggle with heterogeneous logs, weak proxies, and missing data (Bliznak et al., 2024; Elkhawaga et al., 2022). By identifying semantic governance as a “cornerstone” for explainability and compliance, this study highlights a precondition often underexplored in applied research.

The third tension involves the use of LLMs as explanatory interfaces. Fahland et al. (2025) warn that linguistic fluency can create unwarranted trust. This study reframes that warning as a requirement: if LLMs are employed, they must operate with grounding in process models and governed logs, including automatic fact-checking, and undergo human review. This sociotechnical alignment, often absent in practice, brings AI deployment closer to ISO 42001's principles of verification and accountability. Another persistent gap concerns how to operationalize risk proportionality in high-volume, high-variability environments. Although literature proposes paths (McIntosh et al., 2024; Weimer et al., 2025), reproducible protocols for process tiering and integrated BPM control SLAs remain scarce. The findings suggest BPM as the



natural vehicle for this orchestration of roles, metrics, and routines (an area that still calls for empirical validation).

**Table 4.** Theoretical Framework: Alignment between BPM, AI, and ISO/IEC 42001

Dimension	Core Concept	Key Elements	Alignment
Governance and Accountability	Organizational and ethical structures defining roles, responsibilities, and human oversight	Process Owner, Data Owner, Model Owner; decision committees; contestation channels; code of ethics	Ensures accountability and legitimacy in AI use; connects algorithmic governance with process management and ISO 42001 controls
Risk Management and Compliance	Identification and mitigation of technical, ethical, and regulatory risks across the AI lifecycle	AI Impact Assessment (AIA); risk matrix; proportional controls; periodic audits	Enables continuous compliance monitoring and integration of preventive, operational, and retrospective controls
Process-Anchored Explainability	Ability of AI systems to justify decisions in a process-relevant and understandable manner	BPMN-based XAI; role-specific explanations; LLMs grounded in process logs	Turns transparency into auditable evidence; ensures relevance for operators, managers, and auditors
Process Data Governance	Semantic and technical management of AI and BPM data	Metadata, lineage, ontologies, log quality, OCEL, data catalogs	Provides traceability and reproducibility foundations, supporting explanation integrity and audit reliability
Layered Dynamic Compliance	Adaptive controls throughout the process lifecycle	Design-time, run-time, and post-hoc compliance; process mining; feedback loops	Reduces risks and enables rapid responses to deviations, consistent with ISO 42001's risk-proportionality principle
Sociotechnical Capabilities and Adoption	Human and organizational conditions that enable AI-BPM integration	Digital competencies, fairness perception, feedback design, human-in-the-loop	Promotes acceptance and operational legitimacy of AI governance
Continuous Improvement and Learning	Cyclic learning structure based on audits, metrics, and knowledge management	Playbooks, model/explanation versioning, ProcessOps/MLOps	Supports SGIA evolution through lessons learned and replicable standards

Source: Authors, based on the reviewed literature.

Three main contributions emerge: (i) an operational mapping between ISO 42001 and BPM that translates “what must be demonstrated” (standard) into “how to demonstrate” (process), emphasizing process-anchored explainability and layered compliance; (ii) the formulation of dual transparency as a control-design criterion, connecting XAI to process semantics and organizational roles (operator, manager, auditor); and (iii) the elevation of semantic governance of event logs to strategic infrastructure, linking OCEL, ontologies, and data lineage to auditable evidence and continuous improvement – integrating insights from data governance (Bliznak et al., 2024), log engineering (Berti et al., 2024), and knowledge management (de Borba, 2021; Khazieva et al., 2024; Martino et al., 2025).

## 6 CONCLUDING REMARKS

This study was guided by three research questions. RQ1 asked about the main challenges in aligning AI-mediated BPM practices with ISO/IEC 42001; RQ2 explored the opportunities arising from this convergence; and RQ3 investigated feasible strategies for integrating the standard's



requirements into business process flows. Through an integrative review, these questions were answered by systematizing evidence across three axes: (i) challenges: process-anchored explainability, data governance and process semantics, and layered dynamic compliance with sociotechnical determinants; (ii) opportunities: standardized explanation templates embedded in BPMN and event logs, the design of preventive, operational, and retrospective control mechanisms, and the institutionalization of data governance as a value infrastructure; and (iii) strategies: a practical roadmap comprising defined roles and forums (Process/Data/Model Owner), standardized AI Impact Assessment (AIA), layered compliance (design, run, post), data lineage catalogs, MLOps/ProcessOps with model and explanation versioning, human-in-the-loop oversight, and grounded use of LLMs with human review.

The objective was to identify, categorize, and critically analyze challenges, opportunities, and strategies for aligning BPM, AI, and ISO/IEC 42001. This goal was achieved by: (1) mapping an operational bridge between the management grammar of the standard (governance, risk, evidence, improvement) and the execution architecture of BPM (modeling, monitoring, process mining, indicators); (2) proposing the construct of dual transparency, technical (how the model decides) and operational (how to act upon the output), as a criterion for useful and auditable explainability; and (3) organizing an implementation roadmap that positions controls according to process maturity and criticality, consistent with the ISO/IEC 42001 principle of risk proportionality.

Three theoretical contributions stand out. First, the systematic articulation between ISO 42001 and BPM translates "what must be demonstrated" (standard) into "how to demonstrate it" (process). Second, the notion of dual transparency is established as a control-design requirement connecting XAI, process semantics, and organizational roles (operator, manager, auditor). Third, semantic governance of event logs (metadata, lineage, ontologies, including OCEL) is elevated to a condition for traceability, reproducibility, and organizational learning.

From a practical perspective, the article proposes a managerial checklist for implementation: (a) establish defined roles and committees with control SLAs and contestation channels; (b) standardize AIA templates linking risks to controls and process evidence; (c) adopt layered compliance (semantic validation at design, predictive conformance monitoring at run time, periodic audits with process mining); (d) maintain living catalogs and data lineage for process logs and ontologies; (e) operate MLOps/ProcessOps with model and explanation versioning and regression testing; (f) train staff by role and design explainable feedback loops; and (g) when applicable, employ LLMs only as conditioned explanatory interfaces grounded in BPMN/logs and subject to human review.

The social and regulatory contributions are reflected in the recommendations for meaningful transparency to stakeholders and evidence-based auditable compliance. The proposed alignment strengthens trust, accountability, and the protection of rights such as privacy and non-discrimination in critical sectors (healthcare, finance, and public administration). ISO/IEC 42001 is positioned as a unifying framework for Mult regulatory compliance through obligation–control–evidence matrices and tiered control mechanisms by process criticality.

The article also has limitations: (1) it is based on an integrative review with temporal (2015–2025) and linguistic (English/Portuguese) constraints, without quantitative meta-analysis; (2) methodological and domain heterogeneity may introduce publication or sector bias; (3) the analysis



relies primarily on technical-academic and secondary literature about the standard, which may omit insights from real audits and proprietary documents; and (4) the causal effectiveness of the proposed strategies was not tested in field experiments.

Five future research directions are proposed: (1) development of standardized role- and risk-based explainability quality metrics (fidelity, stability, utility) and their decision-making impacts; (2) experimental studies comparing layered compliance architectures (design/run/post) in terms of nonconformance cost, response time, and operational safety; (3) cost-benefit and governance analyses of OCEL and log enrichment in regulated contexts; (4) protocols and boundaries for grounded LLM-based explainability (automatic checks, factual verification, human review) within BPM; and (5) risk-tiering models and control SLAs integrated into the BPM lifecycle, including sector-specific guidelines (healthcare, finance, public administration) and interactions with emerging regulatory frameworks.

Ultimately, the results demonstrate that governing AI through process is key: ISO/IEC 42001 defines what must be managed and evidenced, while BPM defines how to embed this management into real work. When explainability is anchored in the process, compliance operates in layers, and process data are governed with semantic rigor and lineage, organizations transform innovation into responsible, auditable, and sustainable value.

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