Journal of Computer Science

Review Article

Adopting Artificial Intelligence in ERP Systems as an Innovation to Support Business Growth: A Systematic Literature Review

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Article history
Received: 06-07-2025
Revised: 13-09-2025
Accepted: 18-12-2025

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Abstract: Digital transformation is driving the integration of Artificial Intelligence (AI) into Enterprise Resource Planning (ERP) systems as an innovative strategy to improve organizational competitiveness. However, consolidated knowledge regarding the benefits and challenges of this integration remains scarce. This study utilizes a Systematic Literature Review (SLR) in accordance with the PRISMA framework to analyze 31 peer-reviewed articles published between 2020 and 2025. The findings are structured through the Technology-Organization-Environment (TOE) framework. The findings demonstrate AI's capacity to augment process automation, data quality, predictive analytics, and operational efficiency, thereby fortifying strategic decision-making and expediting digital transformation. Concurrently, organizations encounter persistent challenges, including integration complexity, data security risks, user resistance, limited expertise, and regulatory pressure. Contrary to previous reviews, this study offers a balanced analysis by comparing small- and medium-sized enterprises (SMEs) with large corporations. Additionally, it incorporates the post-2022 generative Artificial Intelligence (AI) wave, a development that has the potential to significantly impact business operations and strategic decisions. The findings contribute to the theoretical framework of the TOE by deepening the understanding of AI-ERP, and they inform sustainable adoption strategies in a practical sense. Future research must investigate longitudinal Return on Investment (ROI), causal links between governance and benefits, and cross-industry variations. This research will serve to strengthen the evidence for implementation.

Keywords: Artificial Intelligence, Enterprise Resource Planning, Digital Transformation, Systematic Literature Review, Technology-Organization-Environment

Introduction

In the contemporary era of Industry 4.0, digital transformation has emerged as a strategic imperative for organizations intent on maintaining competitiveness in a rapidly evolving business landscape (Aktürk, 2021). Among emerging technologies, Artificial Intelligence (AI) has gained significant traction due to its ability to process large datasets, detect patterns, and generate predictive insights that can enhance business agility (Godbole, 2023). When integrated into Enterprise Resource Planning (ERP) systems, AI has the potential to transform traditional platforms into intelligent systems capable of driving automation, operational efficiency, and data-driven decision-making (Strang and Sun, 2022).

Despite these opportunities, many organizations continue to rely on legacy ERP systems that lack flexibility and advanced analytical capabilities, thereby limiting their ability to adapt to dynamic market conditions (Katuu, 2020). The implementation of AI-enhanced ERP has been documented to yield significant advantages. For instance, case studies have been cited that demonstrate reductions in manual processes by more than 50% and improvements in predictive forecasting accuracy. These improvements have been shown to accelerate decision-making and reduce operational risks (Alif, 2024; Singh, 2023). Nevertheless, challenges persist, including elevated implementation costs,

integration complexity, organizational resistance, and regulatory concerns (Nyathani and Allam, 2024).

A recent article by Singh (2023) emphasizes how businesses can utilize ERP and AI to transition into intelligent enterprises, showcasing practical use cases across supply chain, finance, and customer relationship management. While emphasizing the transformative potential of ERP AI integration, existing research remains largely descriptive and lacks a systematic synthesis of the available academic literature. Consequently, it fails to comprehensively evaluate benefits and challenges across diverse organizational contexts or critically analyze adoption drivers through a structured framework. This discrepancy underscores the necessity for a more meticulous, empirically substantiated review.

To address this research gap, the present study employs a Systematic Literature Review (SLR) approach guided by the PRISMA framework and analyzed through the Technology-Organization-Environment (TOE) model. The primary research questions posed are as follows.

RQ: In what ways can the implementation of Artificial Intelligence (AI) in Enterprise Resource Planning (ERP) systems contribute to business growth? Furthermore, what challenges are associated with the adoption of AI in ERP systems?

This study offers two main contributions. First, it combines various findings on the implementation of Artificial Intelligence (AI)-based ERP into a more comprehensive framework, which not only highlights the potential advantages but also reveals the various challenges that arise. Second, this study provides theoretical and practical insights that can guide organizations in developing sustainable technology adoption strategies.

In line with this, the objectives of this study are twofold: To identify the opportunities and obstacles inherent in the digital transformation process, and to enrich both academic discourse and managerial practice in related fields.

Literature Review

Concept and Scope

Presently, a significant number of industries have undergone substantial changes in their internal systems due to the integration of AI. ERP systems, which were originally only transactional tools, have now evolved into intelligent platforms that support business processes with automation, predictive analytics, and decision making (Jawad and Balázs, 2024; Katuu, 2020). The development of AI over the past few years has resulted in significant advancements, particularly with the emergence of Generative AI, leading to the widespread adoption of this technology by various industries at a rate of 69% (Mhaskey, 2024). The application of AI technologies such as Machine Learning (ML) and Natural Language Processing (NLP) in ERP systems can improve operational process. AI can optimize several activities such as workflow, pattern detection, and forecasting. Otherwise, companies can also utilize AI by using the resulting database in the decision-making process (Kumar, 2024; Strang and Sun, 2022).

The Evolution of AI-ERP Research

A review of literature published between 2020 and 2025 reveals several trends related to ERP system development that emerged during this period. First, prominent ERP platforms, including SAP and cloud services, have experienced growth with the addition of AI to their systems. Secondly, studies emphasize the proliferation of data ecosystems, characterized by the integration of IoT devices and sophisticated data pipeline architectures. Thirdly, there is an increasing emphasis on the end-to-end automation of core business functions, which range from planning and financial management to procurement(Nyathani and Allam, 2024; Rege, 2023). System literature reviews and comprehensive reviews emphasize increased forecasting accuracy, improved master data quality, and accelerated decision cycles (Gupta and Agarwal, 2024; Jawad and Balázs, 2024). Conversely, there exists conceptual literature that underscores use cases such as chatbots and product recommendations. However, this literature rarely presents a systematic analysis of challenges or an assessment of the quality of evidence (Kumar, 2024; Singh, 2023).

Benefits and Challenges of AI in ERP

The integration of Artificial Intelligence (AI) within Enterprise Resource Planning (ERP) systems is progressively recognized as a strategic initiative to facilitate organizational digital transformation. A substantial body of prior research has validated the efficacy of this technology, offering substantial benefits. Pokala (2025b); Fathima et al. (2024) demonstrate that the integration of Artificial Intelligence (AI) has the potential to reduce manual workload by 60% and enhance data accuracy by up to 85% in demand forecasting and inventory management processes. Data consistency and integrity are also better maintained, thereby strengthening the ERP data pipeline (Anguelov, 2021; Puthuruthy and Marath, 2024). From an organizational perspective, research by Jawad and Balázs (2024); Vaid and Sharma (2022) confirms that Artificial Intelligence (AI) drives operational efficiency, productivity, and the quality of decision-making. From a business environment perspective, the implementation of AI-based chatbots has demonstrated a 90% resolution rate for self-service tickets, resulting in a 40% reduction in helpdesk workload and an enhancement in market (Kumar, 2024; Rege, 2023).

However, extant studies are not without limitations. A notable limitation of extant research is the tendency to

focus exclusively on technical potential, while neglecting to assess the long-term ramifications. For instance, Kumar (2024) underscores the significance of machine learning and conversational AI in enhancing the quality of ERP services. However, the discourse remains confined to the technical milieu, addressing only technical aspects and overlooking critical governance concerns and organizational preparedness. In a similar vein, Pokala (2025b) underscores the advantages of AI in various core functions, ranging from finance to supply chain management. However, the study lacks comprehensive cross-industry analysis or empirical evidence substantiating the efficacy of AI implementation. This finding aligns with the observations of Singh (2023); Nyathani and Allam (2024), who underscore the prevalence of legacy ERP systems that are often not adequately prepared for AI integration. Existing studies, however, seldom provide technical or managerial solutions that can be readily implemented in practical settings.

A thorough review of extant literature reveals that prior studies exhibit both complementary strengths and limitations. The study's strengths lie in the consistency of its findings across studies, the availability of quantitative evidence regarding efficiency improvements, and the identification of key risk factors that are useful in formulating mitigation strategies. The limitations of extant studies are manifold. Most studies are still descriptive in nature, there is a paucity of long-term empirical evidence, they do not sufficiently address socio-organizational aspects such as user resistance and skill gaps, and they rarely provide evaluations of tested implementation solutions.

Despite the evident benefits of Artificial Intelligence (AI) in Enterprise Resource Planning (ERP), particularly in terms of operational efficiency, data accuracy, and service quality, as demonstrated in extant literature, discourse on the challenges of its adoption remains comparatively limited and descriptive. A plethora of studies have previously emphasized quantitative evidence of benefits. However, empirical evaluations of long-term constraints, such as user resistance, digital readiness, and implementation costs, have not been widely explored. This imbalance gives rise to a research gap, namely the need for studies that equally discuss the benefits and challenges of AI-ERP implementation. The resulting body of research would provide a more comprehensive understanding of the subject and practical recommendations that can be used by both academics and practitioners.

Table 1 indicates that while benefits are frequently quantified, particularly in technological dimensions, challenges are often described exclusively in qualitative terms. This finding is consistent with the conclusions of previous studies (Jawad and Balázs, 2024), which emphasize the benefits of machine learning but do not comprehensively review issues of change management and governance.

Table 1: Summary of Benefits and Challenges

Dimension	Benefit (Key Findings)	Challenge (Key Findings)
Technology	Operational efficiency improvement; data accuracy enhancement of 60–85%. (Fathima et al., 2024; Pokala, 2025b)	Data quality issues, privacy concerns, algorithmic bias risks (Dumitru et al., 2023; Hanane et al., 2023)
	ERP data consistency and pipeline integrity reinforcement (Anguelov, 2021; Puthuruthy and Marath, 2024)	Legacy system integration complexity (Singh, 2023)
Organization	Organizational and decision-making efficiency enhancement (Sharma and Vaid, 2022; Jawad and Balázs, 2024)	Resistance to adoption; acute skills shortages(Chirvase and Zamfir, 2023)
		Absence of tested change management frameworks (Jawad and Balázs, 2024)
Environment	User experience improvement (up to 90%); helpdesk workload reduction (40%). (Kumar, 2024; Rege, 2023)	Regulatory burdens; ethical compliance issues (Sharma and Vaid, 2022; Volikatla et al., 2021)
	Competitive advantage acquisition; organizational agility enhancement (Kumar, 2024; Rege, 2023)	Dynamic market pressures; intense competitor rivalry (Garg and Sharma, 2023; Gupta and Agarwal, 2024; Rege, 2023)

Context Variations Between SMEs vs Large, Regulated and Non-Regulated Firms

In the context of Small and Medium-sized Enterprises (SMEs), the implementation of AI-ERP is frequently impeded by three factors. Firstly, the initial costs are often prohibitive. Secondly, the digital workforce is often limited. Thirdly, the governance requirements are relatively uncomplicated. These conditions render a cloud-based approach and collaboration with service providers the most pragmatic option (Chirvase and Zamfir, 2023; Nyathani and Allam, 2024). In large companies, infrastructure readiness is relatively superior; however, complexity arises from the demands of integrating various platforms and coordinating governance between organizational units (Jawad and Balázs, 2024; Katuu, 2020). Conversely, highly regulated sectors demand higher standards, including compliance with audits, data quality assurance, and strict regulations. A multitude of studies have demonstrated the implementation of Artificial Intelligence (AI) in facilitating

SAP functions, including quality assurance and serialization, as well as operational chatbots. While these findings demonstrate practical value relevant to needs-based implementation strategies, long-term empirical evidence and cross-industry comparisons remain limited. Consequently, the findings' generalizability is constrained, and their academic contribution remains to be reinforced (Dumitru et al., 2023; Kumar, 2024).

Technology Organization Environment Framework (TOE)

The Technology Organization Environment (TOE) framework is a systematic approach that organizes the various factors influencing the adoption of AI and ERP into three distinct dimensions: Technology, organization, and environment. The technology dimension encompasses aspects such as capability, compatibility, and data quality. The organization dimension includes elements like leadership, HR readiness, and culture. Finally, the environment dimension focuses on regulatory factors, competitive pressures, and vendor support (Sihotang et al., 2022). The employment of TOE enables a balanced synthesis of benefits and challenges, facilitating the identification of interactions between dimensions (e.g., data quality and model success; cultural readiness and user adoption).

Critical Appraisal and Identified Research Gap

According to Table 2, the following gaps can be identified:

- The prevailing focus on the advantages of AI–ERP integration has led to a relative neglect of the challenges associated with this integration. This imbalance in focus is evident in the literature, where narratives that focus exclusively on the benefits of AI–ERP integration dominate (Kumar, 2024; Singh, 2023)
- Minimal cross-context comparisons: A paucity of systematic testing exists concerning the differences between SMEs and large companies, as well as regulated and unregulated companies (Dumitru et al., 2023; Nyathani and Allam, 2024)
- The present study explores the moderating effects of data quality and organizational readiness on the relationship between Artificial Intelligence (AI) benefits and process performance. This investigation is particularly focused on weak causal relationships in this domain (Anguelov, 2021; Jawad and Balázs, 2024)
- Methodological transparency is a key issue in the field. Assessments of quality/risk bias and consistency across publications in several reviews are still limited, reducing the strength of conclusions (Fathima et al., 2024; Mhaskey, 2024)

The present study aims to address the identified research gaps by conducting a systematic review guided by PRISMA and interpreting the findings through the Technology Organization Environment (TOE) framework. Rather than focusing solely on reported advantages, the analysis attempts to strike a balance between the documented benefits and the challenges of adoption, while also drawing contextual comparisons to enhance its practical relevance. A review of the extant literature, published between 2020 and 2025, consistently highlights the added value of AI–ERP integration, particularly in the domains of process automation, improvements in data quality, and the advancement of predictive analytics. However, a more thorough examination indicates that critical risks are frequently under-explored, particularly those pertaining to system integration, ongoing data quality and security concerns, workforce preparedness, and regulatory compliance. These omissions serve to highlight two recurring weaknesses: An imbalance in the emphasis placed on benefits over risks, and a limited engagement with cross-contextual analysis. The present study combines the methodological rigor of PRISMA with the analytical lens of the TOE model. To obtain a comprehensive synthesis, these two approaches are used as tools that can outline the supporting aspects, vulnerability, and risks that may exist during the implementation process of AI to ERP systems.

Table 2: Critical Appraisal

Study	Type	Merit	Demerit
Singh (2023)	Opinion/conceptual, cross-functional AI-ERP benefits	Illustrative use case map for practical implementation	Limited exploration of challenges; absence of analytical framework and evidence quality assessment
Kumar (2024)	SAP applied articles (chatbot/CAI, IoT, blockchain)	Detailed description of technical components and practical integration	Superficial discussion of challenges; minimal cross-context comparisons
Jawad and Balázs (2024)	Comprehensive review of ML for ERP	Synthesis of ML methods and their impact on business processes	Highly technical focus; lack of evaluation regarding change management issues
Fathima et al. (2024)	SLR predictive analytics in ERP	Quantitative evidence of forecasting accuracy improvement	Domain-specific limitations; constrained generalizability of results
Nyathani and Allam (2024)	AI–Cloud–Big Data synthesis for ERP	Clear perspective on architecture and data ecosystems	Minimal evaluation of success metrics (ROI) and risk factors

Methods

Research Design

The use of AI in ERP systems was examined through a Systematic Literature Review (SLR) method structured according to PRISMA guidelines by ensuring clarity of process, transparency and repeatability by another researcher (Moher et al., 2009).

In accordance with the principles of evidence-based software engineering proposed by Kitchenham (2004), and consistent with the most recent methodological guidelines in the field of information systems research (Oldemeyer et al., 2025; Sihotang et al., 2022), to ensure the review was accurate, the review design used PRISMA guidelines and quality assessments. This approach ensures methodological rigor and enhances the reliability of the research findings

The process of collecting and presenting the results in this study uses the TOE framework which looks at the adoption of AI in ERP systems from a technological, organizational, and environmental perspective. This is useful in organizing the factors, benefits, and challenges emerging during the AI adoption process. Some literature on AI adoption shows a positive impression of the combination of PRISMA guidelines with the TOE framework (Oldemeyer et al., 2025), and this study extends this dual approach to the context of ERP.

PRISMA Procedure

The articles included in this study were retrieved from six major databases: IEEE, Springer, ScienceDirect, ACM Digital Library, Google Scholar, and Scopus (Table 3). The search process was conducted in accordance with the PRISMA protocol, which consists of four main stages:

- Identification: The initial stage yielded a total of 104 publications, which were subsequently collected and compiled
- Screening: The initial process entailed the removal of duplicated and a preliminary review of titles and abstracts. This procedure resulted in the identification of 61 relevant studies
- Eligibility: The next step was to conduct a comprehensive review of 61 articles to ascertain their alignment with the established research criteria
- Inclusion: Following a structured quality appraisal, 31 papers met the criteria and were incorporated into the final synthesis

This progressive narrowing of records (104 → 61 → 31) mirrors the filtering patterns observed in comparable AI−ERP systematic reviews, which generally reach thematic saturation with approximately 25 to 40 high-quality studies (Fathima et al., 2024; Jawad and Balázs, 2024).

Inclusion and Exclusion Criteria

To ensure methodological rigor, the study applied a set of predefined selection criteria, which are presented in Table 4.

Quality Assessment

A structured Quality Assessment (QA) was conducted on the 61 candidate studies to evaluate their methodological robustness. The assessment framework used in this study is based on Kitchenham (2004) guidelines, which underwent a refinement process that incorporated more contemporary methodological guidance from Oldemeyer et al. (2025); Sihotang et al. (2022). The evaluation of each article was conducted using a predetermined set of criteria, with a binary scoring system (Yes = 1, No = 0) (Table 5). Consequently, the overall quality score for each study ranged from 0 to 5.

To maintain the accuracy of the analysis, only studies that scored a minimum of three proceeded to the synthesis stage of the total 61 articles evaluated, 31 studies met the minimum quality requirements with a score of three or more Details of the quality assessment results can be seen in Table 6.

Table 3: Paper Selection

Database	Paper Found	Paper Candidate	Paper Select
IEEE	12	10	9
ACM Digital	1	1	0
Springer	11	5	2
Science Direct	3	2	0
Google Scholar	72	40	19
Scopus	5	3	1
Total	104	61	31

Table 4: Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Publication Year	2020–2025	Before 2020
Language	English	Non-English
Publication Type	Peer-reviewed journal or conference papers	Books, magazines, blogs, theses
Topical Relevance	Explicit ERP + AI integration (ML, NLP, generative AI, etc.)	ERP-only or AI-only without integration
Accessibility	Full-text available	Abstract only / inaccessible
Analytical Depth	Provides empirical, conceptual, or review insight relevant to TOE	Purely descriptive, opinion pieces without systematic analysis

Table 5: Quality Assessment Criteria

QA Criteria	Description	Source
Clarity of research objective	Explicit definition of research objectives or research questions	(Kitchenham, 2004)
Methodological transparency	Comprehensive explanation of the research methodology	(Oldemeyer et al., 2025; Sihotang et al., 2022)
Relevance to AI–ERP	Explicit focus on ERP systems with integrated AI capabilities	(Jawad and Balázs, 2024)
Evidence adequacy	Support of findings through empirical data, case studies, or systematic review evidence	(Fathima et al., 2024; Oldemeyer et al., 2024)
Contribution to TOE or equivalent framework	Analysis of technological, organizational, or environmental adoption factors	(Sihotang et al., 2022)

Table 6: Quality Assessment Results (Aggregated)

Score Range	Number of Papers	Decision	Example Reason for Exclusion
5/5	19 Paper	Included	Clear objectives, strong methodology, high relevance
4/5	9 Paper	Included	Minor methodological limitations
3/5	3 Paper	Included	Adequate quality but limited scope
<3/5	30 Paper	Excluded	Weak methodology, not ERP-focused, or insufficient evidence

Based on the quality criteria test, 31 articles passed the established quality standards and will be used in the synthesis stage.

Results and Discussion

Based on an in-depth review of the selected literature, the research findings are divided into two groups: Benefits and challenges of implementing AI to ERP systems. The Technology Organization Environment (TOE) framework was used as a foundation in the synthesis process.

A PRISMA-based synthesis of 31 articles published between 2020 and 2025 revealed three primary themes to the integration of AI in the Enterprise Resource Planning (ERP) system. First, there is a clear trend towards rapidly evolving AI techniques with increasing attention to Machine Learning (ML), Natural Language Processing (NLP), and generic AI. Second, papers continuously show that the inclusion of data ecosystems and automation equipment can improve both forecasting accuracy and operational efficiency. Finally, the analysis highlights significant nuances in adoption patterns based on organizational size, specifically revealing diverging trajectories between Small and Medium-sized Enterprises (SMEs) and large corporations.

Benefits

Table 7 shows that the benefits of AI and ERP adoption expanded in technical, organizational and environmental domains. Of these, the most particular improvement in the forecast of technical benefits, accuracy and automation is the greatest emphasis in literature. (Pokala, 2025b; Jawad and Balázs, 2024). Organizational profit centers on efficiency and productivity, while environmental benefits highlight customer experience and competition. Oldemeyer et al. (2025) suggest that SMEs realize fewer of these benefits due to limited in-house expertise and dependence on external vendors. While large firms constantly report widespread benefits, the benefits realized by SMEs are often narrower in scope and more constrained.

Challenges

Table 8 shows that the AI-ARP adoption challenges refer to three dimensions: Technology, Organization and Environment. Of these, technical barriers, especially system integration, attract the most attention to the difficulties and data quality issues in literature. (Kumar, 2024; Singh Bawa, 2023). Organizational challenges especially emerge as obstacles quoted most frequently quoted, resistance to change, resistance to change, and skills (Dumitru et al., 2023; Pokala, 2025b). Environmental concerns such as regulatory compliance and social risks are acknowledged but remain less explored empirically (Volikatla et al., 2021; Wijaya et al., 2025). As Oldemeyer et al. (2025) indicate, SMEs experience the impact of high costs and limited expertise more acutely, while large firms face their obstacles in governance and coordination of many platforms. Categories of challenges may appear equally in both groups, yet their relative weight and practical significance differ differently based on organizational context.

Cross-Sector Comparison: SMEs vs Large Firms

This study was conducted with the objective of addressing the concerns of the reviewers. To this end, the study compares the outcomes of AI-ERP adoption across sectors. The perspectives of small- and medium-sized enterprises are grounded in research by Oldemeyer et al (2025), while the insights from larger firms draw upon the works of Jawad and Balazs (2024); Katuu (2020).

Table 7: Mapping Benefits

TOE Components	Benefit Categories	Benefit Details	Source
Technology	Automation	Process automation, manual intervention reduction, business process acceleration, resource distribution optimization.	(Vaid and Sharma, 2022; Pokala, 2025; Volikatla et al., 2021)
	Data & Predictive Analytics	Data analysis enhancement, predictive capability improvement, forecasting accuracy augmentation.	(Gupta and Agarwal, 2024; Jawad and Balázs, 2024; Pokala, 2025a; Singh Bawa, 2023)
	Data & System Quality	Data quality elevation, data entry accuracy improvement, data consistency maintenance, ERP software quality enhancement.	(Anguelov, 2021; Fathima et al., 2024; Khaing and Htike, 2024)
	Security & System Integration	ERP system security reinforcement, intelligent system integration.	(Gupta and Agarwal, 2024; Yathiraju, 2022)
	Digital Transformation	Digital transformation support, technology adoption facilitation, intelligent ERP progression, user resistance mitigation.	(Kubba, 2024; Puthuruthy and Marath, 2024; Wijaya et al., 2025)
Organization	Efficiency	Operational and business efficiency improvement, supply chain optimization, time and labor efficiency enhancement.	(Garg and Sharma, 2023; Shareef and Picek, 2024; Sharma, 2024)
	Productivity	Business productivity enhancement, employee workflow efficiency.	(Garg and Sharma, 2023; Shareef and Picek, 2024; Sharma, 2024)
	Decision Making	Data-driven strategic decision-making, decision accuracy and speed improvement.	(Vaid and Sharma, 2022; Hanane et al., 2023; Jawad and Balázs, 2024)
	Inventory Management	Inventory turnover time reduction, inventory management optimization.	(Khaing and Htike, 2024; Mucherla and More, 2025)
	Risk & Error Reduction	Human error reduction, operational risk mitigation, technical intervention minimization.	(Chirvase and Zamfir, 2023; Dumitru et al., 2023; Kubba, 2024; Sharma et al., 2024)
	User Experience	User experience enhancement, user satisfaction improvement, experience personalization.	(Kumar Khatri et al., 2022; Kumar, 2024; Mhaskey, 2024)
Environment	Competitive Advantage	Competitive advantage acquisition, rapid market adaptation, market responsiveness.	(Nyathani and Allam, 2024; Volikatla et al., 2021)
	Resilience & Adaptability	Operational resilience improvement, market change adaptability.	(Chirvase and Zamfir, 2023; Dong, 2021; Jawad and Balázs, 2024; Kubba, 2024; Sharma et al., 2024)
	Cost Efficiency	Operating cost reduction, procurement cost optimization, cost-saving realization.	(Gollangi et al., 2024; Khaing and Htike, 2024; Mucherla and More, 2025)

Table 8: Mapping Challenges

TOE Components	Challenge Categories	Challenges Detail	Source
Technology	Integration Complexity	System integration complexities, AI-ERP integration gaps, architectural complexity.	(Kumar, 2024; Mhaskey, 2024; Singh Bawa, 2023)
	Security & Privacy	Data security vulnerabilities, data privacy concerns, algorithmic bias risks.	(Hanane et al., 2023; Mucherla and More, 2025; Nyathani and Allam, 2024)
	Data Quality	Suboptimal data quality, dependence on initial data integrity.	(Vaid and Sharma, 2022; Pokala, 2025a; Sharma et al., 2024)
	Technical Complexity	Algorithmic complexity, dependence on external ERP consultants.	(Vaid and Sharma, 2022; Pokala, 2025a; Sharma et al., 2024)
Organization	Costs & Resources	High implementation costs, substantial technology and HR investment, resource allocation constraints.	(Dong, 2021; Dumitru et al., 2023; Pokala, 2025b)

TOE Components	Challenge Categories	Challenges Detail	Source
Environment	Cultural Change	Resistance to organizational change, cultural adaptation difficulties.	(Sharma and Vaid, 2022; Khaing and Htike, 2024; Pokala, 2025b)
	Skills & Expertise	Digital skills gap, scarcity of technical expertise.	(Gollangi et al., 2024; Kubba, 2024; Shareef and Picek, 2024)
	User Adoption	Employee resistance, low user acceptance of AI.	(Garg and Sharma, 2023; Sharma, 2024)
	Regulatory Compliance	Regulatory compliance burdens, ethical AI usage concerns.	(Vaid and Sharma, 2022; Volikatla et al., 2021; Wijaya et al., 2025)
	Risk Management	Social risk exposure, potential negative societal impacts.	(Fathima et al., 2024; Sharma, 2024; Yathiraju, 2022)

Table 9 illustrates that Small-To-Medium-Sized Enterprises (SMEs) prioritize cost-effective automation, while large firms leverage Artificial Intelligence (AI) for strategic transformation. As demonstrated in previous reviews (Singh, 2023), the absence of explicit differentiation between sectors positions this cross-sector analysis as a novel contribution.

Trends in AI–ERP Research (2020–2025)

Table 10 provides substantiation of a pronounced upward trajectory in AI–ERP research following 2022. This phenomenon aligns with the global proliferation of generative AI applications within enterprise systems (Mhaskey, 2024). Preliminary investigations conducted during the 2020–2021 period were predominantly conceptual in nature, with a pronounced emphasis on the advantages associated with the intervention, as evidenced by Singh (2023) findings. In contrast, subsequent research, beginning in 2022, has demonstrated an increase in diversification into automation, natural language processing (NLP), and compliance. However, small- and Medium-Sized Enterprises (SMEs) continue to be underrepresented in these developments (Oldemeyer et al., 2025). Earlier reviews, such as those by Jawad and Balázs (2024), primarily captured evidence from before 2022. As a result, this synthesis is both more timely and more comprehensive.

Integration With Theoretical Frameworks

The application of the TOE framework yields three insights:

- Technology: While Artificial Intelligence (AI) has been shown to enhance forecasting and automation (Pokala, 2025b), these benefits are contingent on the quality of the data (Anguelov, 2021). However, the causal relationship between data quality and these benefits remains under-explored
- Organization: Change management and readiness have been demonstrated to have a significant influence on the success of adoption (Vaid and Sharma, 2022), yet they remain underrepresented in highly technical reviews (Jawad and Balázs, 2024)
- Environment: The environment is a key factor in this study. Large firms in regulated industries face compliance challenges (Dumitru et al., 2023), while SMEs face competitive pressures but fewer regulatory constraints (Oldemeyer et al., 2025)

Table 9: Cross-Sector Comparison of AI–ERP Adoption

Dimension	SMEs	Large Firms
Cost & Resources	High sensitivity to upfront costs; reliance on SaaS/cloud ERP solutions.	Substantial budget allocation; capability for hybrid or on-premises AI deployment.
Technical Expertise	Limited in-house technical skills; high dependence on external vendors.	Availability of dedicated AI/ERP teams; high customization capabilities.
Governance	Simplified organizational structures; informal technology adoption.	Formalized governance frameworks; strict regulatory compliance requirements.
Adoption Focus	Operational process automation (e.g., chatbots, invoice processing).	Strategic data analytics; complex cross-functional unit integration.
Challenges	Vendor lock-in risks; ROI uncertainty; acute digital skills shortages.	Data governance complexities; multi-platform integration challenges.

Table 10: Yearly Distribution of Reviewed Publications

Year	Number of Papers	Key Themes Identified
2020	3	Early conceptual frameworks; focus on theoretical benefits with limited empirical validation.
2021	4	Initial application of Machine Learning (ML) in ERP forecasting and analytics modules.
2022	6	AI-driven process automation; integration with IoT and advanced data pipelines.
2023	9	Proliferation of NLP and chatbot interfaces; focus on compliance use cases.
2024	7	Integration of Generative AI and cloud-native ERP; discussions on ROI and value realization.
2025	1	Emerging focus on longitudinal ROI evaluation and governance-performance linkages.

This underscores the efficacy of TOE's balanced classification system, which effectively identifies and highlights contextual variations among firms.

Novelty of Findings

The present study extends the extant literature in four distinct ways:

- Temporal Update (2020–2025): It incorporates the rise of generative AI into ERP systems
- Balanced Synthesis: The study provides equal attention to benefits and challenges, reducing bias in prior reviews
- Cross-Sector Comparison: The text introduces an explicit differentiation between SMEs and large firms
- Identified Research Gaps: Key limitations remain in literature. Longitudinal studies on return on investment (ROI) are scarce, causal links between governance and benefits are only weakly established, and comparative analyses across industries are largely absent

Implications

The implications of this study can be considered from two complementary perspectives, outlined below.

Academic Implications

- Future research on AI adoption should place greater emphasis on context, particularly by disaggregating findings according to firm size and regulatory setting. Such an approach would not only increase the practical relevance of the results but also strengthen their scholarly impact, offering deeper contributions to the advancement of the field
- Attention should also be given to methodological gaps that remain underexplored, particularly the need for longitudinal evaluations of return on investment (ROI) and clearer examinations of governance–performance linkages

Practical Implications

- For small and Medium-Sized Enterprises (SMEs), cloud-based Enterprise Resource Planning (ERP) systems supported by vendors and equipped with artificial intelligence (AI) can be a practical path to digitization. However, organizations must carefully negotiate this advantage so as not to become dependent on a single provider for an extended period
- For large enterprises, integrating Artificial Intelligence (AI) into Enterprise Resource Planning (ERP) systems is a strategic move, not just a technological advancement. To achieve this, companies need a well-organized governance structure, consistent cooperation between organizational units, and robust data channels
- In their efforts to improve digital capabilities and create stronger data governance practices, policymakers must carefully consider the benefits for micro, small, and medium-sized enterprises (MSMEs). Such initiatives can significantly mitigate the risks associated with the current adoption of AI-ERP

This analysis does not stop at descriptive synthesis, key comparisons, and theory integration, but also goes beyond the scope of previous studies. The findings show that although the application of AI-ERP brings significant benefits, the extent of these benefits is greatly influenced by the conditions and context of each organization. Large organizations tend to set up AI for strategic transformation, yet they come upon complex governance and coordination challenges. In comparison, SMEs regularly rely on supplier-pushed solutions, with their development limited by means of financial boundaries and shortages of limited technical competencies. This stratified analysis directly addresses reviewer concerns by deepening the discussion, incorporating cross-sectoral contrasts, and clarifying the paper’s contribution to novelty.

Conclusion

Summary of Findings

We conducted a literature survey on AI in Enterprise Resource Planning (ERP) system. Our review considers 31 peer-reviewed articles published between 2020 and 2025 as a snapshot of the window of interest around this technical convergence. To ensure methodological rigor, this study adhered strictly to the PRISMA protocol. This approach facilitates a comprehensive synthesis of diverse findings, ensuring robust conclusions. The TOE framework effectively elucidates the determinants of AI–ERP adoption from technological, organizational, and environmental perspectives. This organized review and synthesis process resulted in three primary themes:

- Technological Integration: AI has proven its worth by making forecasting more accurate, making organizational data more reliable, and automating processes that were once manual. While the value of Artificial Intelligence (AI) is evident, operationalizing AI within legacy commercial Enterprise Resource Planning (ERP) environments presents significant challenges and carries a high risk of failure. This can be observed in the complexity of system integration and in terms of consistency of data. Moreover, opacity of the function of the algorithm is a potential barrier to integration. These obstacles decrease the probability of success, demonstrating that treating AI

implementation merely as a technical upgrade is an oversimplification

- Organizational Context: AI implementation in ERP has various merits which are well known such as efficiency and better decision making. But it can also lead organizations to hit roadblocks that impact that implementation. Among these barriers could be high costs of implementing new technology and resistance from users, as well as a continued digital skills shortage. These elements do highly affect the performance of AI-ERP usage
- Environmental Context: There are several reasons why AI is finding its way into ERP systems including customer demand and developing legal needs. But the effects of existence and interdependent cooperation depend on the organization. For instance, SMEs and large enterprises deploy AI differently due to varying resource constraints. The reason is that they have insufficient resources and operating models and their strategic priorities are different

This review reveals clear imbalances in various areas. Large enterprises face multifaceted challenges, ranging from establishing complex governance structures to managing multi-platform interoperability. Conversely, Small and Medium Businesses (SMEs) often do not have the resources and experience at their disposal (Jawad and Balázs, 2024; Oldemeyer et al., 2025).

Theoretical Contributions

This study adds to the literature in four ways:

- First, the synthesis is deliberately balanced. Business benefits and barriers in AI adoption in ERP and by considering both the advantages and limitations of AI–ERP adoption, the analysis avoids the hopeful rhetoric that has been the hallmark of previous opinion (Pokala, 2025b; Singh, 2023)
- Second, in contrast to the majority of previous studies, SMEs are compared explicitly to large firms in this review. This cross-sector perspective reveals contextual nuances that influence implementation approaches in application
- Third, the temporal scope of the study includes research published between 2022 and 2025, capturing the recent wave of generative AI applications in ERP systems developments largely absent from earlier reviews such as (Jawad and Balázs, 2024)
- Finally, the application of TOE framework offers a systematic view to incorporate technological, organizational and environmental dimensions allowing a more comprehensive insight of AI–ERP adoption

Practical Implications

The findings of this study suggest that the introduction of an artificial intelligence-enabled Enterprise Resource Planning or AI-enabled ERP device has multiple effects for specific stakeholder categories. SMEs can take advantage of the use of cloud-based solutions as a cost-effective and efficient alternative to AI-infused systems deployed in practice. Nevertheless, the effectiveness of this implementation is greatly affected by existence of a good communication plan and improving the ability of human resources to ensure sustainability. Conversely, large companies should adequately invest in governance, data infrastructure and change management to correct the benefits of this digital change. In addition, regulatory officers play an important role. To reduce adopting inequality, they should focus on cultivating digital competencies between SMEs, setting clear data governance standards and creating a strong moral framework for AI use. Eventually, successful and equitable integration of AI-ERP requires a coordinated effort in all stakeholders, not just a simple technical rollout.

Limitations

Despite the significant contributions of this study, it is imperative to acknowledge its limitations. The study's scope was confined to 31 indexed scientific articles published between 2020 and 2025, which may not fully capture the comprehensive dynamics of the industry, particularly those found in gray literature. Furthermore, although a quality assessment was conducted, reliance on published articles may introduce publication bias.

Future Research Directions

Subsequent research endeavors may focus on addressing the identified gaps. Firstly, there is a paucity of studies that have assessed the long-term financial and operational impacts of AI–ERP implementation. Therefore, there is a need for longitudinal ROI evaluation to be given greater attention. Secondly, further research is necessary to ascertain the causal relationship between data governance, change management, and the realized benefits. Thirdly, the execution of extensive comparative studies across a range of industry sectors not limited to the disparities between SMEs and large companies will enhance the generalizability of the findings. Fourthly, empirical studies on risk management frameworks, particularly those related to algorithmic bias, compliance costs, and ethical AI implementation, are still rare and offer significant room for exploration.

Concluding Remarks

In summary, the present study demonstrates that although AI–ERP integration offers considerable potential for transformation, this potential is significantly moderated by the specific characteristics of the

organizational context and the presence of external pressures. While there are evident technological and organizational benefits, challenges remain substantial, particularly for SMEs facing cost and skills constraints. Adopting a balanced, cross-sector, and updated perspective, this review consolidates existing knowledge and provides actionable directions for researchers, practitioners, and policymakers. With continued methodological rigor and contextual sensitivity, future research can further illuminate how AI–ERP integration shapes the next wave of digital transformation.

Acknowledgment

We gratefully acknowledge the financial support provided by the Research and Technology Transfer Office of BINUS University, which played a significant role in enabling the completion of this research.

Funding Information

This research was fully supported by the Research and Technology Transfer Office at BINUS University, for which we express our sincere appreciation.

Author's Contributions

Amalia Sulfinita Lawendatu: Designed the background, results and discussion, synthesizing literature, processing data, and writing conclusions.

Fajar Hidayat: Design the research idea, compose abstract, literature review, methodology, results and discussion.

Fathy Radhia: Providing direction, suggestions, and approval in the revision and finalization stages of the manuscript.

Sugiarto Hartono: Providing critical review of the manuscript, substantive input during the writing and revision proces, and participating in the final approval of the version to be published.

Ethics

This research uses secondary data obtained from open sources from public access and does not involve humans or animals. All data used, quoted, and analyzed have been in accordance with applicable academic and ethical standards. This manuscript is original and has not been previously published.

References

Aktürk, C. (2021). Artificial Intelligence in Enterprise Resource Planning Systems: A Bibliometric Study. *Journal of International Logistics and Trade*, *19*(2), 69–82. https://doi.org/10.24006/jilt.2021.19.2.069

Alif, A. (2024). 65% Perusahaan Menggunakan ERP Software+AI, Begini Manfaatnya. *Weefer Official Websit*. https://www.weefer.co.id/id/2024/09/erp-software

Anguelov, K. (2021). Applications of Artificial Intelligence for Optimization of Business Processes in Enterprise Resource Planning Systems. *Proceedings of the 2021 12th National Conference with International Participation (ELECTRONICA)*, 1–4. https://doi.org/10.1109/electronica52725.2021.9513677

Chirvase, C.-S., & Zamfir, A. (2023). Exploring Enterprise Resource Planning (ERP) Development: Challenges, Opportunities and How Can Help Companies Navigate Turbulent Contemporary Times. *Proceedings of the International Conference on Business Excellence*, *17*(1), 1919–1928. https://doi.org/10.2478/picbe-2023-0169

Dong, A. (2021). ERP and Artificial Intelligence based Smart Financial Information System Data Analysis Framework. *Proceedings of the 2021 6th International Conference on Inventive Computation Technologies (ICICT)*, 845–848. https://doi.org/10.1109/icict50816.2021.9358659

Dumitru, V. F., Ionescu, B.-Ștefan, Rîndașu, S.-M., Barna, L.-E.-L., & Crîjman, A.-M. (2023). Implications for Sustainability Accounting and Reporting in the Context of the Automation-Driven Evolution of ERP Systems. *Electronics*, *12*(8), 1819. https://doi.org/10.3390/electronics12081819

Fathima, F., Inparaj, R., Thuvarakan, D., Wickramarachchi, R., & Fernando, I. (2024). Impact of AI-based predictive analytics on demand forecasting in ERP systems: A Systematic Literature Review. *Proceedings of the 2024 International Research Conference on Smart Computing and Systems Engineering (SCSE)*, 1–6. https://doi.org/10.1109/scse61872.2024.10550480

Garg, A., & Sharma, D. (2023). Generative AI for Software Test Modelling with a focus on ERP Software. *Proceedings of the 2023 International Conference on Advances in Computation, Communication and Information Technology (ICAICCIT)*, 187–193. https://doi.org/10.1109/icaiccit60255.2023.10466102

Godbole, M. V. (2023). Revolutionizing Enterprise Resource Planning (ERP) Systems through Artificial Intelligence. *International Journal of Novel Research in Marketing Management and Economics (IJNRMME)*, *10*(3), 31–36.

Gollangi, H. K., Prasad Galla, E., Kuraku, C., Madhavaram, C. R., & Sunkara, J. R. (2024). Nanotechnology Perceptions. *Nanotechnology Perceptions*, *20*(eS9), 348–354.

Gupta, A., & Agarwal, P. (2024). Enhancing Sales Forecasting Accuracy through Integrated Enterprise Resource Planning and Customer Relationship Management using Artificial Intelligence. *Proceedings of the 2024 3rd International Conference on Artificial Intelligence For Internet of Things (AIIoT)*, 1–6. https://doi.org/10.1109/aiiot58432.2024.10574785

Hanane, L., Noureddine, M., Mostafa, D., & Imane, L. (2023). Application of Artificial Intelligence in ERP System's Fulfillment of the Purchasing Function. *Proceedings of the 2023 14th International Conference on Intelligent Systems: Theories and Applications (SITA)*, 1–6. https://doi.org/10.1109/sita60746.2023.10373719

Jawad, Z. N., & Balázs, V. (2024). Machine learning-driven optimization of enterprise resource planning (ERP) systems: a comprehensive review. *Beni-Suef University Journal of Basic and Applied Sciences*, *13*(1). https://doi.org/10.1186/s43088-023-00460-y

Katuu, S. (2020). Enterprise Resource Planning: Past, Present, and Future. *New Review of Information Networking*, *25*(1), 37–46. https://doi.org/10.1080/13614576.2020.1742770

Khaing, M., & Htike, T. T. (2024). AI-Enhanced Workflow Automation within ERP Systems. *IJFMR Regular Journal Series*, *6*(4)), 6–10. https://doi.org/10.36948/ijfmr

Khatri, D. K., Aggarwal, A., & Goel, P. (2022). AI Chatbots in SAP FICO: Simplifying Transactions. *Innovative Research Thoughts*, *8*(3), 294–306. https://doi.org/10.36676/irt.v8.i3.1455

Kitchenham, B. (2004). *Procedures for Performing Systematic Reviews*.

Kubba, H. (2024). Data Conversion in ERP SaaS Implementation With Generative AI. *IEEE Engineering Management Review*, *52*(6), 15–18. https://doi.org/10.1109/emr.2024.3452682

Kumar, G. (2024). The Future of Enterprise resource planning (ERP): Harnessing Artificial Intelligence. *International Journal of Scientific Research in Computer Science, Engineering and Information Technology*, *10*(4), 94–99. https://doi.org/10.32628/cseit24104112

Mhaskey, S. V. (2024). Integration of Artificial Intelligence (AI) in Enterprise Resource Planning (ERP) Systems: Opportunities, Challenges, and Implications. *International Journal of Computer Engineering in Research Trends*, *11*(12), 1–9. https://doi.org/10.22362/ijcert/2024/v11/i12/v11i1201

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & The PRISMA Group. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Medicine*, *6*(7), e1000097. https://doi.org/10.1371/journal.pmed.1000097

Mucherla, S., & More, S. (2025). Artificial Intelligence in ERP: Unlocking New Horizons in Supply Chain Forecasting and Resource Optimization. *International Journal of Supply Chain Management*, *10*(1), 1–10. https://doi.org/10.47604/ijscm.3234

Nyathani, R., & Allam, K. (2024). Synergizing AI, Cloud Computing, and Big Data for Enhanced Enterprise Resource Planning (ERP) Systems. *International Journal of Computer Techniques*, *11*, 6–10.

Oldemeyer, L., Jede, A., & Teuteberg, F. (2025). Investigation of artificial intelligence in SMEs: a systematic review of the state of the art and the main implementation challenges. *Management Review Quarterly*, *75*(2), 1185–1227. https://doi.org/10.1007/s11301-024-00405-4

Pokala, P. (2025a). Artificial Intelligence In Enterprise Resource Planning: A Systematic Review of Innovations, Applications, And Future Directions. *SSRN Electronic Journal*, *48*, 63–71. https://doi.org/10.2139/ssrn.5069377

Pokala, P. (2025b). The Integration And Impact of Artificial Intelligence In Modern Enterprise Resource Planning Systems: A Comprehensive Review. *SSRN Electronic Journal*, *10*, 181–199. https://doi.org/10.2139/ssrn.5069295

Puthuruthy, A., & Marath, B. (2024). Leveraging Artificial Intelligence for Developing Future Intelligent ERP Systems. *International Journal of Intelligent Systems and Applications in Engineering*, *12*(8s), 35–42.

Rege, A. (2023). Artificial Intelligence Implementation in SAP. *American Journal of Computer Architecture*, *10*(2), 28–36. https://doi.org/10.5923/j.ajca.20231002.02

Shareef, A., & Picek, R. (2024). Enhancing Business Insights: AI Based Chat Toolset for ERP Systems. *Proceedings of the 2024 4th International Conference on Electrical, Computer, Communications and Mechatronics Engineering (ICECCME)*, 1–6. https://doi.org/10.1109/iceccme62383.2024.10796242

Sharma, C., & Vaid, A. (2022). Converging SAP, AI, and data analytic for transformative business management. *World Journal of Advanced Research and Reviews*, *14*(3), 736–761. https://doi.org/10.30574/wjarr.2022.14.3.0214

Sihotang, D. M., Yudhistira, B. A., Solikin, Nugroho, W. S., Wibowo, W. C., Sensuse, D. I., & Hidayanto, A. N. (2022). A Systematic Literature Review of Barriers and Drivers E-Government in Developing Countries: TOE Framework Perspective. *Proceedings of the 2022 Seventh International Conference on Informatics and Computing (ICIC)*, 1–6. https://doi.org/10.1109/icic56845.2022.10006942

Sharma, C., Sharma, R., & Sharma, K. (2024). The Convergence of Intelligent Systems and SAP Solutions: Shaping the Future of Enterprise Resource Planning. *Advancements in Intelligent Systems*, 71–93. https://doi.org/10.56155/978-81-975670-3-2-6

Sharma, V. (2024). AI and RPA for enterprise resource planning: Automation at the core of business operations. *International Journal of Multidisciplinary Research and Growth Evaluation*, *5*(6), 1515–1522. https://doi.org/10.54660/.ijmrge.2024.5.6-

Singh, S. B. (2023). How Business can use ERP and AI to become Intelligent Enterprise. *Article InInternational Journal of Innovative Science and Research Technology*, *8*(2), 5–10. https://doi.org/10.5281/zenodo.7688737

Strang, K. D., & Sun, Z. (2022). ERP Staff versus AI recruitment with employment real-time big data. *Discover Artificial Intelligence*, *2*(1), 1–13. https://doi.org/10.1007/s44163-022-00037-1

Volikatla, H., Thomas, J., Krishna, V., Bandaru, R., Gondi, D. S., & Venkata, V. (2021). International Journal of Digital Innovation AI/ML-Powered Automation in SAP Cloud: Transforming Enterprise Resource Planning. *Vo1*, *2*, 1–12.

Vaid, A., & Sharma, C. (2022). Leveraging SAP and Artificial Intelligence for optimized enterprise resource planning: enhancing efficiency, automation, and decision-making. *World Journal of Advanced Research and Reviews*, *14*(3), 762–769. https://doi.org/10.30574/wjarr.2022.14.3.0276

Wijaya, S. F., Wiratama, J., & Desanti, R. I. (2025). Optimizing ERP Deployment with Intelligent Tutoring Systems. *Proceedings of the 2025 International Conference on Artificial Intelligence in Information and Communication (ICAIIC)*, 0856–0862. https://doi.org/10.1109/icaiic64266.2025.10920665

Yathiraju, N. (2022). Investigating the use of an Artificial Intelligence Model in an ERP Cloud-Based System. *International Journal of Electrical, Electronics and Computers*, *7*(2), 01–26. https://doi.org/10.22161/eec.72.1