

# Design and Implementation of Cloud-Based Information Systems for SMEs: Enhancing Efficiency and Scalability

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## Abstract

Small and Medium Enterprises (SMEs) play a critical role in economic growth and employment, yet their ability to remain competitive is often constrained by limited capital, fragmented information infrastructure, and uneven digital capabilities. In recent years, cloud-based information systems have been increasingly adopted as an alternative to conventional IT infrastructures, particularly due to their scalability, flexibility, and reduced upfront investment requirements. This study examines the design and implementation of cloud-based information systems in SMEs and evaluates their implications for operational efficiency and organizational scalability. Using a quantitative explanatory research design, data were collected from SMEs that have implemented cloud solutions and analyzed through Partial Least Squares Structural Equation Modeling (PLS-SEM). The results indicate that organizational readiness and security risk management are decisive factors shaping the effectiveness of cloud system implementation. SMEs with adequate preparedness and structured risk controls are more likely to achieve measurable improvements in process efficiency, data integration, and decision-making responsiveness. In addition, the findings highlight that modular and scalable system architectures allow SMEs to adjust operational capacity in line with market fluctuations while avoiding excessive infrastructure costs. By empirically linking system design choices with organizational and governance conditions, this study contributes an integrated framework to the literature on SME digital transformation. The results also provide practical guidance for managers and policymakers in formulating cloud adoption strategies that support long-term digital resilience.

*Keywords:* Cloud Computing; Small and Medium Enterprises (SMEs); Information Systems; Scalability; Digital Transformation.

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## Introduction

Small and Medium Enterprises (SMEs) remain central to employment creation, innovation diffusion, and value-chain development across diverse economies, yet persistent constraints on access to capital, infrastructure adequacy, and specialized digital talent often weaken their strategic role. These barriers do not merely slow technology uptake; they shape the quality of information processing and managerial decision-making that SMEs can sustain, particularly when markets become more volatile, and customer expectations shift toward fast, data-informed services. In this context, the post-pandemic environment intensifies the relevance of digital resilience and operational agility as preconditions for continuity rather than optional capabilities, and structural obstacles to ICT adoption continue to reproduce competitiveness gaps across firm sizes (Arendt, 2008; Dorasamy & Kikasu, 2024).

Cloud computing has therefore gained prominence not simply as an alternative hosting option, but as a technological paradigm capable of reconfiguring how SMEs mobilize computing resources, store and synchronize data, and deploy modular applications without front-loaded capital expenditure. By enabling on-demand access to scalable resources and service-based software delivery, cloud systems reduce the technical entry barriers that typically prevent smaller firms from implementing integrated information systems at comparable levels of reliability and performance. Prior research suggests that cloud adoption can enhance organizational flexibility and strategic agility through modular architectures and interoperability, making it easier for SMEs to add functionality incrementally, respond to changing market needs, and avoid rigid infrastructure lock-in (Al-Mutawa et al., 2024; Guo et al., 2025; Reed, 2021).

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Even so, claims about cloud benefits require careful interpretation because the value of cloud adoption is not uniformly realized. Evidence indicates that SMEs may experience tangible improvements in internal coordination, service responsiveness, and process efficiency when cloud systems are coupled with real-time analytics and centralized data governance; however, outcomes remain contingent on organizational readiness, employee digital competence, and the capacity to manage risks, particularly around data security and compliance. In practice, governance weaknesses can offset technical advantages by reducing trust, limiting usage, and increasing perceived vulnerability, which in turn constrains organizational learning and system routinization (Hasan & Akter, 2022; Berililana et al., 2021; Omrani et al., 2022). Post-pandemic recovery has further intensified the urgency for digital resilience across economic sectors, including SMEs, where adaptive use of digital platforms has become central to survival and competitiveness (Bortoló et al., 2023).

A further limitation in the existing literature is the imbalance between studies that emphasize adoption intentions or perceived advantages and those that articulate implementation frameworks that integrate system design choices, security management, and performance evaluation into a single empirically tested model. As a result, many SMEs lack actionable guidance that links architectural decisions to measurable operational outcomes, while numerous empirical studies remain highly context-specific or conceptually framed without sufficient integration between technical design and organizational mechanisms (Kgakatsi et al., 2024; Prasetyani et al., 2025). This gap becomes critical when SMEs require not only justification for adoption but also a structured pathway to implement secure, scalable, and operationally aligned cloud-based information systems. Prior systematic reviews indicate that, while determinants of cloud adoption in SMEs have been extensively explored, empirical integration of organizational readiness, security governance, and operational performance outcomes remains limited, particularly in implementation-oriented studies (Jayeola et al., 2022; Mkhize et al., 2025).

Responding to these shortcomings, this study designs and evaluates a cloud-based information system framework tailored to SME operational realities, and empirically tests how organizational readiness and security risk management shape the effectiveness of cloud-based systems in improving operational efficiency and scalability. By integrating architectural design principles with quantitative explanatory analysis, this research aims to contribute to digital transformation scholarship and to produce implementation-relevant evidence for practitioners and policymakers seeking to strengthen SME digital resilience.

## Method

This study adopts a quantitative explanatory approach to test the relationships among organizational readiness, security risk management, operational efficiency, and scalability within SMEs implementing cloud-based information systems. The explanatory orientation is appropriate because the inquiry is not limited to describing cloud adoption patterns but is designed to evaluate theoretically grounded causal associations among constructs that jointly determine implementation outcomes (Baskerville & Pries-Heje, 2010; Palvia et al., 2003; Peffers et al., 2007). Consistent with recent cloud adoption research, the study uses a cross-sectional design to capture organizational conditions and outcomes at the time of implementation or early operationalization, acknowledging that cross-sectional data can restrict long-horizon causal inference while remaining suitable for hypothesis testing on inter-construct relationships under practical field constraints (Rahman & Hossain, 2024; Al-Sharafi et al., 2023; Alkhasoneh et al., 2025).

Data were collected using a structured questionnaire derived from established frameworks, integrating the Technology-Organization-Environment (TOE) perspective with a modified UTAUT model to ensure construct coverage across technological capability, organizational preparedness, and governance-related risk considerations. Prior to full deployment, the instrument underwent pilot testing to evaluate internal consistency and measurement quality, including Cronbach's alpha, composite reliability, and convergent and discriminant validity to reduce construct ambiguity and strengthen the interpretability of model estimates (Kumar & Sharma, 2025; Shetty & Panda, 2023). Respondents were purposively selected from SMEs that had adopted, or were actively implementing, cloud solutions, with emphasis on decision-makers such as IT managers, owners, or operational leads who hold sufficient visibility over implementation processes and performance outcomes.

To clarify the operational flow embedded in the implemented system, the study documents the end-to-end process logic that supports inventory and sales operations. This process representation is important because implementation effects

on efficiency and scalability depend not only on abstract technology features but on how workflows are digitized, standardized, and connected to centralized data repositories. The system flow is summarized in Figure 1, which describes authentication, dashboard access, inventory management and reporting, as well as sales transaction processing and payment confirmation.

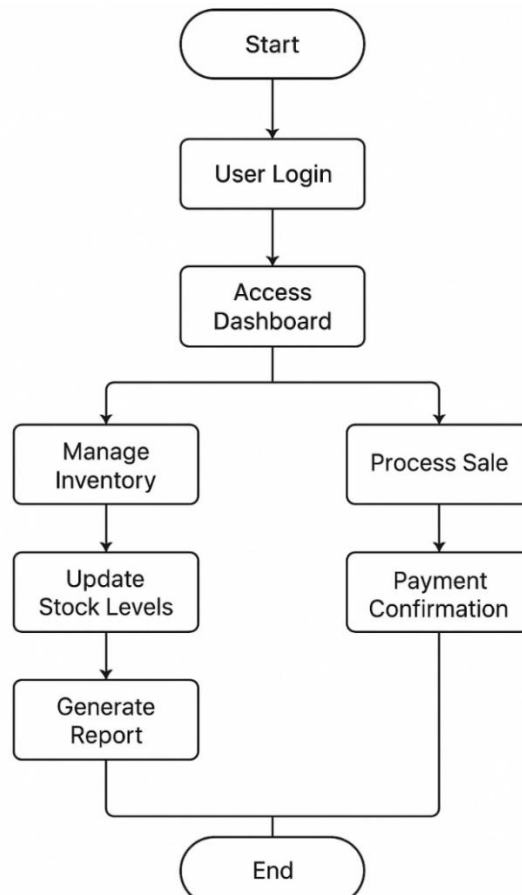


Figure 1. Flowchart

In Figure 1, the system process begins when a user accesses the application and authenticates through a login mechanism to ensure their identity. If the login process fails, the system redirects the user to the login page. If successful, the user is taken to the dashboard, which displays a summary of the data and available feature options. From this dashboard, the system provides two main flows: inventory management and sales processes. In the inventory management flow, users can manage product data, including adding, editing, and deleting products or stock, which is then followed by automatic stock level updates in the database. Furthermore, the system is also capable of generating various inventory reports, such as low stock information, best-selling products, and inventory graphic visualizations. Meanwhile, in the sales process flow, users enter transaction data including items, quantities, and prices. The system then records the transaction status after payment confirmation is made through various available methods, such as cash, transfer, or QRIS. Once both flows are completed, the system process ends and the system is ready to begin the next process cycle.

The proposed implementation framework is presented as a cloud-based information system architecture that connects front-end access, application logic, data management, and cloud infrastructure services, with explicit attention to modularity and security controls. Figure 2 introduces the framework at a conceptual level, while Tables 1–3 specify the architecture layers, core modules, and icon meanings so that the design choices are transparent and reproducible within other SME settings.

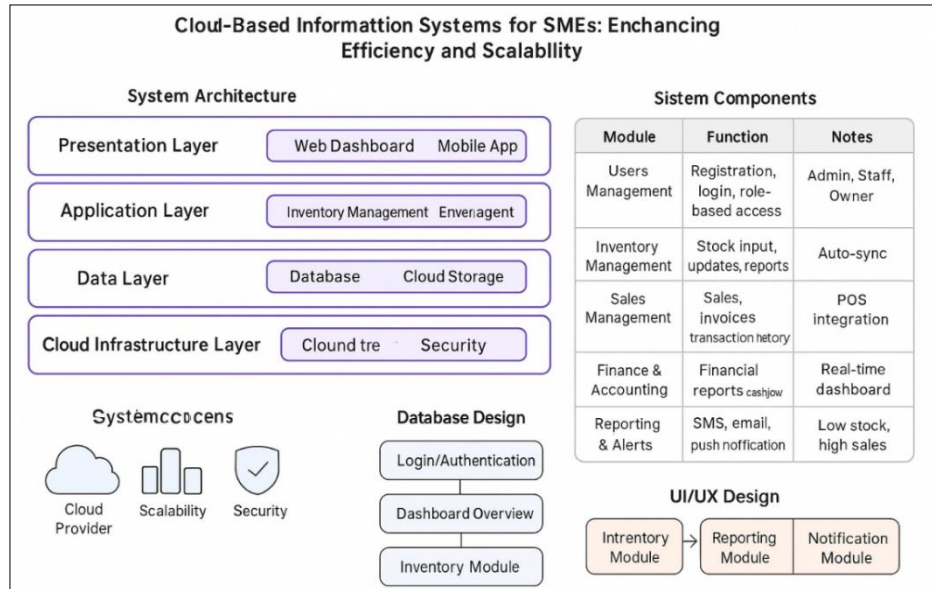


Figure 2. Cloud-Based Information Systems for SMEs: Enhancing Efficiency and Scalability

Cloud-Based Information System for Small and Medium Enterprises: Improving Efficiency and Scalability, consisting of four main sections: System Architecture, System Components, Database Design, and User Interface/User Experience Design.

Table 1. Cloud-Based System Architecture: Four Main Layers

Layer	Description	Components
Presentation Layer	The user interface is used by administrators, business owners, or staff. The system can be accessed via a browser or mobile app.	Web Dashboard, Mobile App
Application Layer	Contains the system's business logic and main functional modules. All processes, such as inventory management, transactions, and reports, run on this layer.	Inventory Management, Sales Management, Finance, Reporting, Alerts
Data Layer	The storage layer that holds all of the system's operational data. This layer ensures the availability, consistency, and security of the data used by the system.	(SQL/NoSQL)
Cloud Infrastructure Layer	Providing hosting, security, scalability, and performance through cloud services (AWS, Azure, GCP).	Cloud Provider, Security, Auto-Scaling

System Components (Main System Modules). This section displays a table of the core modules in the system:

Table 2. System Components: Main System Modules

Module	Function	Notes
Users Management	Registration, login, and role-based access	Administrator, Staff, Owner
Inventory Management	Input, update, stock report	Automatic synchronization
Sales Management	Sales transactions, invoices, history	Can integrate POS
Finance & Accounting	Cash flow statement, income statement, cash flow	Dashboard real-time
Reporting & Alerts	Notifications via SMS/Email/Push	Low stock alert, high sales

The database design reflected in the framework emphasizes centralized access patterns, with authentication gating all subsequent module calls, and the dashboard functions as a data aggregation layer that retrieves inventory, sales, financial indicators, and notifications in near real-time. This arrangement is intended to minimize data fragmentation and reduce reconciliation overhead, two recurring inefficiencies in SMEs operating with partially digitized processes. In parallel with data design, the UI/UX flow is structured to reduce cognitive burden for non-technical users by presenting modular navigation, task-focused screens, and condition-based alerts, acknowledging that adoption sustainability depends on usability and perceived usefulness in day-to-day operations rather than on technical sophistication alone. The three core icon semantics used in the Design are summarized in Table 3 to maintain interpretive consistency.

Table 3. System Icons

Icon	Meaning
Cloud Provider	The system runs on cloud infrastructure.
Scalability	The system can be scaled up according to user needs.
Security	Secure system that complies with data protection standards

After hypothesis testing and model evaluation, the study employs Partial Least Squares Structural Equation Modeling (PLS-SEM) because it supports simultaneous estimation of measurement and structural models and is suitable for complex models often used in SME cloud adoption research, particularly when sample sizes are moderate. The objective is explanation and prediction of implementation outcomes (Ali et al., 2023). The analysis examines direct, indirect, and mediating pathways through which organizational readiness and security risk management affect operational efficiency and scalability, and findings are interpreted in dialogue with prior empirical work to clarify the mechanisms linking governance and capability conditions to performance outcomes (Nyimbili & Chalwe, 2023). The explanatory orientation adopted in this study follows the logic of theoretical design, emphasizing the articulation of causal mechanisms between constructs rather than descriptive association alone, as emphasized in prior methodological literature (Baskerville & Pries-Heje, 2010; Bentouhami et al., 2021).

## Results and Discussion

### Result

The empirical results indicate that organizational readiness is a primary determinant of cloud implementation success in SMEs, as reflected in higher system utilization and improved operational performance among firms with adequate infrastructure, leadership commitment, and employee digital competence. This outcome reinforces the view that cloud-based systems do not automatically generate value through technical deployment alone; instead, organizational alignment and preparedness shape whether the system becomes embedded into workflows, informs managerial decisions, and reduces process friction. The observed association is consistent with arguments that readiness is a precondition for translating digital tools into operational capability and sustaining transformational effects (Omrani et al., 2022).

Security risk management also demonstrates a statistically significant influence on adoption outcomes, emphasizing that trust and perceived control over data are central to sustained cloud use. SMEs that implemented systematic controls such as access management, encryption practices, and compliance monitoring reported higher perceived reliability and user confidence. This pattern supports the proposition that risk mitigation is not a peripheral technical add-on; it is a mechanism that stabilizes usage by reducing uncertainty and reinforcing governance legitimacy within the organization, which aligns with prior evidence on cybersecurity risk management in SME contexts (Alahmari & Duncan, 2020).

Operational efficiency outcomes further show that cloud-based systems can yield practical productivity gains through process automation, faster access to integrated data, and improved cross-functional coordination. Respondents reported efficiency gains and reduced operational bottlenecks attributable to centralized databases and near real-time analytics, enabling faster decision cycles and reducing repetitive manual reconciliation. Quantitatively, the reported productivity improvements of approximately 20% to 30% are consistent with recent empirical reports suggesting that cloud adoption supports measurable performance enhancement, particularly when workflows are re-engineered rather than merely digitized (Abidemi, 2024; Uddin et al., 2023).

Scalability appears as a distinctive advantage, as SMEs leveraging modular architectures were able to adjust resource allocation in response to demand fluctuations without substantial capital expenditure. This supports the argument that scalability is not simply a technical property of cloud infrastructure but a strategic capability that shapes responsiveness, experimentation with new tools, and resilience under market volatility. The evidence aligns with the proposition that scalable cloud configurations strengthen competitiveness by enabling incremental growth pathways and reducing the sunk-cost risks typically associated with on-premise infrastructure expansion (Bentouhami et al., 2021).

## Discussion

The integrated findings support an explanation that successful cloud-based system implementation in SMEs is governed by the interaction of organizational capability conditions and governance mechanisms rather than by technology availability alone. Organizational readiness emerges as the foundational layer because it determines whether the system architecture, modules, and data flows represented in Figures 1 and 2 can be operationalized into routines that reduce inefficiency and enhance decision quality. This interpretation is coherent with the broader digital transformation argument that internal capabilities—particularly managerial commitment and workforce digital competence—shape the conversion of digital investments into performance outcomes, thereby explaining why nominal adoption does not always translate into realized benefits (Wang et al., 2025).

Security risk management, as evidenced by its significant association with implementation outcomes, functions as a trust infrastructure that legitimizes cloud use and reduces uncertainty costs. When SMEs establish credible controls, system usage becomes more stable because employees and managers perceive lower exposure to data misuse, service disruptions, or compliance violations. In this sense, security practices become an enabling condition for efficiency and scalability, not merely a protective layer, reinforcing earlier insights that risk mitigation influences both acceptance and sustained utilization of cloud environments (Alahmari & Duncan, 2020).

Efficiency gains can be interpreted as the outcome of workflow integration and information processing acceleration. Cloud systems reduce delays associated with fragmented data storage and manual consolidation, thereby improving coordination and allowing SMEs to act on information faster and with greater consistency. This mechanism is particularly relevant for resource-constrained firms because it permits performance improvements without proportional increases in staffing or infrastructure spending, strengthening the argument that cloud-based information systems can partially level the operational playing field between SMEs and larger enterprises (Abidemi, 2024).

The scalability effect underscores that cloud adoption has strategic implications beyond short-term efficiency. By enabling incremental expansion through modular architectures, SMEs can add functionality, integrate analytics and automation, and adjust capacity according to growth trajectories. This supports the view that cloud computing functions as an adaptable platform that can evolve with business strategy rather than a fixed IT asset, strengthening longer-term competitiveness in dynamic environments (Bentouhami et al., 2021). To make the architectural explanation explicit and replicable, the study restates the high-level layered architecture as a general model for SMEs, presented in Figure 3 and Table 4.

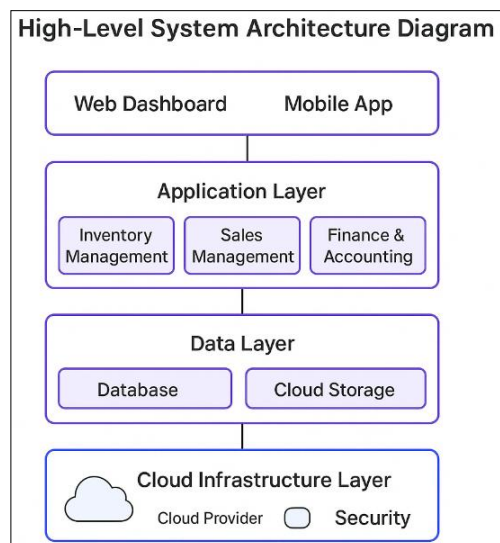


Figure 3. High-Level system Architecture diagram

This diagram illustrates the general architecture of a cloud-based information system for SMEs. It consists of four main layers.

Table 4. The general architecture of a cloud-based information system for SMEs

Layer	Explanation
Presentation Layer	The interface used by users consists of a Web Dashboard and Mobile App. The dashboard is used by administrators or business owners, while the mobile app can be used by employees/operational staff.
Application Layer	Contains the business logic of the application, consisting of modules: Inventory Management, Sales Management, and Finance & Accounting. All processes such as stock updates, transaction inputs, turnover calculations, and reports are controlled at this layer.
Data Layer	Storing all operational data, consisting of databases (SQL/NoSQL) and cloud storage for storing files such as invoices, product photos, export reports, and other unstructured data.
Cloud Infrastructure Layer	The infrastructure layer is provided by cloud services such as AWS, Azure, or Google Cloud. Important features at this layer include Security, Scalability (Auto-Scaling), and Backup & Recovery.

The database structure supporting transaction integrity and auditing capability is further described through an ERD representation. Figure 4 presents the ERD, while Table 5 summarizes the core entities and their operational roles, ensuring that the data model supports multi-item transactions, payment traceability, and consistent linkage between customers, orders, and products.

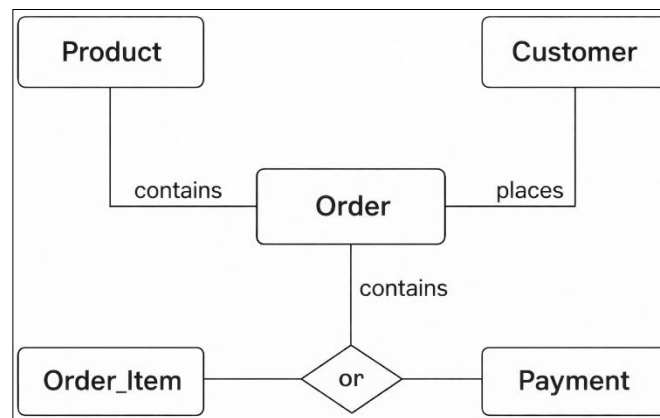


Figure 4. Entity Relationship Diagram (ERD)

Table 5. ERD describes the core database structure used by the system

Entity	Function
Product	Storing product data, such as codes, names, prices, and stock levels.
Customer	Storing data on customers who make transactions.
Order	Stores order transaction data, connected to the Customer.
Order_Item	Store the details of each item purchased in a single order (because one order can contain multiple items).
Payment	Storing payment data for an order (proof of payment, payment method, status).

The operational interface logic is captured in the modular dashboard workflow shown in Figure 5, which aligns with the study’s emphasis on usability and role-based task separation. The dashboard perspective is analytically relevant because it operationalizes how the architecture is experienced by users, and therefore how efficiency gains are produced through reduced navigation friction, clearer responsibilities, and easier extensibility when new modules are added.

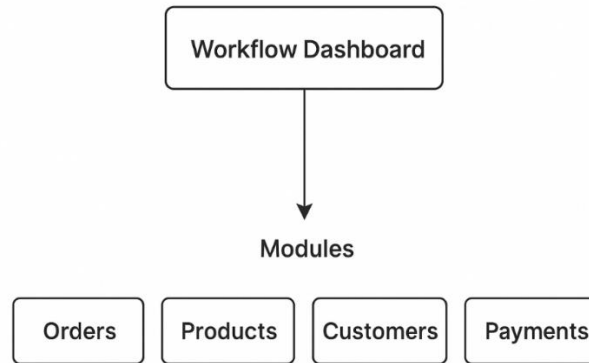


Figure 5. Workflow dashboard and Modules diagram

**Main Storyline:** User logs in to the Workflow Dashboard, the user selects the module they want to access: Orders Module → create, view, track orders. Products Module → stock input, price update, check item availability. Customers Module → managing customer data and purchase history. Payments Module → upload proof of payment, check payment status, and generate reports. **Advantages of Modular Dashboard Design:** Separating functions according to user roles. Simplifying development and maintenance. Allows the addition of new modules (e.g., HR, Supplier, Shipping) without changing the core system. Emerging integrations between cloud platforms and IoT-based infrastructures indicate potential future extensions of SME information systems toward data-intensive and automation-driven operations (Dritsas & Trigka, 2025).

## Conclusions and Suggestions

### Conclusions

This study examined the design and implementation of cloud-based information systems in SMEs by empirically testing how organizational readiness and security risk management shape operational efficiency and scalability outcomes. The findings indicate that cloud computing is best understood as an enabling platform whose performance effects depend on the organizational capacity to internalize new workflows and manage governance risks. SMEs that exhibit readiness through adequate infrastructure, leadership commitment, and digital competencies are more likely to translate cloud adoption into streamlined operations and improved decision-making quality, supporting the argument that readiness is a core condition of digital transformation success (Wang et al., 2025; Omrani et al., 2022).

The results also show that security risk management is not secondary to implementation but constitutes a decisive factor that supports sustained utilization by strengthening trust and reliability perceptions. SMEs implementing systematic controls for data protection, access governance, and compliance monitoring report higher confidence in cloud operations, which stabilizes adoption and supports performance realization, consistent with prior evidence that risk mitigation influences technology acceptance and continued use (Alahmari & Duncan, 2020). In combination, these findings support the conclusion that cloud-based systems can deliver meaningful efficiency improvements and scalability advantages by enabling automation, real-time data access, and elastic resource allocation, offering SMEs a feasible pathway to achieve performance gains without infrastructure-heavy growth models (Abidemi, 2024; Bentouhami et al., 2021). The study contributes by empirically validating an integrated framework that links technological design, organizational capability, and governance mechanisms, thereby extending cloud adoption research toward implementation-relevant evidence.

### Suggestions

Implications for practice suggest that SMEs should treat cloud adoption as an organizational change program rather than a purely technical procurement. Strengthening readiness through targeted investment in employee digital skills, the establishment of clear IT governance routines, and managerial commitment to workflow standardization is likely to increase implementation success and reduce post-deployment underutilization. At the same time, SMEs should adopt security practices as part of core system design, including access control policies, encryption and backup routines, and

continuous monitoring, because these mechanisms reduce uncertainty and support user trust, which is essential for sustained system usage and performance realization.

From a design standpoint, SMEs are advised to leverage modular architectures to capture scalability benefits progressively, enabling incremental integration of analytics, automation, or other advanced tools without forcing disruptive changes to the core system. At the policy level, the findings imply that training programs, advisory support, and financial incentives can reduce adoption barriers and strengthen SME ecosystem competitiveness by aligning capability-building with secure implementation practices. Future research would benefit from longitudinal designs that observe post-implementation trajectories over time, comparative cross-country analyses to test contextual sensitivity, and deeper exploration of how emerging technologies such as AI and IoT interact with cloud architectures to shape SME operational resilience and innovation capacity.

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