Designing Scalable Enterprise Systems: Learning From Digital Startups

Research Paper

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Abstract. The literature on enterprise systems (ES) has typically assumed that the business processes they support are relatively stable and subject to standardization. However, the dynamic nature of digital technologies challenges this assumption, highlighting the need for more flexible ES as processes evolve continuously. This shift is particularly evident in digital startups, which require adaptable systems to meet changing demands. To address this challenge, we used a design science research (DSR) approach involving 11 digital startups to identify ES requirements and design principles suited to dynamic environments. We present design knowledge through nine design principles crafted through a complete DSR process comprising problem identification, objectives definition, design and development, demonstration, evaluation, and communication. Our research highlights the need for scalable, adaptable architectures over rigid models. Our findings contribute to the discourse on the future of ES by proposing design principles that support flexibility and scalability in digital startups.

Keywords: Enterprise systems, Business process management, Digital entrepreneurship

1 Introduction

As digital technologies advance and markets evolve, organizations increasingly require flexibility to adapt (Heinig, 2022). Yet enterprise systems (ES), designed to support business processes, often impose rigid structures that limit adaptability in dynamic environments (Sunyaev et al., 2023). In response, market analysts and ES providers advocate for 'composability', which refers to the ability to select, assemble, and rearrange components to meet evolving needs (Gartner, 2020; Heinig, 2022; Sunyaev et al., 2023). In ES, this is enabled by the modularity and recombinability of digital innovation through APIs (Yoo et al., 2010), allowing flexible configuration of business processes.

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Despite the growing emphasis on flexibility, much ES and business process management (BPM) literature (Berente et al., 2016; Weske, 2019) assumes stability after design. Recent studies challenge this view in the digital age (Baiyere et al., 2020; Mendling et al., 2020), but offer limited guidance on evolving ES architectures. A recent *Journal of Information Technology* call for papers highlights a paradigm shift in ES, urging support for agility and innovation through broader integration and new technologies (Winter et al., 2024).

This shift is especially visible in fast-scaling organizations like digital startups, where operational processes must evolve rapidly (Huang et al., 2017; Tumbas et al., 2017), and ES are central to shaping them (Wuttke et al., 2024). One example process where such scalability is vital is the source-to-pay (S2P) process of digital startups which is not customer-facing, but illustrative of internal scalability, control, and efficiency challenges.

To learn about how we can design ES that are able to cope with the dynamics of digital startups, this paper asks: *What are the requirements and design principles for ES that support operational scalability in digital startups, and what could a corresponding system architecture look like?*

In addressing this question, we conduct a design science research (DSR) project (Peffers et al., 2007) within digital startups, where scalable and adaptable ES are critical. Drawing on interviews with 11 startup representatives, we identify seven key requirements, six design principles, and propose a corresponding system architecture. Using the echeloned DSR approach (Tuunanen et al., 2024), we focus on validated design requirements and initial design principles, contributing to early-stage DSR (Beermann et al., 2024). We illustrate how scalability, flexibility, and modularity can be achieved through individual system components, thereby advancing the understanding of ES design in dynamic environments such as digital startups.

To structure our contribution, we begin by outlining the need for scalable ES in digital startups (Section 2) and describe our DSR approach (Section 3). We then present key findings, including requirements and design principles (Section 4), followed by a discussion of implications (Section 5), and conclude with limitations and future research directions (Section 6).

2 The Need for Scalable Enterprise Systems in Digital Startups

Existing literature establishes ES as information systems that transcend specific functions or processes by integrating components to support end-to-end processes, foster synergy, and maintain organizational coherence (Cao et al., 2022; Robey et al., 2002). Today's ES include systems for enterprise resource planning (ERP), supply chain, customer relationship management systems, and business intelligence and analytics (Sunyaev et al., 2023). Existing literature on ES in established organizations outlines key requirements for ES: they must reliably support critical processes like accounting (Murphy and Simon, 2002) and require careful planning to deliver promised value amid high costs, with failures potentially eroding trust (Murphy and Simon, 2002; Schlichter and Rose, 2013). Additionally, ES should enhance decision-making and efficiency

(Holsapple and Sena, 2005) through streamlined processes (Smolander et al., 2021) and robust data models (Bender et al., 2022). They also address specialized domain needs, requiring interoperability among niche systems and scalability for varying transaction volumes (Bender et al., 2021). These requirements illustrate how ES have traditionally been guided by principles of integration and control (Berente et al., 2016; Berente and Yoo, 2012). These logics are deeply embedded in the business processes that ES implement, a phenomenon referred to as infrastructural alignment (Baiyere et al., 2020). However, with the growing need for adaptability in digital environments (vom Brocke et al., 2024; Winter et al., 2024), such as digital startups, ES must evolve beyond rigid structures toward more flexible and responsive configurations.

Digital startups, defined as young firms that leverage digital artifacts for value creation and capture (Lin and Maruping, 2022), rely on digital technologies from inception (Tumbas et al., 2017). Their rapidly growing user base, driven by scalable digital innovation (Huang et al., 2017), compels them to manage business processes that support expansion (Wuttke et al., 2024). Unlike industrial-aged organizations, startups prioritize agility and speed through what Er et al. (2024) term adaptive process experimentation, operating on a logic of flexibility and experimentation. Consequently, the ES they adopt significantly influence business process design (Wuttke et al., 2024) and must align with these unique, scalable, and adaptive approaches (Er et al., 2024; Huang et al., 2017; Tumbas et al., 2017). While Sunyaev et al. (2023) advocate for composable ES, traditional ES logics often conflict with the flexible methods that give digital startups their competitive edge (von Briel et al., 2017), risking negative implementation outcomes due to misaligned stakeholder dynamics and logic incongruence (Berente et al., 2019). Therefore, managers must choose systems that resonate with the adaptive logic of digital startups.

In summary, the literature has only begun to explore the scaling of business processes and associated ES in dynamic contexts. It indicates that digital startups need ES that offer both flexibility and stability in business processes, allowing them to scale in line with the startups's growth ambitions (Wuttke et al., 2024).

3 Research Design

To study requirements and design principles for ES tailored to digital startups, we follow the DSR approach proposed by Peffers et al. (2007). This approach is appropriate for generating design knowledge about innovative solutions for problem-solving (Hevner et al., 2004; Tuunanen et al., 2024), which aligns with our research question. We followed the six stages of the "problem-centered approach" (Peffers et al., 2007, p. 56). Given our goal of supporting digital startups with ES that align with their institutional logic, these organizations serve as the primary context for our design efforts.

The first DSR phase, *problem identification & motivation*, is to specify a specific research problem and justify the value of a potential solution (Peffers et al., 2007). Motivated to study how digital startups use ES to scale, we selected the S2P process for in-depth study. S2P is a foundational process that often transitions early from informal to structured workflows, making it illustrative for studying internal ES scalability.

Quickly, we observed the use of various ES, which are poorly integrated, creating unnecessary complications in the form of operational redundancies, double work, and non-alignment between actors.

The second stage, *objectives of a solution*, is about inferring objectives for a solution from the identified problem (Peffers et al., 2007). Tackling digital startups' need for tailored ES, we opted for a project designing an ES architecture, including design requirements, design principles, and an instantiated architecture.

The third stage, *design & development*, is about designing and developing the central artifact (Peffers et al., 2007). We divided this phase into two sequential phases, where Table 1 provides an overview of our data collection. In the first step, we collected requirements grounded in the startups' experience with their S2P process by conducting 14 interviews across 11 digital startups. Each startup participated in one or two interviews, primarily with founders or CEOs, and in one case with a purchasing manager. The interviews lasted between 12 and 105 minutes, with an average duration of around 42 minutes. All startups are based in Germany, except for one (Finance App), which is located in the UK. We aim to develop ES for dynamic, growth-oriented organizations. This is why we chose digital startups as the ideal research environment. The startups we have chosen come from different industries, such as FinTech, e-commerce, climate technology, and AI. This gives us a broad perspective on various requirements for ES. They also vary in size, from 4 to 80 employees. Additionally, they are at different stages of development and therefore have different scaling needs, as the founding years range from 2016 to 2023. All of our startups work digitally and also use many tools and systems. This makes them highly relevant for analyzing flexibility needs. The interviews with founders and operational staff therefore provide a wide range of perspectives on ES needs. Our selection is deliberately based on practical relevance and diversity to derive feasible design principles for scalable ES from the requirements. To consolidate the interview data into requirements, we applied thematic coding to identify recurring challenges and goals across cases.

Insights from interviews on the Source-to-Pay (S2P) process highlight core enterprise system requirements like modularity, scalability, and integration. These needs are common across many business processes, allowing the architectural principles developed for S2P to be adapted to other areas such as Order-to-Cash or Hire-to-Retire, providing a flexible foundation for broader application. Hence, we phrased these requirements in the form of user stories. In the second step, we formulated design principles for the ES architecture based on the requirements inspired by the structure of Seidel et al. (2018).

Table 1**.** Interviewed startups (Details = founding year, industry; NoE = number of employees).

Name and market offering	**Details**	**NoE**
Finance App: SaaS platform for creating and sharing financial models with interactive, real-time data visualizations	2020, B2B	30
Workplace App: SaaS platform for hybrid workspace solutions	2019, B2B	80
Trading App: FinTech platform for enabling banks & companies to offer investment and trading features within their apps	2022, B2B	30

Publisher Comp: Media publishing and design services	2022, B2B	5
Ecommerce Comp: Ecommerce platform for merchandise and accessories	2022, B2C	8
Retail App: Manufacturer and distributor of high-quality, pollutant-reducing activated carbon filters; trader of smoking accessories and textiles	2016, B2B/B2C	70
Coffee App: Importer and trader of Vietnamese coffee and coffee utensils	2017, B2B/B2C	4
Textile App: Manufacturer and distributor of seat covers, interior products, and accessories for vehicles and furniture; developer and trader of camping vehicles	2018, B2C	11
Savings App: App development and deployment for personal equity management	2022, B2C	14
Climate Tech: Platform for monitoring and tracking carbon removal processes with integrated consultancy services	2023, B2B	8
AI Startup: AI-powered tool for multilingual meeting summaries, transcript generation, task and decision extraction, and question answering	2019, B2B	11

The fourth stage, *demonstration*, is about applying the artifact to demonstrate its usefulness (Peffers et al., 2007). Once we had developed a first draft of the requirement and the design principles, we opted to illustrate the feasibility of our requirements and design principles by proposing an ES architecture as an initial step toward implementing such systems. To make this artifact tangible and facilitate functionality demonstration and evaluation in interviews, we implemented a basic S2P business process using Camunda, following the architectural blueprint. Developing this simple instance of our proposed architecture raised additional questions and provided insights that helped us refine our design.

The fifth stage, called *evaluation*, is to observe and measure the ability of an artifact to solve the identified problem (Peffers et al., 2007). We evaluated the design requirements, principles, and the corresponding architecture by conducting another round of four evaluation interviews (see Table 2), partly with the participants of the first rounds and partly with experts in the field. In these sessions, we presented the developed architecture, the requirements, and design principles, asking the experts for feedback.

Table 2. Evaluation Interviews

Role	**Experience**	**Evaluated Artifact**	**Min.**
Team lead at large ES vendor	16 years in research, 10 years at vendor	Requirements, design principles, and architecture	60
Senior researcher at large ES vendor	9 years in research, 3 years at ES vendor	Requirements, design principles, and architecture	45
Software engineer at large ES vendor	3 years at ES vendors	Requirements, design principles, and architecture	60

CEO of publisher company	8 years as CEO, user experience with ES	Architecture	15

Finally, the *communication* stage aims to share details about the artifact and its production process (Peffers et al., 2007). Thus, as demonstrated in the evaluation, we aim to present and discuss our findings with vendors and experts from the information systems community in both academia and practice.

4 Findings

This section outlines ES requirements and design principles, including a demonstration and evaluation section based on digital startups' S2P business processes.

4.1 Requirements

In total, we identified 14 key requirements based on interviews with practitioners in digital startups. Many of these reflect the unique demands of startup environments, such as the need for rapid decision-making (ID 3), lean communication (ID 14), or flexible approval structures (ID 5). This highlights how agility, speed, and minimal overhead are not just helpful but essential for early-stage growth. These requirements serve as the foundation for the development of a scalable ES that aligns with real-world needs.

ID 1: *As a CEO, I want orders to be archived, so that I can track expenses and ensure transparency.*

To support agility and transparency in fast-paced startup environments, the ES must allow employees to initiate order requests intuitively and with minimal friction. One interviewee described a typical scenario: *"The flow would probably be that the employee goes to the CTO and says something like, 'Hey, I know of a tool, XYZ. I think it would be cool for me, and maybe for the whole team as well"* (Climate Tech).

ID 2: *As a CEO, I want the system to integrate with our current data structure, so that I can utilize existing data without transformation.*

The ES should retrieve employee details, such as roles or departments, directly from existing HR systems, reducing redundancy and manual entry. A CEO emphasized: *"I would not buy a software for a single task. I would go with the solution that can do the most, so we don't have to deal with data schemes, data formats, integration, redundancy, and everything that goes with that"* (Climate Tech).

ID 3: *As an employee, I want to be able to make small purchases independently, so that I can save time and effort in approval procedures.*

The system should automate approvals for low-value purchases within predefined limits, minimizing delays. One participant remarked, *"Then it goes over the CFO's desk either before or after"* (Climate Tech), suggesting that manual review should be reserved for exceptional cases.

ID 4: *As a CFO, I want to be notified when an employee places an order above their limit, so that I can decide quickly.*

To avoid delays in high-value approvals, the ES should send real-time notifications to the appropriate decision-makers. One interviewee explained, *"Everything that has anything to do with finances goes through the CFO"* (Finance App), highlighting the need for automated messaging when manual decisions are needed.

ID 5: *As a CEO, I want to retain decision authority, so that I can act in the company's interest regarding bigger purchases.*

For strategic or large purchases, the system must allow manual interventions by authorized individuals. One interviewee noted, *"For more expensive, larger software, [the CEO] still decides whether we buy or build a solution ourselves"* (Finance App), underlining the importance of preserving top-level oversight.

ID 6: *As an accountant, I want a well-integrated system that tracks receipts and warranty details, so that recording expenses is efficient.*

The ES should automatically collect and organize all relevant documents, including receipts, invoices, and warranties. As described by one participant, *"The invoices are then directly transferred into our tax software according to their categories"* (Finance App), indicating how streamlined documentation supports financial workflows.

ID 7: *As a CEO, I want orders to be archived to track expenses, so that processes are transparent for subsequent reviews.*

Upon completion of an order, the system should securely archive all associated documents, reducing administrative effort. Currently, this is done manually: *"[...] then passes it on to the CFO, who handles the booking and also archives it"* (Climate Tech), demonstrating the need for automation.

ID 8: *As an accountant, I want a system that automatically tracks all expenses, so that I can concentrate on my core tasks, e.g. analysis.*

The ES must provide accounting systems with all procurement documents, including those for purchases made with personal credit cards. One participant reported, *"The manual integration of purchases made with private credit cards or other payment methods has now become the most time-consuming part of the process"* (Finance App).

ID 9: *As a CEO, I want to have the ability to adjust expenses, so that I can correct mistakes or cancel unnecessary orders.*

Authorized users should be able to intervene in active procurement workflows to adapt to changing priorities. One interviewee remarked, *"Even for larger purchases, such as office furniture that impacts the aesthetics and culture of our office, I ask for input because I know that visual aspects can be critical"* (Workplace App).

ID 10: *As an employee, I want the time between request and receival to be minimized, so that I can continue my work processes seamlessly.*

The ES should enforce time constraints for process completion to preserve speed. One participant explained, *"Simply put, a classic advantage of a startup is having speed, having agility. That means setting up large processes isn't really necessary, in my opinion"* (Climate Tech).

ID 11: *As a CEO, I want the S2P process to be easily scalable, so that I can react quickly to changes and growth in the company.*

Scalability must be supported through flexible, modular process flows that preserve startup agility. As one interviewee put it, *"[...] and it would be beneficial to maintain*

similar structures that allow for flexibility and direct communication" (Workplace App).

ID 12: *As an employee, I want the effort involved in ordering new work materials to be minimized, so that I can concentrate on my core tasks.*

The ES should require only minimal input to create order requests, such as ID and item information. One participant stressed, *"It is important, that we can act fast and efficiently, without being hindered by complex processes"* (Workplace App).

ID 13: *As a purchasing agent, I want to have an overview of all open orders, so that I can process multiple orders at once.*

A centralized interface should allow users to view and manage both active and archived procurement requests. One interviewee noted that informal communication often complicates this: *"Most of the time, we still use Telegram, just through various channels"* (Climate Tech).

ID 14: *As a purchasing agent, I want a unified tool for communication, so that I don't have to switch between different messengers.*

The ES should integrate communication functions to avoid fragmentation and oversight. One participant illustrated the current fragmentation: *"All just send their mails, when they need something"* (Retail App), showing the need for standardized, in-system messaging.

In summary, these requirements underscore the need for ES that not only support existing workflows but also scale with the organization. The following design principles synthesize these requirements into actionable guidance for the development of scalable and startup-appropriate ES.

4.2 Design Principles

Drawing on the identified requirements, we derived nine design principles tailored to the needs of digital startups: (1) *efficiency through automation*, (2) *integration and compatibility*, (3) *data-driven decision-making*, (4) *collection and archiving*, (5) *flexibility and adaptability*, (6) *scalability*, (7) *performance*, (8) *transparency and traceability*, and (9) *user-centered design*. These principles are grounded in empirical insights and reflect recurring patterns across interviews.

The principle of (1) *efficiency through automation* addresses the automation of routine tasks to reduce manual effort and increase productivity. It is derived from requirements 3 and 4, which call for automated approvals based on thresholds and real-time notifications to responsible actors. Examples include automated purchase approvals or material orders, enabling employees to focus on tasks requiring human judgment.

(2) *Integration and compatibility* ensures seamless incorporation of new processes into existing systems. Based on requirements 2, 8, and 14, this principle emphasizes interoperability with HR and accounting systems and alignment with existing communication tools. For example, ES should retrieve employee data from current systems and enable automatic invoice transfer, reducing redundancy and fragmentation.

(3) *Data-driven decision-making* promotes informed actions based on relevant data. Requirements 3 and 5 highlight the need to define approval limits and enable contextual

decisions, such as supplier evaluations. This principle encourages mechanisms that support managerial oversight and conditional logic in workflows.

(4) *Collection and archiving* emphasizes systematic documentation of procurement-related data, such as invoices and receipts. Addressing requirements 6 and 7, this principle supports the implementation of document management systems that ensure accessibility and traceability of past transactions.

(5) *Flexibility and adaptability* focuses on rapid response to change. Derived from requirements 5 and 9, it advocates for customizable approval structures and manual overrides for strategic decisions. For instance, minor purchases should be executable without delay, while critical decisions remain under managerial control.

(6) *Scalability* is essential in dynamic startup environments aiming for growth. Requirement 11 explicitly addresses this need. The principle supports scalable workflows and adaptive approval structures that grow with the organization, such as variable budget thresholds or role-based process logic.

(7) *Performance* addresses the need for timely process execution. Based on requirements 10 and 11, it calls for optimization of throughput to avoid bottlenecks. Fast, responsive workflows ensure continuity in operations, especially when subsequent tasks depend on prior completion.

(8) *Transparency* and traceability ensure process visibility for all stakeholders. Rooted in requirement 13, this principle calls for centralized tracking tools and audit trails, enabling real-time oversight and anomaly detection. Visibility into orders and expenditures strengthens governance and trust in processes.

(9) *User-centered design* emphasizes intuitive and efficient interfaces aligned with user needs. Reflecting requirements 1, 8, 12, and 13, it ensures minimal input effort, simplified workflows, and unified interfaces. Employees should be able to request purchases with only essential data while purchasing managers access streamlined overviews.

4.3 Demonstration

To demonstrate the feasibility of our design principles, we developed the ES architecture shown in Figure 1.

At its core, a workflow engine orchestrates business processes and tracks active process states. It can execute all workflows, potentially serving as the startup's sole ES. This automation reflects the principle of efficiency through automation. The engine also supports flexibility and adaptability, as it is not limited to predefined process models and allows for interchangeable tasks.

A logging service records each process step, enabling the generation of performance metrics such as task durations and cycle times. This supports transparency, traceability, and performance monitoring. Logs and data are stored in an internal database, which may be enriched with external data, enabling collection and archiving. The decision engine, tightly integrated with the workflow engine, uses historical and real-time data to support data-driven decision-making and automation, enabling dynamic process reconfiguration and runtime decisions.

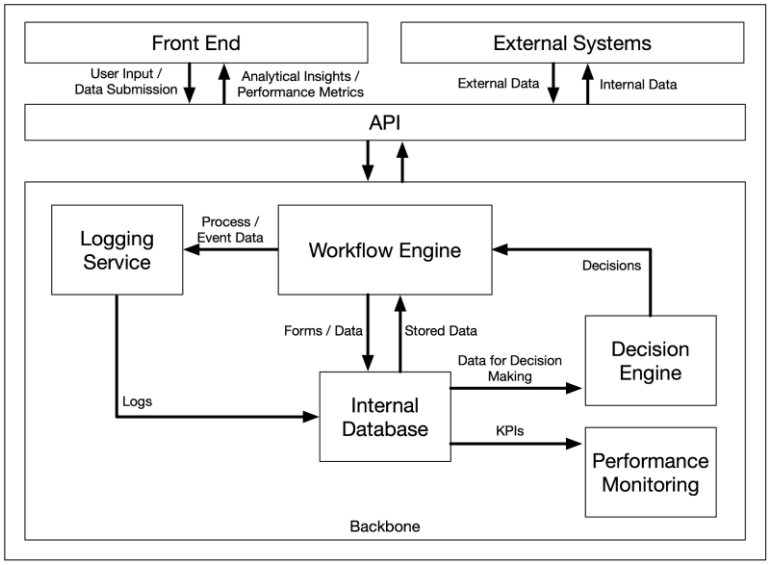

Figure 1. System architecture. The arrows indicate the data flow direction.

An extensible API layer facilitates robust integration not only with the startup's front end but also with a wide range of external enterprise systems, ensuring seamless compatibility with existing applications such as product databases, ERP platforms, and CRM tools. This design supports future scalability and adaptability to evolving business needs. The front end features a user-centered interface that prioritizes ease of use and accessibility for users at all levels. Additionally, it incorporates integrated communication capabilities for automated notifications and reporting, further enhancing operational transparency and enabling smooth collaboration across departments and systems.

The architecture also supports scalability, as the workflow engine can handle any number of parallel process instances. This means that as demand grows, the system can scale horizontally by distributing workload across multiple nodes or instances without compromising performance or reliability. Furthermore, the workflow engine's integration features enable seamless communication with external systems, APIs, and services, ensuring that even complex, multi-system processes can be executed concurrently.

Our architecture supports runtime adaptation and seamless integration, enabling dynamic changes without downtime. To validate this, we implemented a simplified S2P process using Camunda, demonstrating how workflows can be modeled, adapted, and executed in fast-changing startup environments. The system is equally realizable with platforms like n8n or Zapier, supporting flexible, AI-assisted workflows and service integration.

The process begins with an order request stored in the internal database, then transmitted to an external database to test integration. A basic decision engine approves or declines the request based on external data. The process concludes with a Slack notification, demonstrating front-end and communication integration. Camunda logs task timestamps, enabling throughput calculations, and thus validating the performance

monitoring functionality. In conclusion, our prototypical implementation meets the requirements of the proposed ES architecture, indicating its practical feasibility.

4.4 Evaluation

Expert feedback confirmed that automation enhances efficiency and transparency in dynamic workflows. One expert noted: *"[A process] should be quick, so you want to put in as little manual work as possible."* The extended integration and compatibility of the system were also praised as forward-looking. The ability to seamlessly integrate into existing workflows, processes, and software environments helps startups embed their operations into existing digital infrastructures without fundamentally changing their working methods. This flexibility and adaptability were viewed positively. Looking ahead, however, when digital startups scale, *"the question is, when will we manage to take this step towards more integrated solutions?"* as an ES expert noted. Closely linked to automation is data-driven decision-making, supported by the integration of process and business data. This approach was also regarded as beneficial, enabling informed decisions to be made in real-time and thus improving process management.

The interviewees also offered valuable insights and suggestions for improvement. For example, they critically examined the relationship between scalability and performance. Given their close connection, it was recommended that these concepts be presented more clearly and treated as interrelated. A scalable system should always remain efficient, regardless of increasing user load or process extensions, as an ES expert noted: *"Scalability should align with performance, right? […] For me, it's the same. A system that doesn't scale cannot be performant."* Another suggestion concerned managing budgets at the team rather than at the individual level. The experts also recommended introducing an 'intake management' system to enable more flexible approval processes and improve system efficiency: *"The budget itself is at the team level, right? So, I am responsible for keeping that together. […] Have you looked into intake management? Because that's kind of the buzzword that goes in that direction."* As a supplementary recommendation, the evaluators suggested the potential addition of a fraud detection function and a returns management option directly to the architecture to further enhance the system's capabilities. These functionalities were seen as important for security and quality assurance in procurement processes and should be considered especially in growing startups: *"The larger you get, the faster some, let's say, black sheep will come in and take advantage of it. […] I consider goods receipt inspection to be a crucial component, one way or another, in this process."* Furthermore, it was suggested that the decision engine should be integrated as part of the workflow engine and that the role of performance monitoring should be clearly defined. This would create a more precise architecture and improve system monitoring: *"Why is the decision engine separated from that, or isn't the decision engine actually part of the workflow engine?"* Lastly, one expert noted that scalability becomes increasingly complex when business processes are interdependent: *"Scalability becomes challenging when multiple processes interact with one another."*

5 Discussion

The pursuit of standardization and visibility of processes in ES (Berente et al., 2016, p. 201; Berente and Yoo, 2012), often resulting in rigid architectures. Digital startups, by contrast, rely on flexibility and experimentation (Er et al., 2024; Wuttke et al., 2024), creating a mismatch that risks ES implementation failure. Although in the literature scalability is widely acknowledged as critical (e.g., Bender et al., 2021), little guidance exists on how to design ES that meet such demands. To address this, we propose design principles for composable ES (Heinig, 2022; Sunyaev et al., 2023) tailored to startup dynamics, focusing on the S2P process as a representative internal function requiring agility, speed, and governance.

Our principles align with established ES goals: efficiency through automation supports process efficiency (Holsapple and Sena, 2005), data-driven decision-making enhances financial accuracy (Murphy and Simon, 2002), and integration and compatibility promote interoperability (Bender et al., 2021). Scalability is also directly embedded in our design.

What sets our work apart is the focus on process adaptability as a norm, not an exception. Our principle of flexibility and adaptability supports startups' need for ongoing change (Er et al., 2024), enabled by modular architectures (Yoo et al., 2010) with API-accessible components orchestrated by a workflow engine. As startups operate in increasingly heterogeneous ES landscapes (Wuttke et al., 2024), modular integration becomes essential (Yoo et al., 2010).

Rather than prioritizing rigid reliability, our architecture emphasizes transparency and traceability through logging and monitoring. This enables safe experimentation and continuous improvement. Accurate logs facilitate debugging and justify a trade-off between rigidity and agility. While previous workflow architectures share similar goals (Chakroborti, 2020; Georgakopoulos et al., 1995), our contribution lies in applying them to fast-scaling organizations.

While we derive our design principles from digital startups, other organizations going through organizational change might also benefit from prioritizing adaptability in ES. Baiyere et al.(2020), for instance, study how BPM changes in a company undergoing digital transformation. Regarding ES, they find that *"while [the established company's] ERP system provided the functionality for the IT to perform most of its activities, it remained a huge bottleneck considering the time and effort plus cost required each time there was a need to make changes to the system to accommodate emerging demands for creating digital innovations"* (Baiyere et al., 2020, p. 255). They conclude that *"a flexible infrastructure would better support an organization's digital transformation efforts by its capacity to evolve and support the continuous redesign of the business and related processes"* (Baiyere et al., 2020, p. 255). We believe that our design principles can guide ES vendors in designing such flexible infrastructures.

However, this study has limitations. Our sample of 11 startups from Germany and the UK may introduce regional bias. Future research should extend the scope across industries, geographies, and business functions.

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