International Journal of Innovative Research and Scientific Studies, 8(3) 2025, pages: 4795-4811

ISSN: 2617-6548

URL: www.ijirss.com

AI-driven SAP S4/HANA, advancing firm operational efficiency, decision-making and resource optimization

Tarek SAMARA

Umm Al Quwain University College of Business Administration (COBA) - Department of Management Information Systems (MIS) Building 998/2, Sheikh Mohammed Bin Zayed Road Umm Al Quwain, United Arab Emirates (UAE).

(*Email: tareksamara3@gmail.com*)

Abstract

This study examines how AI integration into SAP S/4HANA enhances information system effectiveness in meeting firm needs, including operational efficiency, decision-making, and resource optimization. It aims to provide valuable insights for businesses leveraging AI-powered ERP capabilities in modern business environments. This study employs archival analysis using a qualitative multiple case study approach, triangulating insights from three sources for depth and rigor: a literature review for theoretical grounding, SAP's official proposals, and case studies from several firms. Selection criteria include relevance, credibility, and comprehensiveness. This comparative study evaluates AI's impact on efficiency, decision-making, and resource optimization. Thematic analysis identifies key patterns, challenges, and business outcomes. The findings confirm that AI integration into ERP systems enhances operational efficiency, decision-making, and resource optimization. Archival analysis demonstrates tangible benefits, including reduced downtime, improved supply chain management, automated financial operations, and enhanced predictive analytics. This research bridges theory and practice by connecting academic concepts with real-world AI-driven ERP integration and the implications of AI in SAP S/4HANA, offering a comprehensive perspective. It provides valuable insights for both academics and practitioners. These strengths highlight the study's relevance, originality, and potential impact in the evolving field of AI-integrated enterprise systems.

Keywords: Artificial intelligence, Decision-making, ERP, Information system, Machine learning, NLP, Operational efficiency, Predictive analytics, Resource optimization, SAP S/4HANA.

DOI: 10.53894/ijirss.v8i3.7613
Funding: This study received no specific financial support.
History: Received: 18 April 2025 / **Revised:** 22 May 2025 / **Accepted:** 24 May 2025 / **Published:** 3 June 2025

Competing Interests: The author declares that there are no conflicts of interests regarding the publication of this paper.
Transparency: The author confirms that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.
Publisher: Innovative Research Publishing

1. Introduction

The integration of AI into ERP systems, particularly SAP S/4HANA, is transforming how organizations manage information systems (ISs), enhancing efficiency, agility, and decision-making [1]. By incorporating machine learning (ML) and advanced analytics, AI-driven ERP solutions optimize operations, improve resource allocation, and enhance predictive capabilities. Aktürk.

This study examines the impact of AI-powered ERP systems on operational efficiency, decision-making, and resource optimization, highlighting key benefits such as automation, predictive analytics, and anomaly detection. These technologies reduce errors, strengthen financial oversight, and improve supply chain visibility [2, 3]. Leading ERP systems like SAP S/4H are at the forefront of this evolution, integrating AI and ML to drive real-time business intelligence [4]. AI-driven models enhance resource planning, inventory management, cost reduction, and fraud detection [5] while predictive analytics helps firms anticipate market trends, optimize logistics, and improve customer interactions [6]. AI's growing role in ERP is evident, with 63% of companies integrating AI strategies to enhance efficiency and resilience [7].

The study is structured as follows: an introduction (Section 1), a review of AI integration in ERP (Section 2), theoretical foundations and methodology (Section 3), an archival analysis of industry leaders (Section 4), key findings (Section 5), future challenges (Section 6), and a conclusion (Section 7).

2. Literature Review

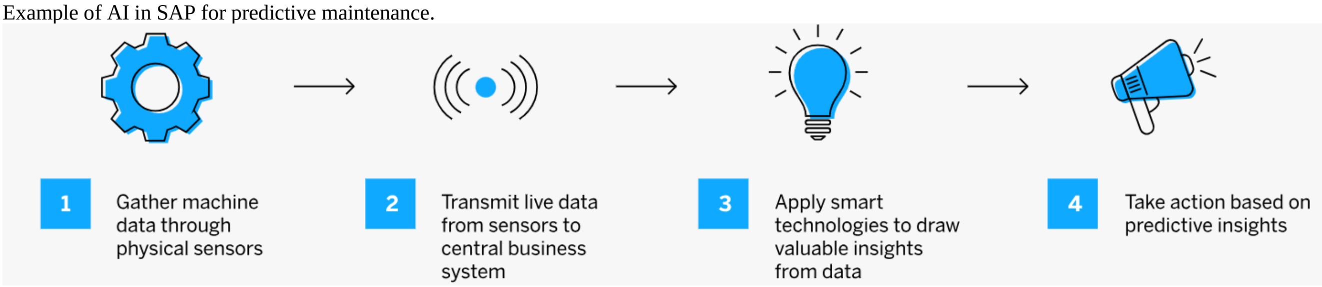
The impacts and benefits of AI integration into SAP S/4HANA on information systems and firm business needs have been identified in the literature review, including the following*:*

Several impacts and benefits on ISs and firm business needs have been identified in the LR, including the following:

2.1. Predictive Maintenance

AI and ML are revolutionizing ISs, particularly in predictive maintenance, by minimizing downtime, optimizing schedules, and extending equipment lifespan, as shown in Figure 1. Integrating predictive analytics into ERP systems enhances decision-making and operational efficiency through real-time insights and advanced forecasting. SAP S/4HANA leverages ML to anticipate equipment failures, reducing downtime and improving maintenance strategies [8, 9].

Figure 1.
Example of AI in SAP for predictive maintenance.



Source: https://www.sap.com/products/scm/apm/what-is-predictive maintenance.html

2.2. Automated Processes Reducing Errors and Delays

AI-driven automation in SAP S/4H enhances efficiency by reducing errors and delays in logistics and invoicing, as shown in Figure 2. AI-based invoice processing leverages Optical Character Recognition (OCR) and machine learning (ML) to streamline operations, including freight management. AI also predicts late payments, resolves implausible meter readings, and automates the release of out-sorted utility billing documents [10-12].

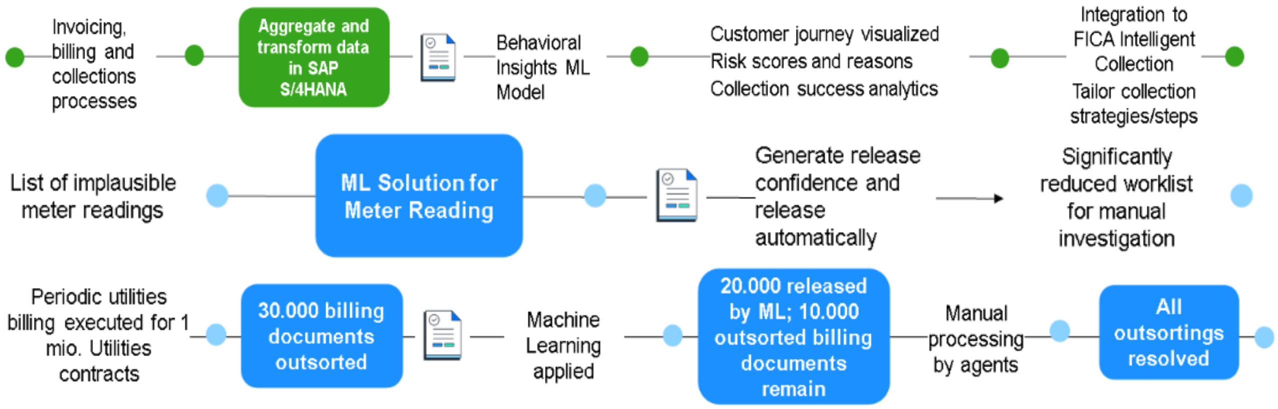


Figure 2.
Example of AI in SAP for reducing errors and delays in processes.
Source: https://learning.sap.com/learning-journeys/transitioning-to-sap-s-4hana-for-utilities/leveraging-artificial-intelligence-solutions-for-enhancing-sap-s-4hana-utilities

2.3. Delays in Financial Reporting Due to Error Resolution Challenges

Delays in financial reporting often result from error resolution challenges, such as data discrepancies and system integration issues. SAP S/4HANA's advanced architecture improves performance with faster data processing and enhanced reporting. When integrated with AI, it further enables predictive analytics, process automation, and real-time decision-making. AI enhances Supply Chain Management (SCM), demand forecasting, and financial operations while automating error detection and providing real-time analytics. SAP S/4HANA's in-memory computing accelerates data processing, facilitating quicker error resolution. This integration improves the accuracy and efficiency of financial reporting, reducing delays and optimizing workflows [8].

2.4. Intelligent Recommendations for Business Workflows

AI integration enhances ERP systems like SAP S/4H by providing intelligent recommendations that optimize business workflows, as shown in Figure 3. These systems improve operational efficiency by automating tasks, enhancing data processing, and enabling predictive analytics. Unlike traditional ERP systems with rigid, pre-programmed models [13]. AI-powered ERP adapts through dynamic, real-time data processing and learning capabilities. This shift enables real-time decision-making in business environments. As highlighted by Ganiuly and Smaiyl [7] and Wamba et al. [14], AI-driven ERP systems streamline business object creation and enhance overall efficiency.

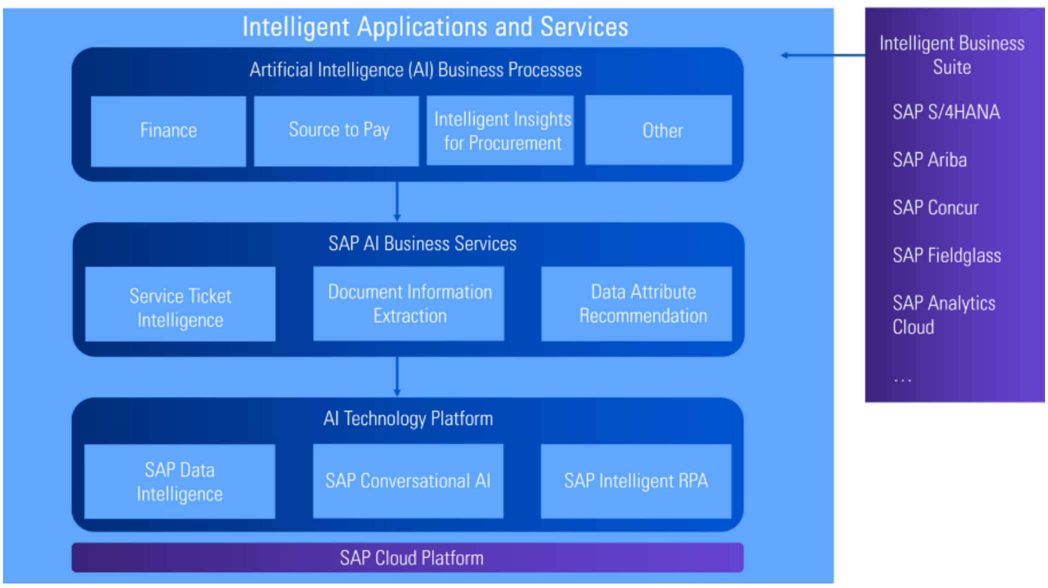


Figure 3.
Example of AI in SAP for intelligent recommendations in business workflows.
Source: https://www.xeptum.com/en/news/use-of-ai-made-easy

2.5. Real-Time and Predictive Analytics for Decision-Making

The integration of predictive analytics in SAP S/4H enhances operational efficiency and strategic decision-making, aligning with future trends in ERP systems [6] as shown in Figure 4. AI and ML-driven intelligent automation extend beyond traditional process automation, enabling autonomous decision-making previously handled by executives. The evolving landscape of cloud ERP solutions highlights AI's role in modern ERP systems, improving efficiency and decision-making [2].

AI technologies such as ML and NLP are embedded in SAP S/4H, enabling real-time data analysis, prediction, and automation. Notably, SAP S/4H integrates ML for predictive analytics, anomaly detection, and NLP, significantly enhancing reporting and forecasting [15-17]. These advancements empower businesses with improved demand forecasting and resource planning, reinforcing ERP systems as critical tools for strategic decision-making.

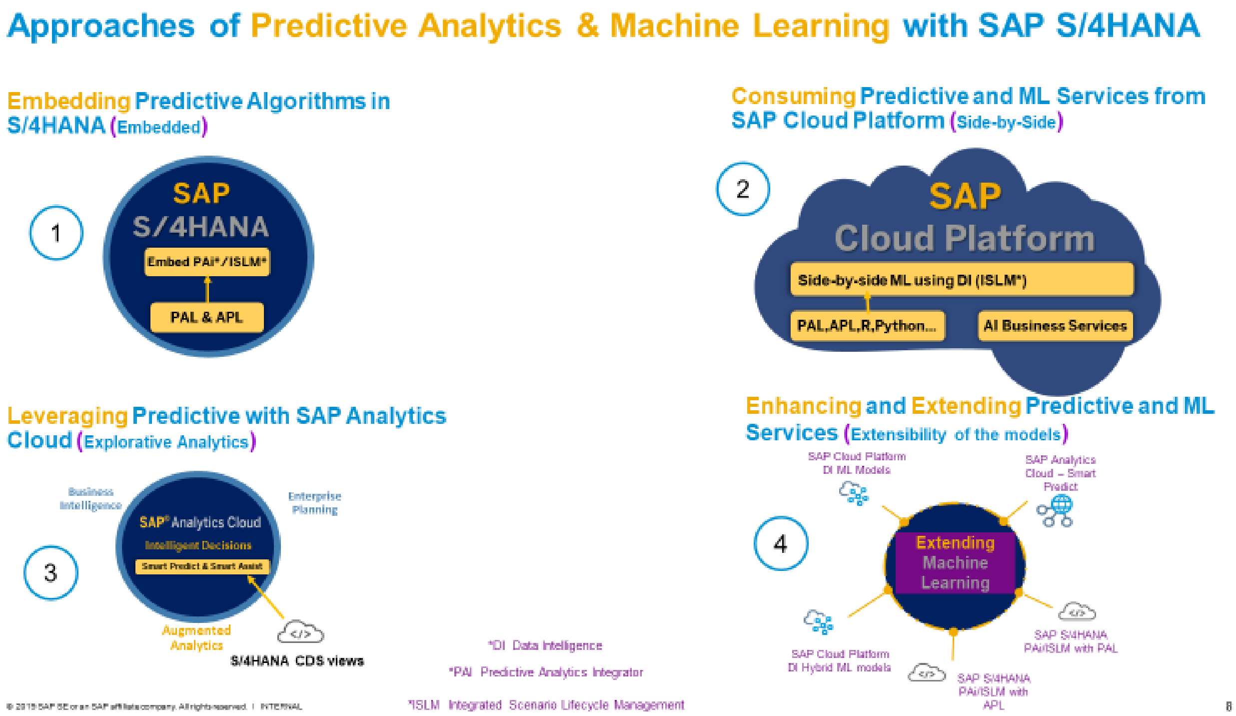


Figure 4.
Example of AI in SAP for real-time and predictive analytics in decision-making
Source: Banda [10].

2.6. Enhanced Customer Insights and Interactions Driven by Predictive Analytics

AI-driven predictive analytics in ERP systems like SAP S/4H enhance decision-making and organizational performance by providing data-driven insights. These tools enable managers to forecast demand, optimize inventory, and improve customer service [18]. By leveraging real-time data analysis and forecasting, predictive analytics strengthens decision-making processes within ERP systems [2]. This integration enhances customer insights, allowing businesses to better prepare for interactions and improve service quality.

2.7. NLP Tools for Business Queries Quickly and Accurately

Integration of AI, particularly NLP, into ERP systems is transforming them into advanced tools for business intelligence and decision-making. NLP models enhance real-time business queries, improve user experience, and streamline communication with the system. The LR highlights how AI and ML enhance SAP S/4H by automating tasks and improving user interactions [19]. By simplifying querying processes, NLP makes data more accessible to non-technical users, bridging the gap between complex ERP functionalities [13] and business decision-making.

2.8. Enhancing Fraud Detection and Compliance in Financial Processes

AI and ML enhance fraud detection and compliance in financial processes by integrating predictive analytics and real-time monitoring into SAP S/4H. This improves risk management, governance, and financial health for institutions. SAP SE integrates AI with SAP S/4H to enable real-time data processing, fraud detection, and automated regulatory compliance [20]. Additionally, a theoretical study examines how NLP and Generative AI function as mediating factors in ERP systems, further strengthening fraud prevention [21].

2.9. Optimized Resource Allocation to Improve Efficiency and Reduce Costs

SAP S/4H integration improves resource allocation and efficiency by enhancing data processing and analytics. It contrasts traditional ERP-driven automation with intelligent automation, emphasizing how AI enables systems to learn, adapt, and optimize previously static processes. The integration of big data analytics with SAP S/4 enhances ERP system performance [8, 11, 22]. This leads to optimized resource allocation, reduced costs, and improved efficiency in AI-powered ERP systems.

2.10. Improved Supply Chain Visibility

The integration of AI into ERP systems, particularly SAP S/4H, enhances flexibility and adaptability in SCM, as shown in Figure 5. AI tools, such as ML and predictive analytics, improve supply chain visibility by processing vast amounts of real-time data. This results in more accurate forecasting, better inventory management, and the ability to predict and prevent disruptions. A case study on SAP S/4H implementation demonstrates how AI improves demand forecasting and inventory optimization, leading to increased operational efficiency and strategic decision-making [8, 23, 24]. The integration of AI also enhances shipment tracking and logistics management, further optimizing the SCM.

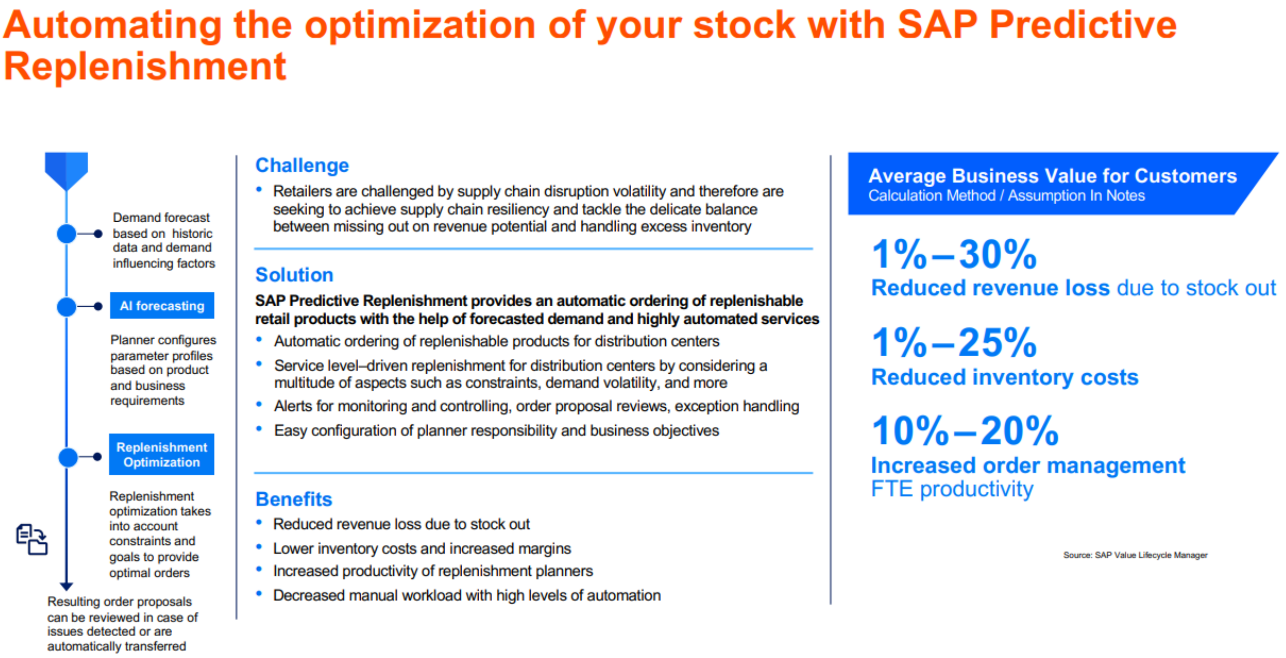


Figure 5.
Example of AI in SAP for enhanced supply chain visibility.
Source: Sarferaz [5].

2.11. Inefficient Coordination Between Stakeholders

Inefficient coordination between stakeholders in SCM and logistics often causes delays and increased costs. This issue stems from miscommunication, a lack of real-time data sharing, and fragmented systems. Integrating AI with SAP S/4H can address these challenges by providing real-time data, predictive insights, and automation, which enhance decision-making and streamline operations. AI optimizes forecasting, inventory management, and route planning, while SAP S/4H improves collaboration among stakeholders. Together, these technologies reduce inefficiencies, enhance coordination, and boost SCM performance [24, 25].

Furthermore, AI integration promotes better inventory management and demand forecasting, while SAP S/4HANA provides a comprehensive view of the supply chain, encouraging collaboration, reducing manual processes, and increasing transparency. AI governance technology also helps improve social performance by fostering better collaborative relationships with stakeholders and enhancing the efficiency of social responsibility initiatives [21, 26].

2.12. Workforce Planning to Align Organizational Goals with Skill Requirements

A study explores the crucial relationship between workforce planning and organizational success, emphasizing the need to align workforce skills with strategic goals. Effective workforce planning goes beyond filling positions; it involves anticipating future skill needs to maintain competitiveness and adaptability in a rapidly changing business environment. The integration of AI into ERP systems has significantly improved workforce planning by offering more flexibility than traditional systems. AI's ability to process large volumes of real-time data enables organizations to align their workforce with evolving goals and dynamic skill requirements. This enhances employee skills, optimizes talent allocation, identifies skill gaps, and prepares the workforce for future challenges, fostering a more agile approach to workforce management. Ultimately, AI is key in aligning organizational goals with employee skills and competencies [9, 27].

Consequently, the literature review, as illustrated in Figure 6, highlights the impact and benefits of integrating AI into SAP S/4HANA (Independent Variables: IVs) on information systems (IS) and a firm's operational needs (Dependent Variables: DVs). Furthermore, it facilitates the creation of Table I, which categorizes and synthesizes the research variables while linking them to relevant references from the literature review for clarity and ease of analysis.

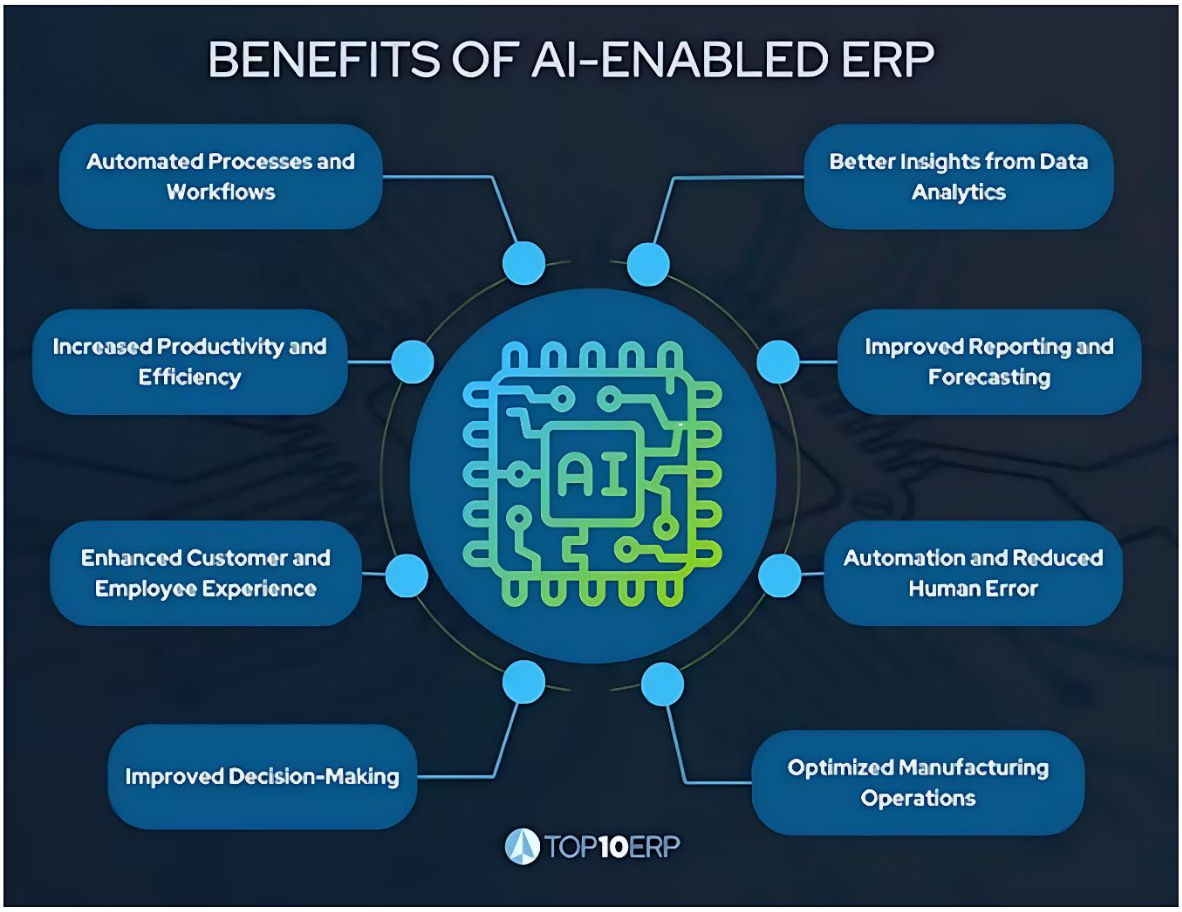


Figure 6.
Benefits of AI-enabled ERP.
Source: Morrison [4]

Table 1.
Impact of Integrating AI into SAP S/4H firm's OE, PADM, and RO.

Impact of Integrating AI into SAP S/4 H (IVs) on IS (MV) and Firm's Needs (DVs)	Benefits of integrating AI into SAP S/4 H	References
1 - Q1 and H1: Operational Efficiency (OE)	1.1 - Predictive maintenance to avoid downtime, optimize schedules, and extend equipment lifespan ≈ H1.1	Sharma and Vaid [28]
	1.2 - Automated processes for logistics, freight, and invoice handling, reducing errors and delays ≈ H1.2	Barua, et al. [29]
	1.3 Addressing delays in financial reporting and workflows due to error resolution challenges ≈ H1.3	Kunchala [30]
	1.4 - Intelligent recommendations for business workflows to streamline the creation of business objects ≈ H1.4	Wamba, et al. [14]
2 - Q2 and H2: Predictive Analytics and Decision-Making (PADM)	2.1 - Real-time and predictive analytics for decision-making, improving demand forecasting and resource planning ≈ H2.1	Bauskar [31]
	2.2 - Enhanced customer insights and preparation for interactions, driven by predictive analytics ≈ H2.2	Zheng [18]
	2.3 - NLP tools for querying business data quickly and accurately ≈ H2.3	Williamson [32]
	2.4 - Enhancing fraud detection and compliance in financial processes ≈ H2.4	Faccia, et al. [33]
3 - Q3 and H3:	3.1 - Optimized resource allocation to improve efficiency and reduce costs ≈ H3.1	Parimi [20]

Resource Optimization (RO)	3.2 - Improved supply chain visibility for better shipment tracking and logistics management ≈ H3.2	Gollangi, et al. [24]
	3.3 - Ensuring effective coordination between stakeholders in supply chain and logistics operations ≈ H3.3	Sharma and Vaid [27]
	3.4 - Workforce planning to align organizational goals with skill requirements ≈ H3.4	Vaid and Sharma [9]

3. Theoretical Framework, Research Questions, Hypotheses, and Methodological Approach

3.1. Theoretical Framework and Empirical Support

This study is anchored in well-established theoretical foundations in the field of IS, each offering a distinct yet complementary lens through which the integration of AI into SAP S/4HANA can be understood. These frameworks guide the development of our hypotheses concerning how AI-enhanced ERP systems improve operational efficiency, decision-making, and resource optimization (cf. Tables I and III).

First, the Resource-Based View (RBV) [15] posits that competitive advantage arises from firm-specific resources that are valuable, rare, inimitable, and non-substitutable. AI-powered SAP S/4HANA capabilities, such as predictive maintenance (H1.1), automated logistics (H1.2), and intelligent workflows (H1.4), can be seen as digital assets that enhance operational efficiency and process excellence. These capabilities enable firms to extract value from data-driven insights, aligning with RBV's emphasis on strategic resource deployment. Second, the Technology-Organization-Environment (TOE) Framework [34, 35] provides a holistic view of innovation adoption. In the context of SAP S/4HANA, technological readiness (e.g., platform capabilities), organizational context (e.g., digital maturity), and environmental pressures (e.g., regulatory compliance, competitive demands) collectively shape how AI functionalities are integrated. These dimensions support our hypotheses on how firms adopt AI to enhance predictive analytics (H2.1, H2.2) and optimize supply chains (H3.2, H3.3).

Third, Transaction Cost Economics (TCE) [44] explains how digital technologies reduce coordination and operational costs by improving information transparency and process integration. AI-enabled features in SAP S/4HANA, such as real-time fraud detection (H2.4), NLP-driven querying (H2.3), and resource planning (H3.1, H3.4), reduce uncertainty and facilitate better-informed decisions. This theory supports the role of AI in minimizing transaction inefficiencies. Fourth, the IS Success Model [36, 37] underscores how system quality, information quality, and service quality collectively influence user satisfaction and organizational benefits. In our study, we extend this model to highlight how AI augments SAP S/4HANA's ability to deliver accurate, timely, and context-aware insights, thereby improving user decision-making and operational control (H2.1–H2.4). Together, these theories create an integrated foundation for analyzing how AI transforms ERP systems into intelligent infrastructures that support operational agility and strategic alignment. Together, these theories frame AI-driven SAP S/4HANA as both a strategic resource (RBV), a sociotechnical innovation (TOE & Socio-Technical Systems Theory: STS), and a vehicle for cost reduction and decision enhancement (TCE, IS Success Model).

Empirical evidence reinforces this theoretical grounding. Studies such as Ateeq et al. [38] and Fosso Wamba et al. [39] confirm that AI integration in ERP improves process automation, data accuracy, and predictive capabilities. Industry white papers and technical documentation from SAP [i-xii] further validate the specific AI use cases aligned with our hypothesis framework, ranging from predictive maintenance to intelligent financial processing. Additionally, prior theoretical work by Klaus et al. [40] affirms the role of IS in enabling decision-support and business performance enhancement.

By synthesizing these perspectives, our research examines how AI-driven SAP S/4HANA operates as a transformative digital infrastructure. The framework supports our central argument that integrating AI into ERP systems can drive measurable improvements in (1) operational efficiency (H1.1–H1.4), (2) predictive analytics and decision-making (H2.1–H2.4), and (3) resource optimization (H3.1–H3.4).

3.2. Research Questions and Hypotheses

This study investigates how AI integration in SAP S/4HANA enhances firms' operational efficiency, predictive analytics, and resource optimization. Informed by the above theoretical foundations, the following research questions and hypotheses are proposed (cf. Table I):

- Q1: Could AI integration into SAP improve firms' operational efficiency (OE)?
  $H_{1:}$ AI integration enhances OE. Sub-hypotheses: H1.1, H1.2, H1.3, and H1.4.
- Q2: Could AI integration into SAP S/4HANA enhance firms' predictive analytics and decision-making (PADM)?
  $H_{2:}$ AI integration improves PADM. Sub-hypotheses: H2.1, H2.2, H2.3, and H2.4.
- Q3: Could AI integration into SAP S/4HANA optimize firms' resource optimization (RO)?
  $H_{3:}$ AI integration enhances RO. Sub-hypotheses: H3.1, H3.2, H3.3, and H3.4.

3.3. Research Methodology

A. Research Design: A quantitative approach is not yet feasible due to AI's early adoption in integrated IS. Instead, our methodology follows an *archival research approach*, drawing on publicly available industry reports and documented case studies, consistent with established practices in IS research [41, 42]. The data were primarily sourced from authoritative outlets such as corporate websites, client communications, and practitioner insights, reflecting recommendations for rigorous and context-rich qualitative inquiry [43]. These materials were produced by consultants, domain experts, and organizational leaders directly involved in the implementation of AI technologies within ERP systems across prominent firms. Such an approach is appropriate for studying real-world IT-enabled transformations where direct access to internal operations may be restricted [7]. All data sources and implementation details are properly cited through footnotes to ensure transparency and traceability of the AI-ERP integration initiatives examined.

B. Data Collection Strategy and Sources: This study gathers data from peer-reviewed journals, conference proceedings, consultancy reports, white papers, and technology reports on SAP S/4HANA's AI functionalities. It also includes company reports from firms like Unilever, Siemens, BMW, and DHL (2020–2024). These sources were selected for their credibility and empirical evidence, aiming to assess AI's impact on organizational performance and efficiency.

C. Selection Criteria: Sources were selected based on relevance, credibility, and comprehensiveness, prioritizing academic, industry, and consultancy reports on AI integration in SAP. Case studies were included to analyze implementation challenges and outcomes, starting with SAP's AI benefits proposal and triangulated with real-world firm applications.

D. Analyzing LR & Case Studies (Triangulation): To ensure a comprehensive understanding of the impact of IIIS, this study adopts a triangulated research strategy: *1 - Literature Review:* Drawing on theoretical frameworks (e.g., TOE, RBV, IPT) and prior empirical studies, this component establishes the conceptual foundation and informs the formulation of research hypotheses. *2 - Archival Case Study Analysis*: Publicly available case studies from globally recognized firms implementing AI in ERP (Unilever, Siemens, BMW, and DHL) offer contextual depth and real-world relevance. *3 - Archival Review of SAP documentation, consultancy report, and technical proposals*: Materials from SAP, including solution briefs, AI-integration architecture, and transformation roadmaps, are used to validate industry practices and future trends from a vendor perspective. This triangulated approach ensures a *multi-dimensional understanding*, reinforces analytical validity, and addresses the complexity of studying IT-enabled innovation in large-scale enterprise systems. Hence, triangulation here serves not just as a methodological choice but as a strategic lens for reinforcing the internal validity, practical relevance, and interpretive strength of the study's findings. It enhances both the credibility and trustworthiness of findings by cross-verifying evidence through distinct lenses [44, 45].

E. Coding Process: A three-step thematic analysis was used to categorize data systematically. Key excerpts from studies and reports were extracted, assigned to research variables, and analyzed for AI's impact on IS, operational efficiency, predictive analytics, and resource optimization patterns. Following [46] this approach ensures transparency and replicability without specialized software.

Step 1 - Defining Research Variables: The study examines how AI integration into SAP S/4H is expected to enhance firms' operational efficiency, predictive analytics & decision making, and resource optimization, as shown in **Table II.**

Table 2.
Defining Research Variables.

Variable Type	Variable Name	Description	Code
Independent Variable (IV)	AI Integration in SAP S/4H	Impact of AI integration into SAP S/4HANA on firms' Operational Efficiency, Predictive Analytics & Decision-Making, and Resource Optimization	AI-SAP
Dependent Variable (DV)	Operational Efficiency	Enhancing Firms' Operational Efficiency through AI-Driven SAP S/4HANA	OE
DV	Predictive Analytics & Decision-Making	Enhancing Firms' Predictive Analytics and Decision-Making through AI-Driven SAP S/4HANA	PADM
DV	Resource Optimization	Enhancing Firms' Resource Optimization through AI-Driven SAP S/4HANA	RO

Step 2 - Data Extraction Evidence: Key insights were gathered from selected sources and categorized under research variables. A structured approach ensured clear links between sources, variables, and insights, with relevant excerpts from the LR. To reinforce the theoretical underpinnings of the research model and validate the proposed hypotheses, **Table III** presents a summary of relevant literature, theoretical frameworks, and their linkages to the study's variables.

Table 3.
Theoretical Framework Linking AI-Driven SAP Integration to Firm OE, PADM, and RO.

Source	Excerpt (Evidence)	Theoretical Anchor Description & Justification Example of Use in SAP	Relevant Variable	Code
Fosso Wamba, et al. [39]	AI-driven ERP improves automation and streamlines workflows, reducing processing time	Technology-Organization-Environment (TOE) Framework: Widely used to analyze technology adoption and its impact on firm performance. E.g., the adoption of AI in SAP S/4HANA is shaped by technological, organizational, and environmental factors. Sharma and Vaid [27]	AI→SAP→OE	IS-OE
Ellis [47] IDC	A recent SCM survey found that 63% of respondents integrate AI strategies into their business goals to boost operational efficiency, enhance resilience, and improve employee productivity.	RBV: Explains how unique IT resources (such as AI-driven ERP) create a competitive advantage and operational efficiency. For example, AI and ML in SAP S/4HANA are strategic resources that drive innovation and efficiency. Bussu [48]	AI→SAP→OE	IS-OE
Ateeq, et al. [38]	AI-enhanced ERP improves data accuracy and predictive analytics, leading to better decision-making	Dynamic Capabilities Theory: Focuses on a firm's ability to integrate, build, and reconfigure resources to address rapidly changing environments. E.g., AI-driven SAP S/4HANA enables firms to adapt, optimize resources, and improve decision-making. Vaid and Sharma [9] and Nendrambaka [22]	AI→SAP→PADM	IS-PADM
Huang and Rust [49]	SAP's AI-driven supply chains offer predictive insights and contextualized decision-making	Socio-Technical Systems Theory (STS): Highlights the interplay between technology, people, and processes in achieving operational outcomes. E.g., AI and ML in SAP S/4HANA transform workflows and decision-making by integrating human and technical systems. Bussu [48]	AI→SAP→PADM	IS-PADM
Mhaskey [50]	AI-driven ERP boosts predictive analytics, increasing user satisfaction by 30% and productivity by 25% due to enhanced personalization of interfaces	IPT: provides a structured model for understanding how information flows through different memory systems and cognitive processes. It explains learning, memory, and decision-making, emphasizing the importance of both the capacity and efficiency of information handling. In the context of AI-driven ERP systems, IPT helps explain how enhanced data processing and personalized interfaces improve user satisfaction and productivity. Bussu [48]	AI→SAP→PADM	IS-PADM
Faccia, et al. [33]	NLP and Generative AI in ERP enhance fraud prevention measures and provide insights into how these technologies can serve as mediating variables (MV) in IS	STS Theory Vaid and Sharma [9]	AI→SAP→PADM	IS-PADM

SAP Insider [51]	AI in ERP achieved a 20% reduction in supply chain costs	RBV Bussu [48]	AI→SAP→RO	IS-RO
Mohammad, et al. [52]	AI applications can reduce SCM costs by up to 20% and improve inventory turnover by 25%	TOE Vaid and Sharma [9]	AI→SAP→RO	IS-RO
Ignite SAP [53]	SAP AI solutions have led to a 15% increase in supply chain workforce productivity and a 10% cost reduction	Dynamic Capabilities Theory Bussu [48]	AI→SAP→RO	IS-RO

Step 3 - Thematic Analysis and Interpretation: Key themes were identified to highlight AI’s role in enhancing ERP systems and business performance. Following a structured thematic analysis approach, findings were categorized into themes, as detailed in Table IV.

Table 4.
Thematic Analysis and Interpretation.

Theme	Findings	Supporting Evidence
AI-SAP improves OE	AI-driven SAP enhances operational efficiency by reducing processing time, automating workflows, and minimizing human errors	Multiple studies confirm that integrating AI into SAP systems automates routine tasks, streamlines processes, and reduces manual intervention, increasing operational efficiency and productivity. Bussu [48]
AI-SAP enhances PADM	AI-driven SAP improves predictive analytics and decision-making through advanced business intelligence, enhancing forecasting and strategic planning	AI and ML in SAP systems enable predictive analytics, providing real-time insights and supporting proactive, data-driven decision-making. These capabilities allow organizations to forecast trends, optimize resource allocation, and improve strategic planning. Vaid, A., & Kunchala [54]
AI-SAP optimizes RO	AI-driven SAP improves resource optimization by increasing supply chain visibility, reducing operational costs, and enhancing efficiency.	AI integration in SAP, especially in supply chain and resource management, enhances visibility, optimizes inventory, and reduces operational costs. Case studies show measurable benefits such as cost savings, improved resource allocation, and greater agility in supply chain operations. Bussu [48]

F. Ensuring Replicability: Replicability was ensured through documented coding rules, a structured framework (Table III), and source tracking for validation. Proprietary software was avoided to maintain accessibility for future researchers.

4. Archival Analysis (Case Studies)

The impact of integrating AI into SAP S/4H (IV) on IS and firms' needs (DVs) will be analyzed based on the official proposals published by SAP and documented feedback from multiple companies’ implementation experiences. The corresponding endnotes provide the sources of data used for the archival analysis. These studies are structured according to the sections outlined in Table I.

4.1. SAP S/4HANA

4.1.1. SAP's proposal offers the following AI capabilities in its package

- Enable predictive maintenance to prevent downtime, optimize scheduling, and extend equipment lifespan [55] (cf. Table I, H1.1: OE): Predict equipment failures and schedule timely interventions, thereby minimizing unplanned downtime. By using condition-based analytics, firms can optimize maintenance schedules and resource allocation. Root cause analysis extends the operational lifespan of assets, ultimately improving operational efficiency and reducing costs.

Tools: SAP PdMS: Predicts failures and schedules maintenance using real-time data; SAP IoT: Monitors equipment conditions with real-time sensor data; SAP Analytics Cloud (SAC): Provides analytics and visualizations for maintenance optimization; SAP Leonardo ML: Enhances predictive models with AI and ML; SAP AIN: Enables collaboration on asset performance data; SAP S/4HANA Asset Management: Manages maintenance, work orders, and spare parts; SAP Business Technology Platform (BTP): Integrates IoT, ML, and analytics for predictive maintenance; SAP FSM: Optimizes field service scheduling with predictive insights.

Benefits for firms: Enhance operational efficiency by minimizing downtime, optimizing maintenance schedules, and extending equipment lifespan. It reduces costs through proactive repairs and accurate inventory forecasting, improving productivity, safety, and sustainability. Real-time monitoring and simulations enable firms to anticipate and prevent equipment failures, ensuring smooth and reliable operations.

- Automate logistics, freight, and invoice processes, reducing errors and delays to address inefficiencies in freight processing [56] (cf. Table I, H1.2: OE): streamline operations by reducing errors, delays, and inefficiencies. It leverages OCR and ML for document processing, enhances demand forecasting and inventory management, optimizes freight operations, automates invoice approvals, and uses RPA to streamline procurement, ultimately improving efficiency, accuracy, and cost savings.

Tools: SAP Leonardo (AI, IoT, and ML for automation forecasting, maintenance, and tracking); SAP AI Core & Foundation: AI model development for logistics and invoicing; SAP Intelligent Robotic Process Automation (RPA): Automates data entry and document processing; SAP S/4H Cloud: AI for invoicing, route optimization, and workflow automation; SAP Concur: AI-powered invoice processing and fraud detection; SAP Integrated Business Planning (IBP): AI-driven demand forecasting and SCM optimization; SAP Ariba: AI automation in procurement and invoice management.

Benefits for firms: Enhance firm operations by reducing processing time, errors, and costs. It improves decision-making through real-time insights and predictive analytics. Automation streamlines logistics and invoice processing, boosts data accuracy, and supports smart manufacturing with real-time production adjustments.

- Addresses delays in financial reporting and workflows [56] caused by error resolution challenges (cf. Table I, H1.3: OE): AI automates real-time error detection and correction, optimizes workflows by dynamically prioritizing tasks, and enhances data accuracy through compliance checks and anomaly detection. It predicts and prevents delays with proactive alerts, improves collaboration via AI chatbots and automated notifications, and accelerates financial close processes through automated reconciliation and data consolidation.

Tools: Through tools like SAP AI Core, BTP, iRPA, and SAC, firms benefit from real-time analytics, predictive alerts, and intelligent automation, leading to faster, more accurate, and collaborative financial processes.

Benefits for firms: Automation of error detection, which reduces delays in financial reporting, enhances operational efficiency, lowers costs, improves decision-making, and ensures accuracy and timeliness in financial workflows.

- Provide intelligent recommendations for business workflows, enhancing the creation of business objects [56] (cf. Table I, H1.4: OE): Enhance business workflows by using embedded AI and ML to provide real-time insights, predictive analytics, and intelligent recommendations. It streamlines processes, improves decision-making, and supports dynamic production scheduling through user-friendly interfaces like SAP Fiori.

Tools: SAP AI Core for managing AI models, AI Business Services for prebuilt solutions like document extraction, and Data Intelligence for preparing and orchestrating AI data. Conversational AI supports chatbot automation, while SAP SAC enables predictive analytics and data visualization. Intelligent RPA automates tasks using bots, Fiori Apps provide AI-driven user interface recommendations, and the BTP facilitates the deployment of intelligent applications.

Benefits for firms: Reduced manual tasks, improved productivity, streamlined workflows, and enhanced automation. AI and advanced analytics in SAP S/4HANA enable faster, more accurate business processes and better decision-making.

- Enable real-time and predictive analytics for enhanced decision-making [57] addressing delayed or inaccurate decisions (cf. Table I, H2.1: PADM): Use real-time and predictive analytics to improve decision-making by enhancing demand forecasting, reducing overstock and stockouts, and optimizing resource planning. AI provides real-time insights and increases forecasting accuracy by analyzing historical and real-time data. Automated replenishment and demand sensing reduce stock issues and forecasting errors, while scenario planning improves response to disruptions. AI also lowers inventory costs and supports retail forecasting through advanced data analysis.

Tools: SAP IBP, SAP Leonardo, SAP Predictive Analytics, SAP Data Intelligence, SAP Advanced Planning and Optimization (APO), and the user-friendly SAP Fiori interface. These solutions enable real-time data access, advanced predictive modeling, and streamlined planning processes.

Benefits for firms: Improved forecasting accuracy, reducing stockouts and excess inventory while enabling real-time market adjustments. This leads to lower inventory costs, increased customer satisfaction, and enhanced agility in managing risks. AI-driven ERP systems optimize decision-making and operations, supported by advanced analytics that offer predictive insights and better inventory management, especially for retailers.

- Enhance customer insights and predictive interaction management [58] (cf. Table I, H2.2: PADM): Predictive analytics forecasts customer behavior and demand, while customer segmentation groups customers for targeted strategies. Personalized interactions tailor recommendations and engagement, and sales forecasting predicts trends to optimize inventory and marketing. Proactive support identifies potential issues early and triggers timely solutions. Dynamic pricing adjusts prices based on demand and market factors, sentiment analysis interprets customer feedback to improve services, and automated recommendations suggest products or services based on customer history.

Tools: SAP Leonardo: AI and ML for predictive analytics and automation; SAP SAC: Business intelligence and real-time insights**;** SAP AI and ML Services: Models for demand forecasting and sentiment analysis; SAP S/4HANA Embedded Analytics: Real-time reporting within SAP; SAP BTP: Integrates data, analytics, and AI for deeper insights; SAP Predictive Analytics: ML for customer behavior and sales predictions; SAP Commerce Cloud: E-commerce personalization and promotion management.

Benefits for firms: Improved customer engagement, smarter decision-making, and personalized experiences that boost satisfaction and revenue. AI-driven marketing, predictive support, and automation enhance efficiency and forecasting, while real-time insights help optimize resources and refine offerings.

- Enhance data retrieval efficiency through NLP tools [56] addressing challenges in accessing specific information swiftly (cf. Table I, H2.3: PADM): NLP tools enhance data retrieval by enabling quick, accurate queries without Structured Query Language (SQL), using chatbots and voice assistants for real-time interaction. They analyze unstructured data to provide relevant, personalized insights and simplify access through SAP Fiori integration, improving the user experience in SAP.

Tools: SAP Conversational AI, which builds chatbots for querying SAP, and SAP CoPilot, a digital assistant for voice and text-based queries, enhance user interaction. SAP BTP leverages AI and NLP to process unstructured data, while SAP Fiori Search enables natural language queries. SAP Leonardo provides AI and NLP tools for data analysis and automation, and SAP SAC generates reports using NLP-based queries. SAP Data Intelligence extracts insights from unstructured data, and the SAP Integration Suite connects third-party NLP tools for efficient data retrieval.

Benefits for firms: Easier, faster, and more accurate data access through natural language queries, improving decision-making, efficiency, and user experience while reducing costs and supporting global users.

- Improve fraud detection and compliance in financial processes [59] (cf. Table I, H2.4: PADM):

Real-time monitoring, anomaly detection, and predictive analytics. It leverages NLP for compliance checks and audit trails, automates regulatory compliance and report generation, and continuously refines fraud detection through adaptive AI models.

Tools: SAP Leonardo ML and Predictive Analytics for fraud prediction. SAP SAC for real-time monitoring and AI insights. SAP BTP supports ML and intelligent app development. Compliance is managed through SAP Governance, Risk, and Compliance (GRC) for audit automation, and SAP Embedded Analytics provides real-time financial analysis. Automation of compliance checks is handled by SAP RPA, while SAP NLP helps detect compliance violations in documents.

Benefits for firms: Enhanced fraud detection through real-time monitoring and predictive analytics, ensured regulatory compliance with cost reduction via automation, and continuous improvement in audits and financial processes through data-driven learning for optimized risk management.

- Enhance resource allocation for improved efficiency and cost reduction [53] (cf. Table I, H3.1: RO): project and workforce matching, demand forecasting to prevent overstock or shortages, automation to reduce labor costs, dynamic resource scheduling to increase efficiency, predictive maintenance to minimize downtime, financial planning for cost optimization, workforce management to balance workloads, SCM optimization for better inventory and logistics, and energy management to support sustainability.

Tools: SAP Embedded Tools (predictive analytics, Fiori dashboards, Universal Allocation), SAP AI Business Services (automation for document processing and chatbots), SAP SCM Solutions (IBP and Digital Manufacturing Cloud for forecasting and production), SAP SAC (AI insights and scenario planning), SAP Data Intelligence (data integration and processing), SAP Ariba (procurement automation), and SAP Workforce Tools (SuccessFactors and Fieldglass for workforce optimization).

Benefits for firms: Improved efficiency, cost savings, better decision-making, real-time resource allocation, enhanced agility, higher customer satisfaction, and support for sustainability and innovation.

- Improves supply chain visibility [60] shipment tracking, and optimized logistics (cf. Table I, H3.2: RO): AI leverages IoT and GPS data to provide real-time shipment updates and predictions. It automates route planning, fleet management, and load optimization to reduce costs and delays. The system offers end-to-end SCM visibility, detects anomalies, and uses digital twins for simulations. Additionally, it enhances risk management by forecasting disruptions and enabling proactive, adaptive planning.

Tools: SAP IBP handles demand planning and inventory optimization, while SAP LBN offers real-time shipment tracking and collaboration. SAP TM manages route optimization and freight. SAP EWM optimizes warehouse operations, supported by IoT Integration for real-time tracking. SAC enables advanced analytics and visualization, complemented by Predictive Analytics for forecasting demand and delays. Digital Twin Technology simulates supply chain processes, and Chatbots automate customer service. Lastly, Blockchain ensures secure and transparent goods tracking.

Benefits for firms: Faster, more transparent, and efficient logistics with reduced costs and improved customer satisfaction, thanks to AI-powered tools that enhance SCM visibility and resilience.

- Enhance Stakeholder coordination in SCM and logistics operations [61] (cf. Table I, H3.3: RO): Addressing challenges in implementing generative AI within SAP modules. This includes improving SCM coordination through predictive analytics, real-time data, and smart logistics; automating processes such as vendor management, inventory optimization, and order processing; increasing visibility and communication among stakeholders for smoother operations; and supporting risk management by predicting disruptions and aiding decision-making.
- Tools: SAP AI Core & Foundation for building and deploying ML models; SAP IBP for AI-driven demand forecasting and inventory optimization; SAP Predictive Analytics for trend prediction and logistics optimization; SAP LBN for real-time logistics collaboration; SAP Ariba for AI-powered supplier and procurement management; SAP Intelligent RPA for task automation to improve efficiency; and SAP Digital SCM for end-to-end supply chain management optimization.
- Benefits for firms: Better integration, coordination, and improved SCM efficiency and responsiveness.

- Improves workforce planning [62] by aligning organizational goals with skill requirements (cf. Table I, H3.4: RO): Forecast hiring needs and skill gaps, matches employees and candidates to suitable roles, recommends personalized training for skill development, and optimizes resource allocation to enhance productivity and achieve organizational objectives.

Tools: SAP SuccessFactors for job matching; SAP Workforce Planning for AI-driven workforce scheduling and resource allocation; SAP AI Core and AI Foundation providing ML and data insights for HR processes; SAP SAC for predictive workforce insights and reporting; SAP SuccessFactors Workforce Analytics for workforce data analysis and benchmarking.

Benefits for firms: Improved workforce planning, optimized staffing, better talent matching, increased agility, reduced hiring bias, enhanced employee retention, and advanced analytics for deeper insights.

4.2. Siemens, Unilever, BMW, Mercedes-Benz, and DHL

This section analyzes how AI is leveraged in SAP S/4HANA to enhance sustainability and user experience, drawing on feedback from various companies' experiences and perspectives.

4.2.1. Siemens [63]

- Impact on operational efficiency: AI-SAP→OE (cf. Table 1, H1). 1.1- Challenge: Faced with inefficiencies in SCM and the need for improved decision-making and adaptability in dynamic industrial environments. 1.2- Solution: Implemented AI-enabled automation in logistics, freight, and invoicing to reduce errors and delays. Integrated Siemens Teamcenter (PLM) with SAP to enhance operational efficiency across the product lifecycle, SCM, and manufacturing. Leveraged AI for predictive maintenance and supply chain optimization. 1.3- Benefits: Reduced unplanned downtime and maintenance costs, improved supply chain and production efficiency, and extended the lifespan of critical equipment by ensuring optimal performance.
- Impact on predictive analytics and decision-making: AI-SAP→PADM (cf. Table 1, H2). 1.1- Challenge: Managing complex supply chains with multiple stakeholders makes demand forecasting and inventory optimization difficult. 1.2- Solution: AI and SAP S/4HANA integrate with IoT sensors to collect machine data (temperature, vibration, pressure); therefore, Siemens Teamcenter (PLM) collects and analyses real-time machine data. Predictive analytics detects anomalies, forecasts failures, and improves supply chain coordination. 1.3- Benefits: The system reduces downtime through predictive maintenance, optimizes resources and supply chain planning, and enhances data-driven decision-making across operations and production.
- Impact on resource optimization: AI-SAP→RO (cf. Table 1, H3). 1.1- Challenge: Inefficient resource allocation and inaccurate demand forecasting disrupted efficiency and raised costs. 1.2- Solution: AI-enabled real-time forecasting and inventory optimization through integration of Siemens Teamcenter with SAP improved coordination across development, manufacturing, and supply chains. 1.3- Benefits: Enhanced decision-making, reduced costs, improved efficiency, and optimized resource use by predicting failures and minimizing unnecessary maintenance.

4.2.2. Unilever Shaik and Siddque [25]

- Impact on operational efficiency: AI-SAP→OE (cf. Table 1, H1). 1.1- Challenge: Faced inefficiencies in SCM, needing to meet rising consumer demand while reducing operational costs. 1.2- Solution: Leveraged AI-driven insights to improve demand forecasting, production planning, and distribution. SAP solutions also support emission reduction and overall operational efficiency. 1.3- Benefits: Optimized SCM led to a 25% reduction in stock-outs, a 10% decrease in transportation costs, and improved customer satisfaction through more reliable product availability.
- Impact on predictive analytics and decision-making: AI-SAP→PADM (cf. Table 1, H2). 1.1- Challenge: Difficulty in preventing quality issues, ineffective marketing strategies, and inventory imbalances (overstock/stockouts). 1.2- Solution: AI-powered quality control in SAP production; ML in SAP S/4HANA for personalized marketing and demand forecasting using real-time and historical data. 1.3- Benefits: Increased sales by up to 35%, reduced product recalls by 50%, improved yield by 10%, and better inventory coordination across operations.
- Impact on resource optimization: AI-SAP→RO (cf. Table 1, H3). 1.1- Challenge: Difficulty in accurately predicting consumer demand and optimizing inventory levels. 1.2- Solution: Integration of AI into CRM and marketing systems to enable data-driven forecasting and coordination. 1.3- Benefits: Enhance demand forecasting and inventory management; ensure efficient resource allocation; enable personalized marketing; improve operational efficiency through cohesive AI-driven processes across CRM and marketing functions.

4.2.3. BMW SmartShift [64]

- Impact on operational efficiency: AI-SAP→OE (cf. Table 1, H1). 1.1- Challenge: BMW needed to improve operational efficiency across a complex global supply chain, reduce defect rates, and enhance supplier coordination and predictive maintenance. 1.2- Solution: AI and SAP SCM were implemented to evaluate supplier risks, streamline procurement, and provide real-time supply chain visibility. Automation tools accelerated the SAP S/4HANA conversion and aligned processes efficiently. 1.3- Benefits: BMW achieved a 20% reduction in inventory costs, a 15% increase in on-time deliveries, and better supplier collaboration. The automation platform also minimized project delays and system freeze times, improving overall performance and operational agility. "We utilized our automation platform and service to accelerate the conversion and align all custom processes to function and perform on the new

S/4H platform. The conversion was handled in the known smartShift speed and quality and enabled BMW to massively reduce freeze times for other projects" (Arndt Hoffmann, smartShift EVP & GM Global SAP Practice).

- Impact on predictive analytics and decision-making: AI-SAP→PADM (cf. Table 1, H2). 1.1- Challenge: High defect rates in manufacturing and quality control, along with the need to predict maintenance requirements. 1.2- Solution: AI models analyze production and sensor data to identify defect patterns and forecast maintenance needs. Image recognition using machine learning detects defects, and decision tools suggest corrective actions. 1.3- Benefits - Improved quality control, reduced defects and downtime, enhanced production efficiency, and more informed, data-driven decisions.
- Impact on resource optimization: AI-SAP→RO (cf. Table 1, H3). 1.1- Challenge: Ensuring containers are accurately assessed for securing, while minimizing unnecessary handling. 1.2- Solution: AI-powered image recognition evaluates container security requirements, determining whether additional securing is needed or if containers can be sent directly to removal stations. 1.3- Benefits: Enhances operational efficiency by reducing unnecessary handling; improves production planning and electric vehicle assembly; optimizes resource use (time, labor, equipment); and enables data-driven decision-making, better operational visibility, and proactive quality management to maintain competitiveness.

4.2.4. Mercedes-Benz SAP [60]

- Impact on operational efficiency: AI-SAP→OE (cf. Table 1, H1). 1.1- Challenge: Managing high transaction volumes with varying country-specific payment behaviors and resolving financial reporting delays caused by manual errors. 1.2- Solution: AI-powered SAP tools like SAP Cash Application automate payment processing, even with incomplete details, and provide real-time validation. AI also assists with error detection and guided resolution. 1.3- Benefits: Reduces manual work and transaction errors, improves payment processing speed, enhances workflow, and increases data accuracy in financial reporting.
- Impact on predictive analytics and decision-making: AI-SAP→PADM (cf. Table 1, H2). 1.1- Challenge: Managing capacity constraints caused by high transaction volumes, despite having effective payment allocation rules; addressing fraud detection and compliance requirements in financial processes; and enhancing predictive maintenance for machinery. 1.2- Solution: AI-powered invoice matching and predictive analytics improve financial decision-making. ML models in SAP predict equipment failures using sensor data, reducing downtime and costs. AI also enhances processing efficiency and addresses transaction bottlenecks. Real-time validation and error-checking strengthen data integrity and AI reliability. Additionally, AI algorithms Analyze historical and real-time data to detect potential fraud. 1.3- Benefits: Improves fraud detection, compliance, and decision-making accuracy; optimizes transaction workload and addresses capacity constraints; reduces manual workload and costs; enables personalized services and strategic resource reallocation; forecasts trend, predicts equipment failures, and reduces downtime and maintenance costs; ensures data integrity and enhances the reliability of AI systems.
- Impact on resource optimization: AI-SAP→RO (cf. Table 1, H3). 1.1- Challenge: Capacity constraints, limited risk, inventory visibility, and costly unplanned downtime. 1.2- Solution: AI optimizes resource planning in materials, labor, and logistics, with predictive maintenance scheduling based on machine usage and resource availability. 1.3- Benefits: Enhanced demand forecasting, better inventory management, reduced waste, timely issue resolution, and automated maintenance scheduling that improves efficiency and minimizes downtime.

4.2.5. DHL AI Expert Network [65]

- Impact on operational efficiency: AI-SAP→OE (cf. Table 1, H1). 1.1- Challenge: DHL faced challenges in managing vehicle maintenance, optimizing delivery routes, ensuring shipment visibility, minimizing disruptions, and improving coordination among warehouses, drivers, and customers. 1.2- Solution: AI-driven process automation provided real-time alerts for shipment disruptions and enabled seamless information flow across the supply chain. 1.3- Benefits: Automation reduced manual tasks, enhanced productivity, improved decision-making, and optimized asset utilization. It also strengthened customer communication, reduced delays, improved transparency, and streamlined logistics workflows, boosting operational efficiency and system reliability.
- Impact on predictive analytics and decision-making: AI-SAP→PADM (cf. Table 1, H2). 1.1- Challenge: Lack of real-time shipment tracking and inefficient demand forecasting. 1.2- Solution: AI processes data from RFID, IoT, and orders to predict delays and optimize logistics. It also analyzes historical data and trends for better demand forecasting. 1.3- Benefits: Improves shipment visibility, proactive decision-making, and customer satisfaction. Aligns inventory with demand, reducing stockouts, overstocking, and storage costs.
- Impact on resource optimization: AI-SAP→RO (cf. Table 1, H3). 1.1- Challenge: DHL faced issues with inefficient delivery routes, limited shipment visibility, and complex logistics, especially in managing fleets and routing. 1.2- Solution: The company implemented AI-driven coordination across warehouses, drivers, and customers. AI was used to optimize delivery routes by analyzing real-time factors such as traffic, weather, and schedules, while ML leveraged GPS data to manage fleet operations efficiently. 1.3- Benefits: This integration enhanced delivery efficiency, reduced fuel consumption, and increased customer satisfaction. It also optimized resource utilization vehicles, time, fuel, and personnel resulting in lower costs, better logistics performance, fewer delays, and smoother coordination across operations.

5. Discussion, Implications, and Summary of Findings

Findings on the impact of an AI integration in SAP S/4HANA on firm performance reveal significant improvements in operational efficiency, decision-making, and resource optimization. A triangulated approach, combining a comprehensive literature review, archival analysis (including the SAP Editor proposal), and insights from multiple companies' experiences and perspectives, validates this integration's added value and effectiveness across diverse business contexts, as shown in Table 4.

Table 4.
Combination and Conclusions of Archival Analysis & LR.

Archival analysis	LR & SAP's Proposal on AI&SAP	Impact of an AI-SAP (IV) on Firm's Needs (DVs)
Siemens Unilever BMW Mercedes-Benz DHL	Enhances OE	H1: AI&SAP Enhances OE & H1.1, H1.2, H1.3 and H1.4 have been validated
	Improves PADM	H2: AI&SAP improves PADM & H2.1, H2.2, H2.3, H2.4 have been validated
	Optimizes RO	H3: AI&SAP optimizes RO & H3.1, H3.2, H3.3, H3.4 have been validated

6. Future AI & ERPs

6.1. Next Steps and Challenges

The future of AI-integrated SAP systems offers strong potential to enhance operational efficiency, decision-making, and resource optimization. Future research should explore long-term impacts, sector-specific challenges, and the balance between AI and human oversight. Key issues include data security, ethical concerns, employee skill gaps, and trust in AI systems. The integration of AI with cloud and hybrid ERP environments, along with sustainability goals, also warrants deeper investigation. A multidimensional research approach is vital to realize the benefits while addressing emerging complexities.

6.2. Recommendations

Organizations adopting AI in SAP should invest in employee training to enhance proficiency with AI tools, quantify the impact of AI through statistical analysis, and conduct pilot projects to evaluate AI capabilities before full-scale implementation.

6.3. Limitations

This study has limitations, including a lack of primary empirical input such as interviews or live case studies, and the exclusion of broader ERP implementation and governance issues. Despite these constraints, the research provides a solid conceptual foundation to navigate and eventually overcome several limitations for future studies. It encourages the use of mixed methods, such as longitudinal analysis and field surveys, to validate and build on these findings. As AI & SAP adoption grows, improved access to empirical data will help overcome current limitations and deepen understanding of its impacts.

7. Conclusion

This study demonstrates that AI-driven SAP S/4HANA systems play a critical role in enhancing operational efficiency, improving decision-making, and optimizing resource utilization. By streamlining business processes, increasing data accuracy, and enabling agile, data-informed management, these intelligent ERP systems empower firms to navigate the complexities of the digital economy. Beyond operational improvements, AI-integrated ERP solutions are reshaping enterprise workflows and unlocking new avenues for innovation and sustained competitive advantage.

The study's findings triangulated through a comprehensive literature review, SAP case study, and archival analysis of feedback on intelligent SAP implementation in several companies validate the proposed hypotheses and confirm the positive impact of AI integration on firm performance. Organizations that strategically implement these systems are better positioned to drive performance gains and achieve long-term resilience in a rapidly evolving technological landscape. Intelligent ERP should thus be viewed not merely as a technological upgrade but as a strategic enabler of digital transformation.

This research contributes to the Management Information Systems field by identifying key success factors for AI-enabled ERP transformation and by providing actionable insights grounded in real-world applications of SAP. By bridging theoretical frameworks with practical implementation evidence, the study offers value to scholars, industry practitioners, and ERP decision-makers seeking to leverage AI for organizational advancement. Nevertheless, future research should extend these findings using real-time data, mixed-method approaches, and cross-industry case studies to further validate the strategic role of AI-integrated ERP systems.

References

[1] M. Hayes and A. Downie, "AI in ERP", IBM," Retrieved: https://www.ibm.com/think/topics/ai-in-erp, 2025.

[2] K. S. Geethanjali and N. Umashankar, "AI-enhanced risk management in SAP S/4HANA: Leveraging predictive analytics for proactive decision-making," 2022. https://doi.org/10.31224/4160

[3] U. Winter, "Streamlining invoice processing with Nagarro's invoice scanner for SAP S/4HANA", Nagarro," 2023.

[4] C. Morrison, "AI in ERP: The next wave of intelligent ERP systems," Top10ERP. https://www.top10erp.org/blog/ai-in-erp, 2025.

[5] S. Sarferaz, *Embedding artificial intelligence into ERP software: A conceptual view on business AI with examples from SAP S/4HANA.* Nature Switzerland: Springer, 2024.

[6] L. Fischer and J. Schreiber, "The future of ERP: Predictive analytics in SAP S/4HANA," *Journal of Systems and Information Technology*, vol. 24, no. 3, pp. 251-267, 2022.

[7] D. Ganiuly and A. Smaiyl, "Intelligent NLP system for translating business requirements into formalized technical project specifications," *International Journal of Science and Research Archive,* vol. 13, no. 2, pp. 1388–1395, 2024. https://doi.org/10.30574/ijsra.2024.13.2.2274

[8] S. S. Parimi, "AI-driven financial data analytics for SAP ERP: Techniques and applications," Retrieved: https://ssrn.com/abstract=4934889, 2024.

[9] A. Vaid and C. Sharma, "Leveraging SAP and artificial intelligence for optimized enterprise resource planning: Enhancing efficiency, automation, and decision-making," *World Journal of Advanced Research and Reviews,* vol. 3, 2022. https://doi.org/10.30574/wjarr.2022.14.3.0276

[10] V. R. Banda, "Embedding generative AI into SAP S/4HANA: A holistic approach to intelligent transformation," AP Community. https://community.sap.com/t5/enterprise-resource-planning-blogs-by-sap/embedding-generative-ai-into-sap-s-4hana-a-holistic-approach-to-intelligent/ba-p/13871541, 2024.

[11] McKinsey & Company, "The state of AI in 2021: A focus on operational excellence," in "McKinsey Reports. https://www.mckinsey.com/business-functions/quantumblack/our-insights/global-survey-the-state-of-ai-in-2021," 2021.

[12] S. Sirse, S. Khanzode, and A. Bhide, "ERP: SAP S/4HANA cloud RISE enterprise solution automation with artificial intelligence features," *International Journal for Research in Applied Science and Engineering Technology,* vol. 11, no. 10, pp. 2055-2062, 2023. https://doi.org/10.22214/ijraset.2023.56384

[13] T. Samara, "Impact of the modularity of ERPs on the information systems disintegration," *International Journal of Strategic Information Technology and Applications (IJSITA),* vol. 7, no. 1, pp. 45-61, 2016. https://doi.org/10.4018/IJSITA.2016010104

[14] S. F. Wamba, A. Gunasekaran, S. Akter, S. J.-f. Ren, R. Dubey, and S. J. Childe, "Big data analytics and firm performance: Effects of dynamic capabilities," *Journal of Business Research,* vol. 70, pp. 356-365, 2017. https://doi.org/10.1016/j.jbusres.2016.08.009

[15] J. Barney, "Firm resources and sustained competitive advantage," *Journal of Management,* vol. 17, no. 1, pp. 99-120, 1991. https://doi.org/10.1177/014920639101700108

[16] F. Fathima, R. Inparaj, D. Thuvarakan, and I. Fernando, "Impact of AI-based predictive analytics on demand forecasting in ERP systems: A systematic literature review," in *Proceedings of the 2024 International Research Conference on Smart Computing and Systems Engineering (SCSE). https://doi.org/10.1109/SCSE61872.2024.10550480*, 2024.

[17] GiriRaaj, "Maximizing SAP analytics in S/4HANA public cloud with M.L.," SAP Community. https://community.sap.com/t5/enterprise-resource-planning-blogs-by-sap/maximizing-sap-analytics-in-s-4-hana-public-cloud-with-m-l/ba-p/13572105, 2024.

[18] Y. Zheng, "Integrating ERP, KM & AI for accounting areas of SMEs," *Highlights in Business, Economics and Management,* vol. 27, pp. 91-105, 2024. https://doi.org/10.54097/90tmy480

[19] A. Vaid and C. Sharma, "Data-driven predictive maintenance and analytics in SAP environments enhanced by machine learning," *World Journal of Advanced Research and Reviews,* vol. 17, no. 2, pp. 926-932, 2023. https://doi.org/10.30574/wjarr.2023.17.2.0019

[20] S. S. Parimi, "Integration of machine learning models for predictive maintenance in SAP financial operations," Retrieved: http://dx.doi.org/10.2139/ssrn.4934830. [Accessed 2024.

[21] S. Ganipaneni, R. K. Pagidi, A. Ayyagiri, and S. P. Singh, "Machine learning for SAP data processing and workflow automation," *Darpan International Research Analysis,* vol. 12, no. 3, pp. 744–775, 2024.

[22] S. K. Nendrambaka, "Leveraging AI and machine learning in SAP S/4HANA Cloud: A research-based approach to supply chain optimization," *International Journal of Scientific Research in Computer Science Engineering and Information Technology,* vol. 10, no. 6, pp. 1878–1885, 2024. https://doi.org/10.32628/cseit241061232

[23] B. O. Antwi and E. K. Avickson, "Integrating SAP, AI, and data analytics for advanced enterprise management," *International Journal of Research Publication and Reviews,* vol. 5, no. 10, pp. 621-636, 2024.

[24] H. K. Gollangi, E. P. Galla, J. R. Sunkara, C. Madhavaram, and C. Kuraku, "The impact of AI and ML on ERP systems and supply chain management," *Nanotechnology Perceptions,* vol. 20, no. S9, 2024. https://doi.org/10.62441/nano-ntp.v20iS9.47

[25] M. Shaik and K. Q. Siddque, "Vision vs. Reality: SAP HANA at unilever and the boardroom of the future," Engineering.com. https://www.engineering.com/vision-vs-reality-sap-hana-at-unilever-and-the-boardroom-of-the-future-tv-report/, 2023.

[26] A. Naqvi, *Artificial intelligence for asset management and investment: A strategic perspective*. Hoboken, NJ: John Wiley & Sons, 2021.

[27] C. Sharma and A. Vaid, "Converging SAP, AI, and data analytic for transformative business management," *World J. Adv. Res. Rev,* vol. 14, no. 3, pp. 736-761, 2022. https://doi.org/10.30574/wjarr.2022.14.3.0214

[28] C. Sharma and A. Vaid, "Disruption with precision: Using artificial intelligence to optimize SAP supply chain management," *World Journal of Advanced Research and Reviews,* vol. 14, no. 2, pp. 707–715, 2023. https://doi.org/10.30574/wjarr.2022.14.2.0128

[29] L. Barua, B. Zou, and Y. Zhou, "Machine learning for international freight transportation management: A comprehensive review," *Research in Transportation Business & Management,* vol. 34, p. 100453, 2020.

[30] M. R. Kunchala, "SAP finance and management accounting with integration of AI and ML," *International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences,* pp. 188-200, 2021. https://doi.org/10.37082/ijirmps.v10.i3.231962.

[31] S. Bauskar, "Predictive analytics for sales forecasting in enterprise resource planning (erp) systems using machine learning technique," *Available at SSRN 4988774,* 2022. https://doi.org/10.2139/ssrn.4988774

[32] O. E. Williamson, "The economics of organization: The transaction cost approach," *American Journal of Sociology,* vol. 87, no. 3, pp. 548-577, 1981. https://doi.org/10.1086/227496

[33] A. Faccia, F. Manni, V. Pandey, and L. P. L. Cavaliere, "Blazing a new trail in ERP integration with NLP and generative AI through APIs: A fraud examination perspective," in *Proceedings of the 2023 8th International Conference on Information Systems Engineering (ICISE '23), Association for Computing Machinery (ACM)*, 2023.

[34] J. Baker, "The technology–organization–environment framework", in Dwivedi, Y., Wade, M. and Schneberger, S. (Eds), information systems theory, integrated series in information systems." New York: Springer, 2012, pp. 231-245.
[35] L. G. Tornatzky and M. Fleischer, *The processes of technological innovation*. Lexington, MA: Lexington Books, 1990.
[36] C. E. Connelly, C. Fieseler, M. Černe, S. R. Giessner, and S. I. Wong, "Working in the digitized economy: HRM theory & practice," *Human Resource Management Review,* vol. 31, no. 1, p. 100762, 2021. https://doi.org/10.1016/j.hrmr.2020.100762
[37] T. H. Davenport and R. Ronanki, "Artificial intelligence for the real world," *Harvard Business Review,* vol. 96, no. 1, pp. 108-116, 2018. https://doi.org/10.1177/0266382118790150
[38] A. Ateeq, M. Milhem, and M. Alzoraiki, "The impact of AI as a mediator on effective communication: Enhancing interaction in the digital age," Frontiers in Human Dynamics. https://www.frontiersin.org/journals/human-dynamics/articles/10.3389/fhumd.2024.1467384/full 2024.
[39] S. Fosso Wamba, M. M. Queiroz, I. O. Pappas, and Y. Sullivan, "Artificial intelligence capability and firm performance: a sustainable development perspective by the mediating role of data-driven culture," *Information Systems Frontiers,* vol. 26, pp. 1-15, 2024. https://doi.org/10.1007/s10796-023-10460-z
[40] H. Klaus, M. Rosemann, and G. G. Gable, "What is ERP?," *Information Systems Frontiers,* vol. 2, pp. 141-162, 2000. https://doi.org/10.1023/a:1026543906354
[41] J. W. Mohr and M. Ventresca, "Archival research methods", in Baum, J.A. (Ed.)." Blackwell: The Blackwell Companion to Organizations, 2002, pp. 805–828.
[42] R. K. Yin, *Case study research and applications: Design and methods*. Sage Publications: Thousand Oaks, CA, 2018.
[43] G. Walsham, "The emergence of interpretivism in IS research," *Information Systems Research,* vol. 6, no. 4, pp. 376-394, 1995. https://doi.org/10.1287/isre.6.4.376
[44] T. D. Jick, "Mixing qualitative and quantitative methods: Triangulation in action," *Administrative Science Quarterly,* vol. 24, no. 4, pp. 602-611, 1979. https://doi.org/10.2307/2392366
[45] S. Mathison, "Why triangulate?," *Educational Researcher,* vol. 17, no. 2, pp. 13-17, 1988.
[46] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qualitative Research in Psychology,* vol. 3, no. 2, pp. 77-101, 2006. https://doi.org/10.1191/1478088706qp063oa
[47] S. Ellis, "The importance of AI in supply chain and operations", IDC," Retrieved: https://podcast.opensap.info/the-future-of-supply-chain/2024/07/10/episode-69-ai-in-supply-chains-navigating-the-data-driven-future-with-idcs-simon-ellis. [Accessed 2024.
[48] V. R. R. Bussu, "Unlocking business potential: Artificial intelligence and machine learning capabilities in SAP S/4HANA," *International Journal of Innovative Science and Research Technology,* vol. 24, no. 3, p. 644, 2024.
[49] M.-H. Huang and R. T. Rust, "A strategic framework for artificial intelligence in marketing," *Journal of the Academy of Marketing Science,* vol. 49, pp. 30-50, 2021. https://doi.org/10.1007/s11747-020-00749-9
[50] S. V. Mhaskey, "Integration of artificial intelligence (ai) in enterprise resource planning (erp) systems: Opportunities, challenges, and implications," *International Journal of Computer Engineering Research Trends,* vol. 11, no. 12, pp. 1-9, 2024. https://doi.org/10.22362/ijcert/2024/v11/i12/v11i1201
[51] SAP Insider, "SAP intelligent technologies: Sap blockchain, home of supply chain news," SAP Community. https://sapinsider.org/topic/sap-intelligent-technologies/sap-blockchain, 2023.
[52] A. A. S. Mohammad, I. A. Khanfar, B. Al Oraini, A. Vasudevan, S. I. Mohammad, and Z. Fei, "Predictive analytics on artificial intelligence in supply chain optimization," *Data and Metadata,* vol. 3, pp. 395-395, 2024. https://doi.org/10.56294/dm2024395
[53] Ignite SAP, "The power of AI in SAP S/4HANA, Ignite SAP," Retrieved: https://ignitesap.com/the-power-of-ai-in-sap-s-4hana/, 2024.
[54] M. R. Kunchala, "Asset capitalization using SAP S/4HANA in field inventory management (FIM)," *International Journal of Science and Research,* vol. 13, no. 5, pp. 1429-1432, 2024. https://doi.org/10.21275/sr24523123535
[55] SAP, "Exploring the business benefits of AI," SAP Community Blogs. https://community.sap.com/t5/technology-blogs-by-sap/exploring-the-business-benefits-of-ai/ba-p/13582611 2024.
[56] SAP, "Unlock AI potential with SAP S/4HANA Cloud public edition," SAP News. https://news.sap.com/2024/06/unlock-ai-potential-sap-s4hana-cloud-public-edition/, 2024.
[57] Bridgwater, "Exploring the business benefits of AI, SAP community blogs," Retrieved: https://community.sap.com/t5/technology-blogs-by-sap/exploring-the-business-benefits-of-ai/ba-p/13582611. [Accessed 2018.
[58] KloudData, "Predictive analytics and machine learning with SAP S/4HANA," Retrieved: https://www.klouddata.com/sap-blogs/predictive-analytics-and-machine-learning-with-sap-s-4hana, 2024.
[59] A. Seifert, "An introduction to AI with SAP," Retrieved: https://blog.asug.com/hubfs/Chapter%20Events/SAP%20AI.pdf, 2024.
[60] SAP, "Intelligent enterprise: AI-driven innovation in SAP S/4HANA," SAP Documents. https://www.sap.com/documents/2022/06/c8529452-2f7e-0010-bca6-c68f7e60039b.html, 2022.
[61] SAP Community, "Simplifying SAP implementations with generative ai innovations," SAP Community Blogs. https://community.sap.com/t5/technology-blogs-by-sap/simplifying-sap-implementations-with-generative-ai-innovations/ba-p/13759780, 2024.
[62] SAP Community, "SAP fiori for SAP S/4HANA: How can end-users personalize SAP Fiori Launchpad?," SAP Blogs. https://community.sap.com/t5/technology-blogs-by-sap/sap-fiori-for-sap-s-4hana-how-can-end-users-personalize-sap-fiori-launchpad/ba-p/13432089, 2024.
[63] Siemens, "IT-OT integration: Lever for digital transformation," Siemens White Paper. https://contentpath.siemens.com/white_paper_it-ot-integration-lever-for-digital-transformation, 2024.
[64] SmartShift, "BMW success story," SmartShift. https://smartshift.com/wp-content/uploads/2023/05/BMW-Success-Story.pdf, 2023.
[65] AI Expert Network, "DHL's AI-powered initiatives to enhance operations," AI Expert Network. https://aiexpert.network/case-study-dhls-ai-powered-initiatives-to-enhance-operations/, 2024.