DOI: 10.2478/orga-2026-0015

Theorizing the Evolution of RPA-ERP Integration: A Three-Dimensional Model

František SUDZINA

Prague University of Economics and Business, Faculty of Informatics and Statistics, Prague, Czech Republic, frantisek.sudzina@vse.cz

Background/Purpose: The integration of Robotic Process Automation (RPA) with Enterprise Resource Planning (ERP) systems presents a complex evolutionary challenge. Existing frameworks fail to capture the divergent strategic paths organizations take. This article proposes a three-dimensional conceptual model to explain this phenomenon, defined by the axes of Integration Locus (Resilience), Task Intelligence, and Scale of Automation.
Methods: A structured literature review of pertinent articles published up to August 1, 2025, was conducted. The findings were used not to generate, but to provide empirical illustration and support for the pre-defined components of the proposed 3D model. A foundational set of 42 papers was identified, from which a curated evidence base of 26 exemplars was selected based on theoretical relevance.
Results: The literature provides strong evidence for all three dimensions. The evolution along the Resilience Axis (from brittle GUI to robust API) is well-documented. The Intelligence Axis is evidenced by the shift from rule-based bots to cognitive agents. The Scale Axis is shown in the move from discrete task automation to end-to-end process orchestration.
Conclusion: The 3D model is a robust framework for explaining the trade-offs in automation strategy. It contributes to theory by synthesizing multiple concepts into a new, comprehensive model and provides a diagnostic tool for practice.

Keywords: Robotic Process Automation (RPA), Enterprise Resource Planning (ERP), Conceptual model, Automation strategy, Digital evolution, Structured literature review

1 Introduction

The integration of Robotic Process Automation (RPA) with the Enterprise Resource Planning (ERP) systems has become a defining feature of contemporary digital transformation. Such transformation is not a singular event but an important and ongoing process of leveraging digital technologies to create and capture value in novel ways (Vial, 2019). While ERP systems were designed to enforce discipline and standardization (Davenport, 1998), the rise of RPA presents a compelling paradox. Instead of pursuing robust, architectural integration, organizations enthusiastically embraced RPA as a non-invasive tool that emulates human interaction with the graphical user interface (GUI). This approach prioritizes rapid deployment over architectural stability, operating at the most fragile layer of the enterprise stack. This article addresses the central puzzle of why organizations choose this technological detour and how they evolve beyond it – a phenomenon that existing frameworks fail to adequately explain.

RPA is often championed as a workaround for legacy system integration challenges. While not a workaround in the strict sense of Alter's (2014) Theory of Workarounds - as it is company sanctioned - it fulfills a similar organizational need - allowing business units to achieve automation

Received: 13th April 2025; Accepted: 9th April 2026

goals without engaging in costly deep system integration. This dual nature - architecturally superficial yet organizationally strategic - fuels widespread organizational adoption by what DiMaggio & Powell (1983) label as institutional pressures.

However, as the phenomenon has matured, a more challenging reality has emerged. The initial, tactical promise of RPA has revealed a set of often competing strategic tensions that organizations must navigate. The very characteristic that makes RPA so appealing - its surface-level, non-invasive nature - is also the source of its greatest weakness. A simple change in an ERP's user interface can render an entire fleet of bots useless, exposing the organization to significant operational risk.

The effectiveness of RPA as a circumvention is further limited within enterprise contexts, where system complexity and regulatory requirements demand robust and auditable process integration. Studies highlight that overreliance on GUI-level automation can exacerbate technical debt and governance challenges, especially as business and IT teams struggle to maintain consistency across multiple interfaces and compliance boundaries (Plattfaut et al., 2022; Flechsig et al., 2022). This tension suggests that RPA's role as a circumvention should be regarded as transitional, prompting a more strategic focus on architectural innovation.

The simplicity of rule-based automation is found to be insufficient for the ambiguity and exception-handling required by real-world business processes. The automation of discrete, isolated tasks is proving to be a point of diminishing returns, creating a strategic imperative to orchestrate entire, end-to-end processes. In parallel to developments in ERP and RPA, Business Process Management (BPM) has matured as both theory and practice, enabling organizations to move beyond manual, siloed operations toward agile and data-driven process integration (Van der Aalst, 2013; Dumas et al., 2018). BPM's adoption of lean, iterative, and process-centric workflows further establishes a backdrop for understanding RPA's strategic role, particularly as process automation shifts from isolated tasks to orchestration at the enterprise level.

This article argues that RPA-ERP integration is not a linear progression but a complex journey defined by three core strategic tensions. First, an architectural tension exists between efficiency of brittle GUI emulation and the resilience of API integration. Second, a capability tension pits simple, deterministic rules against the need for cognitive intelligence. Third, a scope tension drives a shift from discrete task automation to end-to-end process orchestration.

While the existing literature documents these individual pressures and trends, it lacks a comprehensive conceptual framework to explain their interplay and the divergent evolutionary paths they create. The field is in need of a multi-dimensional model that can be used to both diagnose the current state of an organization's automation portfolio and to chart a deliberate strategic course for its future. To address this theoretical gap, a three-dimensional model of RPA-ERP evolution is proposed in this article. It is argued that the maturity of an automation initiative can be understood by its position in a 3D space defined by the orthogonal axes of Integration Locus (Resilience), Task Intelligence, and Scale of Automation. This model yields eight distinct quadrants, representing a spectrum of states from the brittle, tactical starting point of Tactical Automation to the mature, strategic state of Intelligent Process Orchestration.

To provide a theoretical grounding for analyzing this phenomenon, the lens of architectural innovation (Henderson & Clark, 1990) is adopted. This framework distinguishes between innovation in a system's core components and innovation in the linkages (or architecture) that connect them. The evolution along the Resilience Axis is therefore argued to represent a critical shift from a modular approach, which preserves existing system linkages, to an architectural one that fundamentally redefines them. This theoretical lens enables an explanation of not only the technological trajectory but also the organizational challenges that emerge during this transition.

This article is structured as follows. In Section 2, the proposed three-dimensional model is formally presented and its components - the axes, quadrants, and evolutionary paths - are defined in detail. Section 3 then outlines the structured literature review methodology that was employed to curate a robust evidence base for the purpose of illustrating this model. In Section 4, this evidence is presented, with the findings from the literature systematically organized to provide empirical support for each of the model's three dimensions. Finally, in Section 5, the theoretical and practical implications of the model are discussed, before a brief conclusion is offered.

2 A Three-Dimensional Model of RPA-ERP Evolution

To address the multi-faceted evolution documented in the literature and to provide a coherent framework for analyzing the strategic trade-offs inherent in enterprise automation, a three-dimensional conceptual model is proposed. A simple linear trajectory is insufficient to capture the divergent paths organizations take. The evolution of RPA-ERP integration is therefore conceptualized as a journey through a multi-dimensional space. This model is defined by three orthogonal axes: Integration Locus (Resilience), Task Intelligence, and Scale of Automation. The interplay of these dimensions creates an eight-quadrant evolutionary space, visualized as a cube in Figure 1. This framework is designed to serve as both a diagnostic tool for classifying the current state of automation initiatives and as a strategic map for charting their future development.

2.1 The Three Dimensions of Evolution

Each axis of the model represents a fundamental dimension of change, grounded in established theoretical concepts and reflecting a core strategic choice for the organization.

2.1.1 The Integration Locus Axis (The Resilience Path)

This vertical axis describes how an automation agent connects to the ERP system. It represents a fundamental shift in the system's architecture and is therefore best understood through the lens of architectural innovation (Henderson & Clark, 1990). Moving along this axis is a strategic choice to increase operational resilience at the cost of higher initial investment and complexity.

- Front-End Locus (GUI Emulation): This is the initial state, characterized by its form as modular innovation. The RPA bot is treated as a new, self-contained component integrated into the enterprise system via the existing, unchanged architectural linkage - GUI. This linkage, designed for human interaction, is inherently brittle from a machine's perspective, making automations highly susceptible to failure from even minor UI changes. This state prioritizes speed of deployment and non-invasiveness over long-term stability.
- Back-End Locus (API Integration): This is the mature state, characterized by its form as architectural innovation. The focus shifts from adding a component to fundamentally reconfiguring the linkages between systems, primarily through the adoption of robust, machine-to-machine Application Programming Interfaces (APIs), IDocs, or other direct data-level connections. This architectural shift provides high operational resilience, as the integration is no longer dependent on the fragile and mutable presentation layer.

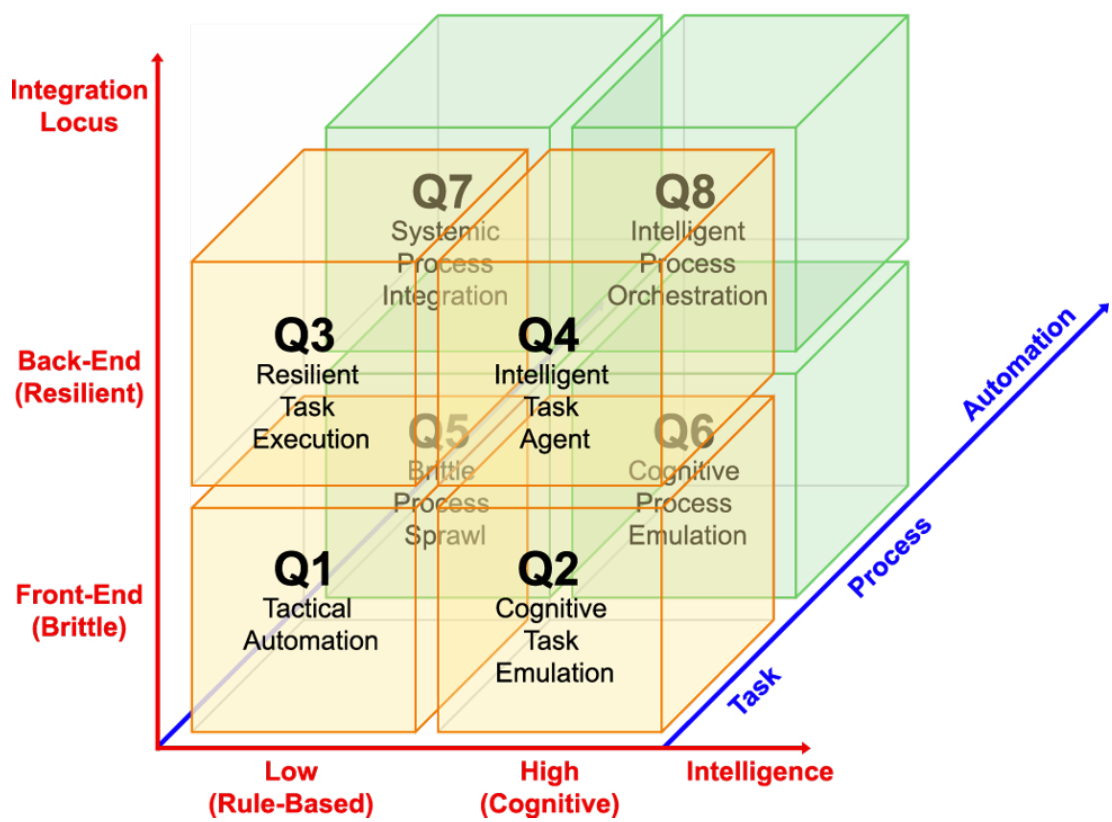

Figure 1: The 3D Cube of RPA-ERP Evolution

Table 1: Characteristics of the Eight Quadrants of Automation Evolution

Quadrant	Scale	Locus	Intelligence	Description
Q1: Tactical Automation	Task	Front-End	Low	*The de facto starting point.* A single, simple, rule-based bot performing a discrete task (e.g., data entry) by emulating a human on the GUI. Offers quick efficiency gains but is the most vulnerable to failure.
Q2: Cognitive Task Emulation	Task	Front-End	High	A single, intelligent bot performing a complex, cognitive task (e.g., classifying an unstructured document) by interacting with the GUI. Powerful but perilous due to its reliance on a brittle linkage.
Q3: Resilient Task Execution	Task	Back-End	Low	A single, simple, rule-behaving bot performing a discrete task via a robust API call. Highly reliable and stable, but limited to rudimentary, well-defined processes.
Q4: Intelligent Task Agent	Task	Back-End	High	A single, intelligent bot performing a complex, cognitive task via a robust API (e.g., an AI agent making a fraud detection decision and logging it). Combines intelligence with resilience for a focused task.
Q5: Brittle Process Sprawl	Process	Front-End	Low	*A dangerous state of maturity.* A fleet of simple, rule-based bots are chained together via the GUI to automate a full process. The failure of one bot can cause a cascading failure across the entire process.
Q6: Cognitive Process Emulation	Process	Front-End	High	A powerful but high-risk state. An intelligent "hyper-bot" orchestrates an entire complex process by navigating multiple GUIs. Capable of end-to-end automation but remains vulnerable to UI changes.
Q7: Systemic Process Integration	Process	Back-End	Low	*The classic EAI/BPM state.* An entire process is automated through a rigid sequence of simple API calls and data transfers between systems. Highly reliable but often inflexible and unable to handle exceptions.
Q8: Intelligent Process Orchestration	Process	Back-End	High	*The aspirational end-state.* A fleet of intelligent agents collaborates via robust APIs to manage an entire, dynamic business process, making decisions and adapting to exceptions in a resilient manner.

2.1.2 The Task Intelligence Axis (The Intelligence Path)

This horizontal axis describes what the automation is capable of doing. It represents a shift from deterministic, pre-programmed execution to cognitive agency. Moving along this axis is a strategic choice to increase the capability and scope of tasks that can be automated.

- Low Intelligence (Rule-Based): This is the foundational state of traditional RPA. Bots are designed to execute simple, pre-programmed, deterministic rules. Their operation is analogous to a script, following a rigid if-then logic with limited ability to handle ambiguity, exceptions, or unstructured data.
- High Intelligence (Cognitive/AI-driven): This is the advanced state where automation is infused with capabilities from Artificial Intelligence (AI), Machine Learning (ML), and Large Language Models (LLMs). These bots can perform tasks

that require cognitive judgment, such as interpreting unstructured text in documents, making predictions based on historical data, or engaging in natural language dialogue to resolve exceptions.

2.1.3 The Scale of Automation Axis (The Orchestration Path)

This depth axis describes how much of the business workflow the automation encompasses. It represents a shift in strategic scope from localized optimization to end-to-end process re-engineering. Moving along this axis is a strategic choice to increase the impact and systemic value of automation.

- Task Automation: This is the initial scope, where automation is applied to a single, discrete activity within a larger business process (e.g., automating only the post invoice step). The value is localized, and the impact is measured in the efficiency gains of that specific task.
- Process Orchestration: This is the mature scope, where automation is applied to an entire, end-to-end business process that spans multiple tasks, systems, and even departments. This is aligned with the concept of hyperautomation, where a fleet of bots, potentially of varying intelligence and integration loci, are orchestrated to manage a complete workflow (e.g., from invoice receipt to final payment and reconciliation).

2.2 The Eight Quadrants of the Automation Evolution Cube

The interplay of these three dimensions creates the eight-quadrant evolutionary space. Figure 1 provides a visual representation of this cube, while Table 1 offers a detailed description of each quadrant's unique characteristics, challenges, and strategic implications.

2.3 Evolutionary Paths and Their Enabling Drivers

The primary strategic goal for organizations is to evolve their automation portfolio out of Quadrant 1 (Tactical Automation). The model reveals that this is not a single path but a series of strategic vectors through the cube, each propelled by a specific set of enabling technologies and methodologies.

- The Resilience Path (a vertical move, e.g., Q1 → Q3) is driven by architectural enablers, primarily the development and use of robust APIs to replace fragile UI-based linkages.
- The Intelligence Path (a horizontal move, e.g., Q1 → Q2) is propelled by cognitive enablers, such as AI, Machine Learning, and Large Language Model capabilities.
- The Orchestration Path (a depth move, e.g., Q1 → Q5) is enabled by scaling technologies and methodologies, such as bot orchestrators, centralized governance, and a strategic focus on end-to-end process design.

The ultimate aspirational state, Quadrant 8 (Intelligent Process Orchestration), requires a synthesis of all three types of enablers. This reframes the managerial challenge as a strategic portfolio management problem: for each process, managers must decide which evolutionary path - and which corresponding investment in enabling technologies - offers the best risk-reward profile.

2.4 Theoretical Grounding and Limitations

This three-dimensional framework's structure builds upon the tradition of evolutionary stage models (e.g., Markus & Tanis, 2000), but advances this tradition by proposing a multi-dimensional, non-linear space of strategic choice rather than a single, predetermined track. The Resilience Axis is a direct manifestation of architectural innovation (Henderson & Clark, 1990), explaining the challenges of moving away from the initial, modular state of RPA. The Intelligence Axis charts the emergence of sociotechnical agency in automation, creating new challenges for organizational control and governance. Finally, the Scale Axis connects the automation of discrete tasks to the broader strategic goals of Business Process Management and, by extension, the established principles of Enterprise Application Integration (EAI) that focus on creating robust, process-oriented architectures (Puschmann & Alt, 2005).

It is important to note the limitations of this framework. As a conceptual model derived from a literature synthesis, it is an abstraction designed to explain broad evolutionary patterns. It does not prescribe a single correct path for every organization, nor does it capture the full granularity of every contextual factor that might influence an automation decision. Its value lies in its utility as a diagnostic lens and a strategic map, rather than a deterministic predictive tool. The validation and refinement of this model through empirical case studies is a critical next step for research.

3 Methodology for Evidence Curation

To provide a robust and representative evidence base to illustrate the proposed 3D model, a structured literature review was conducted. The goal of this process was not to inductively generate a theory from the literature, but rather to transparently curate a set of high-quality, illustrative exemplars from the extant literature that directly correspond to the components of the proposed framework. This approach ensures that the model is grounded in empirical phenomena while maintaining the article's deductive, theory-first structure. The process involved two distinct phases: a broad identification of the relevant literature, followed by a focused curation of the most powerful evidence.

3.1 Literature Identification

To illustrate the proposed conceptual model, a structured search was performed on the Scopus and Web of Science databases to identify the population of relevant literature. The search was conducted for papers published up to August 1, 2025. To ensure a comprehensive initial sample, a broad search string was used, restricted to the titles, abstracts, and keywords of publications: ((“Enterprise Resource Planning” OR ERP) AND “Robotic Process Automation”).

This initial search yielded a total of 57 unique records, of which 5 records were not retrievable. Full-text review showed that 10 were not really on ERP and RPA. This process resulted in a foundational set of 42 pertinent articles and conference papers. This foundational set represents the comprehensive body of contemporary, peer-reviewed work on the topic and serves as the basis for the subsequent curation phase. Figure 2 (see Appendix) presents the PRISMA flowchart detailing the selection process.

3.2 Evidence Curation

Consistent with a theory-driven approach, the foundational set of 42 papers was subjected to a rigorous curation phase. The goal was not to conduct an exhaustive review, but to select exemplars that illustrate the model's axes and quadrants. Each of the 42 papers was evaluated against a set of specific inclusion criteria designed to prioritize illustrative power:

- Clarity of Illustration: Does the paper provide a vivid, detailed, and unambiguous example of a specific axis (Resilience, Intelligence, Scale), a quadrant, or an enabling driver in the proposed model?
- Direct Relevance: Is the paper's central focus on the automation of enterprise processes, or is the RPA-ERP link a peripheral point in a study focused on another topic (e.g., sustainability, financial reporting regulations)?
- Conceptual Power: Does the paper offer a strong, citable finding, a well-articulated case study, or a robust conceptual argument that can serve as an exemplar?

Applying these stringent criteria resulted in a final, curated evidence base of 26 papers (see Appendix). This curated set represents the most potent illustrations of the model's components found within the literature. It includes foundational case studies, cutting-edge research on AI/LLM integration, and key conceptual pieces on governance and strategy that are essential for a rich and textured discussion. This curated set forms the exclusive basis for the empirical illustration presented in the following section.

4 Empirical Illustration of the Model from the Literature

The literature provides compelling evidence for the existence and relevance of all three dimensions of the proposed model. The findings within the curated evidence base are not disparate observations but can be systematically organized to illustrate the tensions and evolutionary trajectories defined by the framework. However, a crucial insight that emerges from this literature is that movement along these axes is not a purely technical matter. These shifts are profound sociotechnical endeavors, whose success depends on establishing critical success factors. The literature on enterprise system implementation, for example, consistently identifies factors such as sustained top management support, clear strategic goals, and effective change management as essential conditions for success (e.g., Ferrer-Gilabert et al., 2025). With this sociotechnical context in mind, this section presents the curated evidence, organized by each of the three axes in turn.

4.1 Evidence for the Integration Locus (Resilience) Axis

The model's vertical axis posits a fundamental architectural evolution from a brittle, front-end locus of integration to a resilient, back-end one. This is arguably the most well-documented and critical challenge in the RPA-ERP domain. The literature provides a clear and consistent picture of the initial, flawed state and the architectural shift required to overcome its limitations.

4.1.1 The Brittle Front-End Locus: The Tactical Starting Point

The initial state of RPA-ERP integration is consistently defined in the literature by its reliance on GUI. This approach is conceptualized from an architectural perspective by Ritschel et al. (2021), who serve as a pillar exemplar for this concept. In their analysis, the “initial idea of RPA” is the “simple emulation of user input and output,” which assumes “no changes of the used software systems and existing Enterprise Architecture (EA).” This is described as a “lightweight solution that does not change the existing application architecture”; this perspective, which is echoed in numerous other studies that emphasize RPA’s non-invasive nature (e.g., Plattfaut et al., 2022; Lai & Hsieh, 2024), perfectly aligns with the proposed model’s definition of the Front-End Locus as a form of modular innovation (Henderson & Clark, 1990), where the RPA bot is treated as a new component plugged into the existing, unchanged architectural linkage of the GUI.

While this approach is tactically appealing due to its speed of implementation, the literature is replete with evidence of its core limitation: operational brittleness. Wornow et al. (2024) provide a stark, empirical account of this problem. In their case studies, RPA adoption was severely inhibited by unreliable execution, noting that because RPA “relies on hard-coded rules, bots cannot adapt to slight variations in input (e.g., a button changing location on a screen).” This leads to a “death by a thousand cuts” where the space of potential failures is essentially unbounded. This critical finding is broadly corroborated across the literature, with numerous studies identifying sensitivity to UI changes as the primary technical challenge, necessitating constant monitoring and frequent maintenance to keep bots operational (Hong, Ly, & Lin, 2023; Sarilo-Kankaanranta & Frank, 2024).

The Front-End Locus, therefore, represents a tactical trap: the initial ease of deployment, often highlighted in practitioner-focused work (Desai, 2020), masks a significant and often unsustainable long-term cost of maintenance and operational risk. Such a phenomenon is a textbook example of incurring technical debt (Kruchten et al., 2012), where the short-term benefits of a quick implementation are traded for long-term fragility and refactoring costs that act as a drag on future innovation. This technical fragility is mirrored by an organizational challenge, as the proliferation of ungoverned, business-led automations necessitates the creation of robust governance frameworks and central oversight, a recurring theme in the literature on critical success factors (Plattfaut et al., 2022).

4.1.2 The Resilient Back-End Locus: The Architectural Solution

In response to the inherent fragility of the Front-End Locus, the literature documents a clear and decisive evolutionary shift towards a more resilient, Back-End Locus of integration. However, the transition is not merely a technical decision but a significant strategic hurdle, often hindered by organizational frictions such as the difficulty of justifying high initial costs and the scarcity of skilled resources (Sarilo-Kankaanranta & Frank, 2024). This represents a move towards architectural innovation, where the focus is on reconfiguring the linkages between systems from the human-centric GUI to machine-centric Application Programming Interfaces (APIs).

A vivid illustration of this transition is provided by Jamithireddy (2025a) in a detailed case study of automating foreign exchange operations in SAP. The proposed architecture is explicitly hybrid, using a mix of integration methods. While some tasks still utilize GUI scripting, the core, mission-critical data movements are re-architected to use robust back-end channels, including “IDoc and BAPI calls as secure pathways for data movement, and OData endpoints for non-blocking communication.” This case demonstrates a conscious strategic choice to invest in architectural change to achieve resilience, a benefit unattainable through a purely front-end approach.

This architectural shift towards resilience extends beyond the application interface to the underlying infrastructure. For mission-critical ERP processes, ensuring business continuity is paramount. A salient exemplar of this is provided by Hung, Chuong, & Diep (2022), who propose a detailed high-availability architecture for RPA systems interacting with ERPs. Their model incorporates active-standby application servers, load balancers, and clustered databases (e.g., MariaDB Galera Cluster with MaxScale Proxy) to prevent single points of failure. This level of infrastructure engineering represents a mature state of the Back-End Locus, where resilience is not just a feature of the integration method but a fundamental property of the entire automation platform.

This trend is not an isolated case but is identified as a key element of mature automation strategies. The systematic review by Moreira et al. (2024) on business process automation notes the general trend towards API integration as a more stable and scalable solution. This is further substantiated by case studies that detail the use of specific API-like connections, such as SAP RFCs (Ozkan & Esgin, 2023), and by more complex architectural frameworks. For example, the advanced manufacturing system proposed by Banta et al. (2024) explicitly grounds its integration between SAP and non-SAP systems in a dedicated API. Collectively, this body of evidence provides strong support for the Resilience Axis, demonstrating a clear evolutionary path from the brittle, modular innovation of the Front-End Locus to the resilient, architectural innovation of the Back-End Locus.

4.2 Evidence for the Task Intelligence Axis

The model’s horizontal axis posits an evolution in automation capability, from the simple execution of deterministic rules to the application of cognitive, AI-driven intelligence. The curated literature provides a clear and compelling narrative of this shift. The foundational state of RPA is defined by its low intelligence, while the most significant recent trend is the infusion of advanced AI capabilities to handle tasks that were previously considered the exclusive domain of human judgment.

4.2.1 Low Intelligence: The Rule-Based Foundation

The starting point of the Intelligence Axis is consistently defined in the literature as the automation of simple, repetitive, and rule-based tasks. This focus is a direct reflection of the economic logic of automation, which has historically targeted routine cognitive tasks that can be fully specified and codified (Autor et al., 2003). This low intelligence state is the bedrock of the traditional RPA value proposition. A perfect pillar exemplar of this is provided by Nguyen et al. (2023) in their design of an RPA model for the order fulfillment process in SAP. The automation is a direct, 1:1 translation of a manual, highly structured workflow. The bot's logic is entirely deterministic: it navigates through a pre-defined sequence of screens, enters data into specific fields, and clicks pre-determined buttons. There is no ambiguity, no handling of unstructured data, and no decision-making beyond a simple, pre-programmed if-then logic. This state, while highly efficient for its intended purpose, is fundamentally limited in scope to tasks that can be perfectly codified into a rigid set of rules. This limitation is a recurring theme, with numerous case studies focusing on similarly structured tasks like data entry or simple reconciliations, which form the bulk of initial RPA implementations (e.g., Banta et al., 2021; Fernandez & Aman, 2018).

4.2.2 High Intelligence: The Emergence of Cognitive Agency

The most consequential evolutionary trend documented in the recent literature is the move towards high intelligence, which dramatically expands the scope of what can be automated. This is not merely an incremental improvement but a qualitative shift, driven by the integration of AI, ML, and LLMs. An empirical illustration of this is found in Jamithireddy (2025b), which details a framework for enhancing cash flow forecasting in SAP. The automation moves far beyond simple data extraction. It employs a sophisticated pipeline of predictive analytics, using machine learning and deep learning models such as regression trees, LSTM networks, and ensemble methods to generate forecasts. The system is designed not just to execute rules, but to learn from historical data, model complex patterns, and provide outputs that are probabilistic and nuanced, representing a fundamental shift from automating a transaction to automating an analytical judgment process, a hallmark of the high intelligence state.

The capabilities of this axis are pushed even further by the application of LLMs, as shown in Schnepf et al. (2024). This groundbreaking case study on using LLM-based agents to automate the entire, notoriously complex procure-to-pay (P2P) process in SAP serves as an example of high intelligence. The LLM agent understands the P2P process from high-level natural language descriptions. Critically, it also demonstrates advanced error handling through natural language interaction. When an error occurs, the agent can engage in a dialogue with a human expert to diagnose the problem and receive instructions for resolution. This ability to handle exceptions and ambiguity through reasoning and interaction is a defining characteristic of the high intelligence state and stands in stark contrast to the rigid determinism of the low intelligence state.

This trend is further corroborated by a growing body of work focused on infusing AI into specific automation tasks. For example, Chi et al. (2023) propose using Natural Language Processing (NLP) to classify unstructured text on supplier invoices, a task impossible for rule-based bots. Similarly, Suleiman and Kassem (2024) propose a cognitive RPA framework that uses NLP to automate data entry from unstructured emails, a finding echoed in other work on intelligent document processing (Wornow et al., 2024).

This infusion of intelligence is also being democratized through low-code platforms. A compelling case study by Santos & Trigo (2023) details the automation of invoice processing using the Microsoft Power Platform. Their solution uses RPA to orchestrate the workflow but relies on Microsoft's AI Builder to perform Optical Character Recognition (OCR) and extract data from unstructured invoice documents. This is an example of moving along the Intelligence Axis, as a task that was impossible for a rule-based bot is made feasible by an integrated cognitive service. Critically, they also note the primary limitation of this approach: the need for human intervention to train the AI model on new invoice layouts, illustrating the new operational challenges that emerge in the high intelligence state. Collectively, this body of evidence provides overwhelming support for the Intelligence Axis, charting a clear and significant evolution from simple, rule-based mimics to sophisticated, cognitive agents capable of automating complex judgment and analysis.

The scope of high intelligence also extends to complex mathematical optimization. Kocsi et al. (2020) demonstrate this by coupling RPA with Genetic Algorithms to solve real-time production scheduling problems in high-mix low-volume manufacturing. In this context, the intelligence is not merely linguistic or predictive, but computational, allowing the automation to dynamically optimize production sequences based on risk analysis - a cognitive task far beyond the reach of simple rule-based scripts. However, high intelligence does not always guarantee a shift to the back-end. Tang et al. (2022) propose a Smart Virtual Robot Automation framework for the SAGE X3 ERP system that utilizes Deep Learning not to bypass the

GUI, but to master it. Their approach uses computer vision (Sikuli) and deep learning to navigate dynamic web interfaces that are resistant to standard scripting, effectively using cognitive capabilities to mitigate the inherent brittleness of the Front-End Locus.

This evolution towards high intelligence is not merely a technical exercise; it is a core component of broader strategic initiatives within the enterprise. The case study of an automotive manufacturer by Banta et al. (2024) provides a pillar exemplar of this strategic integration. Their work details a system architecture that uses intelligent RPA (iRPA) in concert with AI and additive manufacturing as a direct response to the demands of Industry 4.0. In this context, intelligence is not just for handling exceptions or unstructured data; it is for enabling higher value-added processes, product customization, and dynamic reconfiguration of manufacturing systems. This demonstrates that the move along the Intelligence Axis is ultimately driven by the strategic need for greater agility and competitiveness in a rapidly changing industrial landscape.

4.3 Evidence for the Scale of Automation Axis

The model's third dimension, the depth axis, posits an evolution in the strategic scope of automation, from the localized optimization of discrete tasks to the systemic orchestration of entire, end-to-end business processes. The curated literature provides clear evidence for this trajectory, illustrating a growing organizational maturity that moves beyond simple point solutions towards a more holistic and impactful automation strategy.

4.3.1 Task Automation: The Granular Starting Point

The initial and most common application of RPA in ERP environments is at the level of Task Automation. In this state, the scope of automation is deliberately constrained to a single, well-defined activity within a larger, often still manual, workflow. The value is measured in the efficiency gains of that specific step. A pillar exemplar of this is found in the work of Nguyen et al. (2023), where the focus is exclusively on automating the order fulfillment process in an SAP ERP system. The bot is designed to execute a specific set of transactions but does not manage the preceding or subsequent steps in the broader supply chain. The efficiency gains at this granular level are quantifiable. Ratchatawetchakul et al. (2024) provide precise metrics for this state by comparing manual versus automated execution in a cloud-based ERP environment. They report that manual purchasing tasks take 1.29 times longer than their RPA counterparts, while goods receipt tasks take 1.22 times longer. This empirical data validates the immediate operational value of Task Automation, even if the strategic scope remains limited to individual activities. This granular focus is characteristic of the vast majority of initial RPA case studies, which detail the automation of discrete tasks such as invoice processing, data entry, or simple report generation (e.g., Fernandez & Aman, 2018; Banta et al., 2021). While effective for generating quick wins and building organizational momentum, a point often emphasized in practitioner guides (Desai, 2020), this state represents a limited strategic vision, as the larger, cross-functional process remains fragmented.

4.3.2 Process Orchestration: The Strategic Destination

The literature documents a clear evolutionary pressure to move beyond the limitations of task-level automation towards the more strategic and impactful state of Process Orchestration. This represents a fundamental shift in scope, where the goal is to automate an entire, end-to-end business process that spans multiple tasks, systems, and even departments. The conceptual foundation for this shift is articulated by Szelagowski et al. (2022) in their analysis of the future of ERP. They argue that the convergence of ERP with intelligent Business Process Management Systems (iBPMS) is leading towards the emergence of Process ERP Systems. This vision moves beyond the traditional, transaction-focused view of ERP to one where the system is capable of designing, managing, and executing entire end-to-end business processes. The paper explicitly identifies hyperautomation - the orchestrated use of multiple technologies including RPA, process mining, and AI - as the key enabler of this shift. This provides the theoretical language for the Process Orchestration end of the model's Scale Axis, defining it as a strategic move towards holistic, process-centric automation.

This theoretical trajectory is supported by increasingly sophisticated empirical examples. The framework for automating foreign exchange operations detailed by Jamithireddy (2025a) is a clear illustration of a move towards Process Orchestration. An empirical example of this shift in scale is the SOPRANO solution for SAP sales order management, as detailed by Ozkan & Esgin (2023). This pre-packaged, certified RPA solution is explicitly designed to orchestrate the entire process, from automatically collecting purchase orders from customer emails to aggregating them, creating the sales orders in SAP via robust RFC/BAPI calls, and finally sending notifications. The entire process is managed and monitored from the SAP iRPA orchestrator cloud factory. This case study is an illustration of moving from a localized task to a fully orchestrated, end-to-end process, a hallmark of the mature state of the Scale Axis. The automation is not limited to a single task like posting a journal entry, but is designed to manage the entire FX lifecycle, including rate retrieval, journal posting, month-end revaluation, and settlement tracking.

Similarly, the advanced manufacturing architecture proposed by Banta et al. (2024) is explicitly designed to automate an end-to-end make-to-order process, integrating multiple systems from ServiceNow for ticketing, to SAP for production planning, to Autodesk Fusion for design. This focus on automating entire value streams, rather than discrete tasks, is further corroborated by studies on the need for robust governance frameworks and Centers of Excellence (CoE) that take a holistic, process-wide view of automation opportunities (Plattfaut et al., 2022; Hong, Ly, & Lin, 2023). Externally, it is driven by the strategic imperative to compete in modern digital ecosystems, which requires the seamless, end-to-end integration of not just internal systems, but also those of customers and suppliers (Moreira et al., 2024). This body of evidence provides strong support for the Scale Axis, charting a clear evolution from localized task efficiency to systemic process orchestration.

This evolution is not only driven by internal strategic imperatives but is also propelled by external forces. A study by Remlein et al. (2022) on the digitization of accounting in Poland provides a stark example. They demonstrate how the government's mandate for a structured, electronic Standard Audit File for Tax (JPK) acted as a powerful forcing function, compelling organizations to "gradually computerise and even robotise their accounting processes." This regulatory pressure forces a move away from automating discrete, ad-hoc tasks towards the standardized, auditable, and fully orchestrated processes characteristic of the mature end of the Scale Axis.

A parallel external pressure is observed in the domain of sustainability accounting and reporting. Dumitru et al. (2023) argue that the complexity of modern environmental reporting requires a holistic approach where RPA (including iRPA) are not used for isolated data entry, but are integrated into the ERP to aggregate non-financial data across the entire value chain. This reinforces the finding that external compliance demands - whether for tax or sustainability - are primary drivers pushing organizations toward the Process Orchestration end of the Scale Axis.

5 Discussion

The preceding analysis has provided empirical illustration for a three-dimensional model of RPA-ERP evolution. The evidence curated from the literature demonstrates that the maturation of enterprise automation is not a simple, linear progression but a complex journey through a strategic space defined by the competing pressures of architectural resilience, cognitive intelligence, and automation scale. This section now moves from illustration to interpretation, discussing the implications of this multi-dimensional framework for Information Systems theory, managerial practice, and the agenda for future research.

5.1 Implications for Theory

The 3D model's primary contribution to theory is its synthesis of multiple, often separate, theoretical streams into a single, coherent framework that explains a critical contemporary phenomenon. It is demonstrated that the classic path of architectural innovation (Henderson & Clark, 1990), represented by the Resilience Axis, is now complemented and often challenged by a parallel path of infusing cognitive agency into technical artifacts, represented by the Intelligence Axis. This creates a new theoretical tension. This evolution mirrors Zuboff's (1988) seminal distinction between technologies that merely automate routine work and those that informate, creating new data, insights, and challenges for organizational control. The emergence of intelligent agents transforms bots from simple tools into informating artifacts, fundamentally altering the nature of governance required.

Traditional IS theories of control and governance are largely predicated on managing deterministic, predictable technologies. The proposed model, however, identifies eight distinct states of sociotechnical agency, from the simple, tool-like Tactical Automation (Q1) to the aspirational, partner-like Intelligent Process Orchestration (Q8). The emergence of advanced states like Cognitive Emulation (Q2 & Q6) presents a theoretical challenge: how can organizations govern and trust automations that are simultaneously powerful and intelligent, yet architecturally fragile and perilous? This suggests that existing governance frameworks, which are well-suited to the predictable risks of Systemic Process Integration (Q7), may be dangerously inadequate for the novel risks presented by intelligent but brittle agents. This necessitates new theoretical work on managing risk, ensuring algorithmic transparency, and developing frameworks for human-AI collaboration within the core transactional systems of the firm.

Unlike traditional linear life cycle models of ERP implementation (e.g., Ferrer-Gilabert et al., 2025), which prescribe a sequential path through distinct project phases, it suggests that for modern digital phenomena like RPA, evolution is not a single, predetermined track but a series of strategic vectors. This challenges the teleological assumptions of some earlier stage models and calls for a more contingent view of technological maturation, where the optimal path is dependent on a firm's specific strategic context. Furthermore, the entire evolutionary journey through the cube can be powerfully interpreted through the lens of Orlikowski's (1992) duality of technology. The model demonstrates that the relationship between automation technology and the firm is not one of simple impact, but of recursive interaction: organizational choices and constraints shape the form of automation, which in turn creates new structures and capabilities that enable subsequent technological and organizational change.

While the lens of architectural innovation provides the sharpest explanation for the technical challenges of the Resilience Axis, the model's robustness is underscored by its resonance with other foundational theories. The evolution through the cube can also be framed as a search for a better Task-Technology Fit (Goodhue & Thompson, 1995), where the driver for change is the organizational pain caused by a misfit between the automation's capabilities and the process's requirements. From a strategic perspective, the ability to successfully navigate the cube can be conceptualized as a core Dynamic Capability (Teece et al., 1997), separating firms that can continuously reconfigure their automation assets from those stuck in brittle, tactical states.

Finally, a Sociotechnical Systems perspective would frame the entire evolution as a process of joint optimization, where each move to a new quadrant requires a co-adaptation of both the technical system and the organization's social structures, skills, and governance models. The challenges inherent in states like Brittle Process Sprawl (Q5) can be seen as a direct consequence of failing to jointly optimize the social and technical subsystems, prioritizing technical expediency at the expense of organizational stability and resilience (Trist, 1981). Acknowledging these alternative theoretical lenses opens up a rich and multi-faceted agenda for future research into this critical phenomenon.

5.2 Implications for Managerial Practice

The traditional approach of evaluating automation on a simple ROI basis is revealed by the model to be dangerously insufficient, as it often prioritizes the short-term efficiency of Tactical Automation (Q1) while ignoring the hidden, long-term costs of its inherent brittleness. Managers can use the framework to visualize hidden systemic risks; for example, a finance manager might map their current "Invoice Entry" bot to Quadrant 1 (Tactical Automation) because it uses screen-scraping (Front-End) for a single task (Task Scale) using if-then logic (Low Intelligence). Recognizing the high maintenance costs caused by UI changes, the manager can use the model to chart a path to Quadrant 3 (Resilient Task Execution) by investing in an API connector, or to Quadrant 5 (Brittle Process Sprawl) by linking multiple bots together—a move the model flags as high-risk.

More importantly, the model reframes future investment decisions. The question is no longer a simple "should we upgrade?" but a conscious choice of evolutionary path for each process:

- Should investment be directed towards architectural enablers (like APIs) to increase resilience (a vertical move)? This path is appropriate for mission-critical processes where stability is paramount.
- Should investment be directed towards cognitive enablers (like AI/LLMs) to increase capability (a horizontal move)? This path is suited for complex, exception-prone processes where human judgment is the current bottleneck.
- Should investment be directed towards scaling methodologies to broaden impact (a depth move)? This path is for mature automations that are ready to be expanded from a single task to an end-to-end process.

This provides a sophisticated language for a more nuanced strategic dialogue between business and IT leaders, allowing them to consciously balance the competing demands of resilience, intelligence, and scale across their entire automation portfolio.

5.3 Boundary Conditions

While the model addresses the prevalent challenge of integrating RPA with legacy ERPs, it has specific boundary conditions. The model is less relevant in "greenfield" environments utilizing modern, cloud-native ERP stacks (e.g., SAP S/4HANA Public Cloud) where GUI scripting is restricted or impossible, and API interaction is the mandatory standard. In such cases, the Resilience Axis is effectively removed, collapsing the model into a two-dimensional space of Intelligence and Scale. Furthermore, the model assumes a high volume of transactional work; for low-volume, highly variable processes where no "standard" workflow exists, the concept of "Process Orchestration" (Scale Axis) may not apply.

5.4 Limitations and Agenda for Future Research

The model's primary limitation - its conceptual nature - also defines its most urgent contribution: a clear agenda for future empirical research. Key questions emerge directly from the framework:

- Validation of Paths: What contextual factors (e.g., industry regulation, firm size, competitive pressure) lead organizations to prioritize one evolutionary path over another? A comparative case study of firms in the high-risk Cognitive Emulation (Q6) state versus the high-reliability Systemic Process Integration (Q7) state could yield insights into the strategic drivers of these choices.
- Governance and Skills: How do governance

frameworks and required skill profiles differ across the eight quadrants? Ethnographic or survey-based research is needed to understand the new roles (e.g., AI trainer, bot orchestrator), skills, and control mechanisms required to manage a mature portfolio of automations.

- Performance and Value: How does business value differ across the quadrants? While Intelligent Process Orchestration (Q8) is the aspirational state, it is likely the most expensive and complicated to achieve. Research is needed to understand the contingent performance outcomes and to develop ROI models that can account for the distinct value propositions of resilience, intelligence, and scale.
- The Transitional Journey and Organizational Inertia: While the model maps the distinct states, the process of moving between quadrants is a critical and under-researched area. What are the organizational frictions, capability-building processes, and managerial interventions required to navigate a transition, for instance, from the tactical trap of Q1 to the resilient state of Q3? Longitudinal case studies tracking firms during these transitions could reveal the dynamic capabilities that separate successful evolution from stalled efforts, and identify the sources of inertia that keep firms locked in perilous states like Brittle Process Sprawl (Q5).
- Second-Order Effects and the Post-Q8 Landscape: The model posits Q8 (Intelligent Process Orchestration) as an aspirational end-state. However, what are the unintended consequences or second-order effects of achieving this state? Research is needed to explore potential new forms of algorithmic rigidity, the de-skilling of expert human roles, or the emergence of novel systemic risks when core transactional processes are managed by autonomous agents. This critical perspective would investigate whether the solution to one set of problems creates a new, more complex set for the future, moving beyond a purely aspirational view of automation maturity.

Empirical work is needed to validate, refine, and extend the model presented here, transforming it from a theoretically grounded framework into an empirically tested theory of enterprise automation evolution - one that accounts for not only the strategic states but also for the complex dynamics of transition and the critical second-order consequences of automation maturity.

6 Conclusion

This article has proposed and provided evidence for a three-dimensional model of RPA-ERP evolution. The framework reveals that the maturation of enterprise automation is not a simple, linear path but a complex journey through a strategic space defined by the competing pressures of resilience, intelligence, and scale.

The primary contribution of this work is a robust conceptual framework that serves a dual purpose. For researchers, it synthesizes multiple theoretical streams to provide a new, nuanced lens for theorizing about the emergence of sociotechnical agency and architectural change in modern enterprise systems. For practitioners, it offers a diagnostic and portfolio management tool to guide strategic decision-making in the complex landscape of automation. The model demonstrates that the central challenge of modern automation is not the implementation of a single technology, but the strategic navigation of the trade-offs between these three fundamental dimensions.

Ultimately, the evidence suggests that RPA is not an endpoint but a catalyst. It is the entry point that introduces organizations to the broader, more profound challenges and opportunities of intelligent automation. The path forward, charted by the 3D framework, is not a single road but a complex strategic landscape. The ability to consciously and deliberately balance resilience, intelligence, and scale will be the defining characteristic of the next generation of intelligent, human-centric enterprises.

References

Alter, S. (2014). Theory of Workarounds. *Communications of the Association for Information Systems*, 34, pp. 1041–1066. https://doi.org/10.17705/1CAIS.03455

Autor, D. H., Levy, F., & Murnane, R. J. (2003). The skill content of recent technological change: An empirical exploration. *The Quarterly Journal of Economics*, *118*(4), 1279–1333. https://doi.org/10.1162/003355303322552801

Banta, V.-C., Sacală, I.-Ș., Țuțui, D., Crețu, R.-F., & Șerban, E. C. (2024). Manufacturing Processes in the Era of Industry 4.0. Case Study: Analysis of a System Architecture in Automotive Industry. *Studies in Informatics and Control*, *33*(3), 93–102. https://doi.org/10.24846/v33i3y202409

Banta, V.-C., Tanasie, A., & Cojocaru, D. (2021). The main benefits-risks of adopting Robotic Process Automation in Big Four Companies from Romania. A Case Study. In *2021 25th International Conference on System Theory, Control and Computing (ICSTCC)* (pp. 340–345). IEEE. https://doi.org/10.1109/ICSTCC52150.2021.9607188

Chi, W. W., Tang, T. Y., Salleh, N. M., & Hwang, H. J. (2023). A Novel Natural Language Processing Strategy to Improve Digital Accounting Classification Approach for Supplier Invoices ERP Transaction Process. In O. Gervasi, B. Murgante, D. Taniar, B. Apduhan, A. Braga, C. Garau, & A. Stratigea (Eds.), *Computa-*

tional Science and Its Applications – ICCSA 2023, PTI (Vol. 13956, pp. 581–598). Springer International Publishing AG. https://doi.org/10.1007/978-3-031-36805-9_38

Desai, P. (2020). Robotic process automation: RPA Pre-requisite and pivotal points. In *2020 International Conference on Smart Technologies in Computing, Electrical and Electronics (ICSTCEE)* (pp. 446–451). IEEE. https://doi.org/10.1109/ICSTCEE49637.2020.9276861

Davenport, T. H. (1998). Putting the enterprise into the enterprise system. *Harvard Business Review*, *76*(4), 121–131.

DiMaggio, P. J., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review*, *48*(2), 147–160. https://doi.org/10.2307/2095101

Dumas, M., La Rosa, M., Mendling, J., & Reijers, H. A. (2018). *Fundamentals of Business Process Management* (2nd ed.). Springer.

Dumitru, V. F., Ionescu, B.-S., 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

Fernandez, D., & Aman, A. (2018). Impacts of Robotic Process Automation on Global Accounting Services. *Asian Journal of Accounting and Governance*, *9*, 123–132. https://doi.org/10.17576/AJAG-2018-09-11

Ferrer-Gilabert, S., Forés, B., & Lapiedra, R. (2025). Stages and Critical Success Factors in ERP Implementation: Insights from Five Case Studies. *Computer Science and Information Systems*, *22(3)*, 727–753. https://doi.org/10.2298/CSIS240229030F

Flechsig, C., Anslinger, F., & Lasch, R. (2022). Robotic Process Automation in purchasing and supply management: A multiple case study on potentials, barriers, and implementation. *Journal of Purchasing and Supply Management*, 28(1), 100718. https://doi.org/10.1016/j.pursup.2021.100718

Goodhue, D. L., & Thompson, R. L. (1995). Task-technology fit and individual performance. *MIS Quarterly*, *19*(2), 213–236. https://doi.org/10.2307/249689

Henderson, R. M., & Clark, K. B. (1990). Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly*, *35*(1), 9–30. https://doi.org/10.2307/2393549

Hong, B., Ly, M., & Lin, H. (2023). Robotic Process Automation Risk Management: Points to Consider. *Journal of Emerging Technologies in Accounting*, *20*(1), 125–145. https://doi.org/10.2308/JETA-2022-004

Hung, P. D., Chuong, L. V., & Diep, V. T. (2022). Improving Availability for Robotics Automation Process Deployment in Enterprise Cooperative Applications. In Y. Luo (Ed.), *Cooperative Design, Visualization, and Engineering, CDVE 2022* (Vol. 13492, pp. 317–328). Springer International Publishing AG. https://doi.org/10.1007/978-3-031-16538-2_32

Jamithireddy, N. H. (2025a). Automating Foreign Exchange Operations in SAP ERP Using UiPath: A Framework for Improved Efficiency. *Indian Journal of Information Sources and Services*, *15*(2), 245–257. https://doi.org/10.51983/ijiss-2025.IJISS.15.2.32

Jamithireddy, N. S. (2025b). Cash Flow Forecasting in SAP ERP Enhanced by UiPath Automation: A Predictive Analytics Approach. *Indian Journal of Information Sources and Services*, *15*(2), 368–379. https://doi.org/10.51983/ijiss-2025.IJISS.15.2.45

Kocsi, B., Matonya, M. M., Pusztai, L. P., & Budai, I. (2020). Real-Time Decision-Support System for High-Mix Low-Volume Production Scheduling in Industry 4.0. *Processes, 8*(8), 912. https://doi.org/10.3390/pr8080912

Kruchten, P., Nord, R. L., & Ozkaya, I. (2012). Technical debt: From metaphor to theory and practice. *IEEE Software*, *29*(6), 18–21. https://doi.org/10.1109/MS.2012.167

Lai, H.-K., & Hsieh, S.-F. (2024). Evaluating the Impact of Robotic Process Automation on Earnings Management. *Journal of Information Systems*, *39*(1), 103–133. https://doi.org/10.2308/ISYS-2024-032

Markus, M. L., & Tanis, C. (2000). The Enterprise System Experience - From Adoption to Success. In R. W. Zmud (Ed.), *Framing the Domains of IT Management: Projecting the Future Through the Past* (pp. 173–207). Pinnaflex Educational Resources.

Moreira, S., Mamede, H. S., & Santos, A. (2024). Business Process Automation in SMEs: A Systematic Literature Review. *IEEE Access*, *12*, 75832–75864. https://doi.org/10.1109/ACCESS.2024.3406548

Nguyen, T.-D., Le, H.-S., Ho, T.-T., Nguyen, Q.-H., & Truong, H.-P. (2023). Design an RPA model for the fulfillment process in an SAP ERP system. *Journal of the Chinese Institute of Engineers*, *46*(6), 683–691. https://doi.org/10.1080/02533839.2023.2227869

Orlikowski, W. J. (1992). The duality of technology: Rethinking the concept of technology in organizations. *Organization Science*, *3*(3), 398–427. https://doi.org/10.1287/orsc.3.3.398

Ozkan, G., & Esgin, E. (2023). SOPRANO: Seamless Sales Order Management Robotic Process Automation Experience at SAP. In *2023 Innovations in Intelligent Systems and Applications Conference (ASYU)*. IEEE. https://doi.org/10.1109/ASYU58738.2023.10296770

Plattfaut, R., Borghoff, V., Godefroid, M., Koch, J., Trampler, M., & Coners, A. (2022). The Critical Success Factors for Robotic Process Automation. *Computers* *in Industry*, *138*, 103646. https://doi.org/10.1016/j.compind.2022.103646

Puschmann, T., & Alt, R. (2005). Developing an integration architecture for process portals. *European Journal of Information Systems*, *14*(2), 121–134. https://doi.org/10.1057/palgrave.ejis.3000527

Ratchatawetchakul, Y., Bansri, B., Ratchatawetchakul, K., Satchawatee, N., Ratchatawetchakul, W., & Eampoonga, I. (2024). Integrating robotic process automation (RPA) with hybrid cloud enterprise resource planning (ERP). *2024 5th Technology Innovation Management and Engineering Science International Conference (TIMES-iCON) Proceedings*. IEEE. https://doi.org/10.1109/TIMES-ICON61890.2024.10630776

Remlein, M., Jastrzębowski, A., & Obrzeżgiewicz, D. (2022). The impact of legislation on the development of accounting digitisation in Poland; [Wpływ legislacji na rozwój cyfryzacji rachunkowości w Polsce]. *Zeszyty Teoretyczne Rachunkowości, 46*(4), 115–127. https://doi.org/10.5604/01.3001.0016.1305

Ritschel, K., Stenzel, A., Czarnecki, C., & Hong, C.-G. (2021). Realizing Robotic Process Automation Potentials: An Architectural Perspective on a Real-life Implementation Case. In *Gesellschaft für Informatik e.V. (GI) GI. (Hrsg.): INFORMATIK 2021, Lecture Notes in Informatics (LNI)* (pp. 1303–1311). Gesellschaft für Informatik.

Santos, M., & Trigo, A. (2023). Automation of Invoice Processing with ERP Integration Using RPA Tools; [Automatização do Processamento de Faturas com Integração ERP Utilizando Ferramentas RPA]. *Atas da Conferência da Associação Portuguesa de Sistemas de Informação (CAPSI), 23*, 36–52. https://doi.org/10.18803/capsi.v23.36-52

Sarilo-Kankaanranta, H., & Frank, L. (2024). Managing IS Adoption Challenges in Emerging Technologies: A Longitudinal Case Study of Financial Management Services Automation in a Medium-Sized Enterprise. In M. Papadaki et al. (Eds.), *EMCIS 2023, LNBIP 502* (pp. 183–203). Springer Nature Switzerland AG. https://doi.org/10.1007/978-3-031-56481-9_13

Schnepf, J., Engin, T., Anderer, S., & Scheuermann, B. (2024). Studies on the Use of Large Language Models for the Automation of Business Processes in Enterprise Resource Planning Systems. In A. Rapp et al. (Eds.), *NLDB 2024, LNCS 14762* (pp. 16–31). Springer Nature Switzerland AG. https://doi.org/10.1007/978-3-031-70239-6_2

Suleiman, A., & Kassem, G. (2024). Process Mining Enabled Cognitive RPA to Automate Data Entry Tasks in ERP Systems. In *Proceedings of the 21st International Conference on Smart Business Technologies (ICSBT)* (pp. 123–130). SCITEPRESS – Science and Technology Publications, Lda. https://doi.org/10.5220/0012855700003764

Szelagowski, M., Berniak-Woźny, J., & Lupeikiene, A. (2022). The Future Development of ERP: Towards Process ERP Systems? In A. Marrella et al. (Eds.), *BPM 2022, LNBIP 459* (pp. 326–341). Springer Nature Switzerland AG. https://doi.org/10.1007/978-3-031-16168-1_21

Tang, T. Y., Salleh, N. M., & Wong, M. E. L. (2023). Smart Virtual Robot Automation (SVRA)-Improving Supplier Transactional Processes in Enterprise Resource Planning (ERP) System: A Conceptual Framework. In M. Al-Sharafi, M. Al-Emran, M. Al-Kabi, & K. Shaalan (Eds.), *Emerging Technologies and Intelligent Systems, ICETIS 2022, VOL 2* (Vol. 573, pp. 194-203). Springer International Publishing AG. https://doi.org/10.1007/978-3-031-20429-6_19

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509–533. https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z

Trist, E. L. (1981). *The evolution of socio-technical systems* (Vol. 2, p. 1981). Toronto: Ontario Quality of Working Life Centre.

Van der Aalst, W. M. (2013). Business process management: a comprehensive survey. *International Scholarly Research Notices*, *2013*(1), 507984. http://dx.doi.org/10.1155/2013/507984

Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *The Journal of Strategic Information Systems*, *28*(2), 118–144. https://doi.org/10.1016/j.jsis.2019.01.003

Wornow, M., Narayan, A., Opsahl-Ong, K., McIntyre, Q., Shah, N., & Ré, C. (2024). Automating the Enterprise with Foundation Models. *Proceedings of the VLDB Endowment, 17*(11), 2805–2812. https://doi.org/10.14778/3681954.3681964

Zuboff, S. (1988). *In the age of the smart machine: The future of work and power*. Basic Books, Inc.

František Sudzina is an assistant professor at Prague University of Economics and Business. He received his PhD in Sectoral and Intersectoral Economics from Bratislava University of Economics and Business. His research interests include information systems (enterprise software, mobile and web applications), consumer behavior (IT, food and drinks), psychology (primarily personality traits), operations research and econometrics. He is a member of the Academy of Management, the Association for Information Systems, the Operational Research Society, and the Strategic Management Society. ORCID: 0000-0003-1867-9237.

Appendix

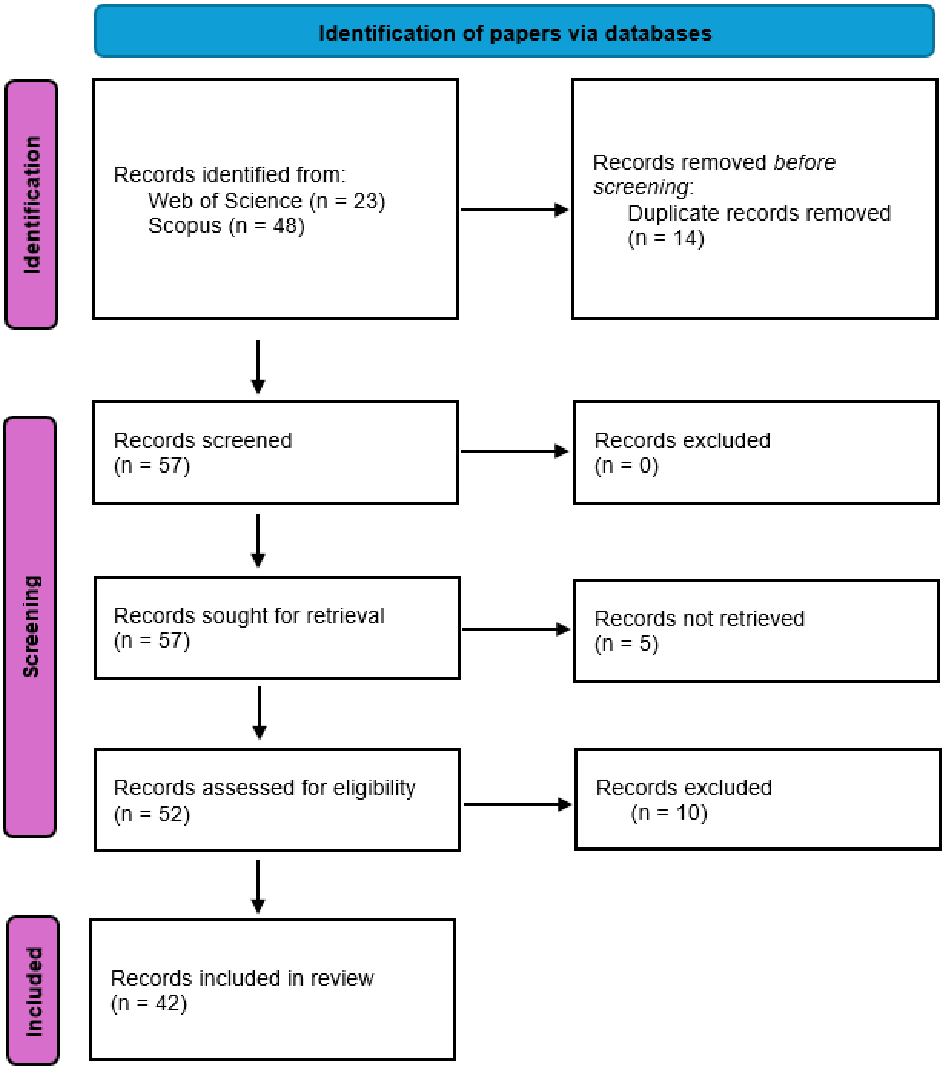

Figure 2: PRISMA Flowchart

Table 2: List of Curated Exemplars

#	Citation	Primary Illustrative Context
1	Banta et al. (2021)	**Intelligence (Low):** Case study on simple data entry and reconciliation tasks in Big Four firms.
2	Banta et al. (2024)	**Intelligence/Scale:** Advanced manufacturing architecture using iRPA and APIs for Industry 4.0; end-to-end process automation.
3	Chi et al. (2023)	**Intelligence:** Using NLP to classify unstructured text on supplier invoices.
4	Desai (2020)	**Resilience (Low):** Practitioner guide highlighting ease of deployment (Front-End) and quick wins.
5	Dumitru et al. (2023)	**Scale (Process):** Sustainability Accounting and Reporting (SAR) requirements acting as an external driver for holistic process orchestration.
6	Fernandez & Aman (2018)	**Intelligence (Low):** Focus on automating simple, structured accounting tasks.
7	Hong, Ly, & Lin (2023)	**Resilience:** Risks of UI sensitivity; need for governance in process-wide automation.
8	Hung, Chuong, & Diep (2022)	**Resilience (High):** High-availability architecture (load balancers, clustered databases) for RPA-ERP.
9	Jamithireddy (2025a)	**Resilience (High):** Hybrid architecture for FX operations using IDoc/BAPI (Back-End) for critical data.
10	Jamithireddy (2025b)	**Intelligence (High):** Cash flow forecasting using predictive analytics and deep learning (LSTM).
11	Kocsi et al. (2020)	**Intelligence (High):** Use of Genetic Algorithms for real-time production scheduling, expanding intelligence beyond NLP to computational optimization.
12	Lai & Hsieh (2024)	**Resilience (Low):** Emphasizes RPA’s non-invasive nature (Front-End Locus).
13	Moreira et al. (2024)	**Resilience:** Systematic review noting the trend towards API integration for stability.
14	Nguyen et al. (2023)	**Intelligence (Low):** Pillar exemplar for rule-based, deterministic order fulfillment bots.
15	Ozkan & Esgin (2023)	**Scale:** SOPRANO solution for end-to-end sales order management using SAP RFCs.
16	Plattfaut et al. (2022)	**Resilience:** Governance challenges arising from ungoverned, business-led automations.
17	Ratchatawetchakul et al. (2024)	**Scale (Task):** Quantifiable efficiency comparisons (e.g., 1.29x speed gain) for discrete production tasks in a cloud ERP.
18	Remlein et al. (2022)	**Scale:** Regulatory mandates (JPK) forcing a move toward standardized, digitized accounting processes.
19	Ritschel et al. (2021)	**Resilience (Low):** Pillar exemplar defining the “initial idea of RPA” as UI emulation (Front-End).
20	Santos & Trigo (2023)	**Intelligence:** Low-code automation of invoice processing using AI Builder for OCR.
21	Sarilo-Kankaanranta & Frank (2024)	**Resilience:** Maintenance challenges due to UI changes; organizational friction in moving to APIs.

Table 2: List of Curated Exemplars (continues)

#	Citation	Primary Illustrative Context
22	Schnepf et al. (2024)	**Intelligence (High):** LLM-based agents for the Procure-to-Pay (P2P) process with natural language error handling.
23	Suleiman & Kassem (2024)	**Intelligence:** Cognitive RPA framework using NLP for unstructured email data entry.
24	Szelagowski et al. (2022)	**Scale:** Concept of “Process ERP” and hyperautomation enabling end-to-end orchestration.
25	Tang et al. (2022)	**Intelligence (High) / Resilience (Low):** Use of Deep Learning and Computer Vision to mitigate the brittleness of GUI-based automation in dynamic web interfaces.
26	Wornow et al. (2024)	**Resilience/Intelligence:** Empirical account of “death by a thousand cuts” (brittleness); use of foundation models.