Navigating the Clouds: An Exploratory Research of Cloud Computing Adoption in Saudi Arabia's Small and Medium Enterprises

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ABSTRACT

The adoption of cloud computing has become essential for SMEs, especially in the e-commerce industry, as it has the potential to improve the efficiency of operations. However, the existing literature indicates significant gaps, including a general lack of comprehensive research focused on cloud computing adoption for SMEs and very limited research on the Kingdom of Saudi Arabia (KSA) context. This study aimed to fill these gaps by evaluating the current status of cloud computing adoption by SMEs in KSA and identifying the challenges facing its implementation in the e-commerce sector. To achieve these objectives, the Technology-Organization-Environment (TOE) framework was employed, analyzing the technological, organizational, and environmental factors that affect cloud service adoption. This study incorporates insights from government agencies, service providers, and SMEs to provide a holistic view. Through a mixed-method approach, combining qualitative and quantitative data, this study offers a detailed understanding of the cloud computing landscape in KSA, providing valuable insights for stakeholders and policymakers.

Keywords-cloud computing; e-commerce; digital transformation; customer experience; SMEs; cloud service models; Infrastructure as a Service (IaaS); Platform as a Service(PaaS); Software as a Service(SaaS)

I. INTRODUCTION

Cloud computing is an innovative technology that makes it possible for computing services such as servers, storage, databases, software, analytics, and intelligence to be provided over the Internet. This model provides the ability to dynamically obtain a configurable pool of computing resources that can be quickly provisioned and de-provisioned without much intervention. IT resources can be delivered as services through cloud computing, eliminating the need for massive investments in hardware and software. For businesses, the value of cloud computing is immense, as it helps to create new products, increase the effectiveness of a company, and offer new opportunities for business models. SMEs benefit from cloud computing, as it provides them with access to sophisticated technologies that are otherwise expensive. Cloud computing empowers SMEs by providing cost-effective, scalable, and secure IT resources, improving their operational efficiency, and enabling them to take advantage of advanced technologies to drive growth and innovation.

Cloud computing technologies are one of the key drivers of Saudi Arabia's (KSA) digital economy with a focus on the e-commerce sector. The relevance of this technology was highlighted at the recent LEAP 2024 event, where major investments in cloud computing platforms were announced. In particular, Amazon Web Services (AWS) and Datavolt announced new investments in data centers in KSA. Such strategic investments contribute to considerable growth and innovation across many industries, including the e-commerce industry, which is likely to experience improvements in operational efficiency, customer satisfaction, and overall revenue [1, 2].

This study aimed to investigate the current state of cloud computing adoption within Saudi Arabia's SME sector, especially in the e-commerce industry. However, there is a significant research gap in the context of cloud computing, with only a few studies exploring the challenges and prospects of SMEs in KSA. This study aimed to address these gaps by evaluating the current level of cloud computing deployment

and the challenges and factors that hinder its acceptance in KSA e-commerce organizations [3]. This study adopted the Technology-Organization-Environment (TOE) framework to assess the technological, organizational, and environmental factors that affect cloud adoption. The study also includes views of government organizations, service providers, and SMEs to paint the picture of cloud computing by conducting interviews and quantifying expert opinions to develop a risk matrix. In addition, a comprehensive analysis of the factors that affect the adoption of cloud services is provided. The findings are intended to be useful for various stakeholders and policymakers, to promote further development of cloud computing adoption in the KSA e-commerce market in a sustainable manner.

II. LITERATURE REVIEW

Many studies use different definitions for cloud computing. However, most of them perceive it as a service rather than a system and identify its service models as the bare driving forces of digital economies in developing countries and are the base infrastructure for global market openings. Due to its relevance to the Internet, cloud computing is seen as the next era of the Internet, where everything, from computing power to a business process or service, is available at any given time and place. On the other hand, different deployment models can meet various needs or scenarios. It is solely up to the individual to decide on public, private, or hybrid resources. Service models provide different service levels, from physical infrastructure (IaaS) and development platforms (PaaS) to application-level services (SaaS) [4, 5].

A. Benefits of Cloud Computing Adoption in E-commerce

Many studies have already discussed the benefits of cloud computing in online shopping. Furthermore, cloud computing's transformative power in digital business makes it an essential component of technological progress that can increase revenue, open a new business front, and stimulate the creation of new jobs. On top of that, the integration of cloud computing technology in e-commerce is also a remarkable demonstration of its power, showcasing its scalability, cost-effectiveness, and resource management. Moreover, different service models, ranging from IaaS and PaaS to SaaS, are also another area to consider. The penetration of cloud services into the IT world is great and has occurred quickly in the past ten years due to its massive adoption and the trend for more flexible and fully scalable IT solutions [6, 7]. Cloud computing services within the e-commerce sector are used to avoid sources of data invalidation and speed up the synchronization process between e-commerce vendors to increase efficiency and operability [6, 8, 9]. In [8], opportunities and challenges were revealed around the pervasive tendencies of cloud computing across different sectors, particularly e-commerce, and its ability to agitate and bring forth revolutionary modifications to the delivery of services by minimizing cost and enhancing performance and efficiency. This study discussed opportunities in the implementation of cloud computing in different business processes to add economic value and offer comprehensive online IT solutions.

B. Drawbacks of Cloud Computing Adoption in E-commerce

Despite these benefits, many studies identified critical security challenges and issues, including multi-tenancy and data leakage risks, which pose significant concerns for data security and network integrity in cloud-based systems. Although cloud computing is an attractive platform for innovation and efficiency, its flaws require implementing sensitive information protection measures and trust mechanisms to protect client confidentiality and their trust in the service or products provided [6, 8, 9]. Security issues are one of the major factors and implementation requires further comprehensive planning to ensure safe deployment. Notwithstanding these benefits, cloud services face some obstacles, of which security is the main one, making it difficult for an organization to move completely to the cloud [8]. Security is one of the challenges highlighted as a possible impediment to the extension and adoption of cloud computing technologies in a substantial measure. The role of information security is given special consideration in this context [5, 6, 10]. The implementation of cloud computing in e-commerce means not only its technological benefits, but also finding a method to solve security problems through good planning, risk assessment, and appropriate security solutions [11]. This ensures that the pros and cons of cloud computing are balanced, allowing it to unlock its full potential while keeping the risks of violation or data breaches at bay and protecting data privacy and security [11-15].

C. Cloud Computing Adoption in Saudi Arabia

As shown in [16], the adoption of cloud computing in KSA educational institutions is influenced by three main factors, namely relative advantage, complexity, and data concern, which accounted for 47.9%. In addition, it was shown that multilevel factors were driving the adoption of cloud computing in educational institutions. In [17], the role, advantages, and drawbacks of cloud computing were investigated among healthcare organizations in KSA. Through a qualitative approach, an in-depth analysis was performed on the decision-making process of healthcare organizations in KSA with respect to cloud computing adoption. The findings classified the factors influencing this process into five main groups: technology, marketing, environment, organization, and people.

Various factors affect the popularity of cloud computing in KSA, where adoption rates are just emerging. This work outlines an integrative model based on the TOE concept, the Diffusion of Innovations (DOI) theory, and institutional theory, as well as adding other essential elements such as trust, privacy, and physical location. The model classifies factors into technological (availability, reliability, and security of networks, etc.), organizational (support of top management, organization size, technology readiness, etc.), and environmental (compliance to regulations, competitors' pressure, trading partners' pressure, the physical location of the company, etc.) factors [18-20]. These factors stress the benefits of cloud computing and the prior theories on the process of technology adoption. This study reflects on the findings of previous studies on factors of cloud adoption and calls for a holistic approach to cover security and organizational readiness issues. Practically,

this study employed an interview approach with IT experts from different sectors in KSA to thoroughly review the model and discover additional aspects.

D. TOE Framework

The TOE framework is one of the most common tools that analyze the logistic components of technology in organizations [21, 22]. The following are factors within each category that might prevent the adoption of cloud computing in e-commerce within this framework.

- Technological factors are composed of features that include, but are not limited to, the complexity of systems, the ability to interface with established platforms, security fixtures, stability, and responsiveness in terms of performance. Technological factors examine the technical limitations and constraints when adapting an organization's infrastructure [22, 23].
- Organizational factors affect the internal composition, the outline structure, and the culture of the organization. They consider aspects such as management, human and social resources, learning needs, embedded culture in the organization, resistance to change, availability of resources in terms of both personnel and finances, and strategic alignment. These factors are reflected in the way technology is implemented and put to work in an organization [23-25].
- Environmental factors: These factors encompass industry regulations, market conditions, competitive pressure, technological trends, legal and regulatory frameworks, and the socio-political context. Environmental factors impose odds and limitations on the organization to take advantage of technology [25, 26].

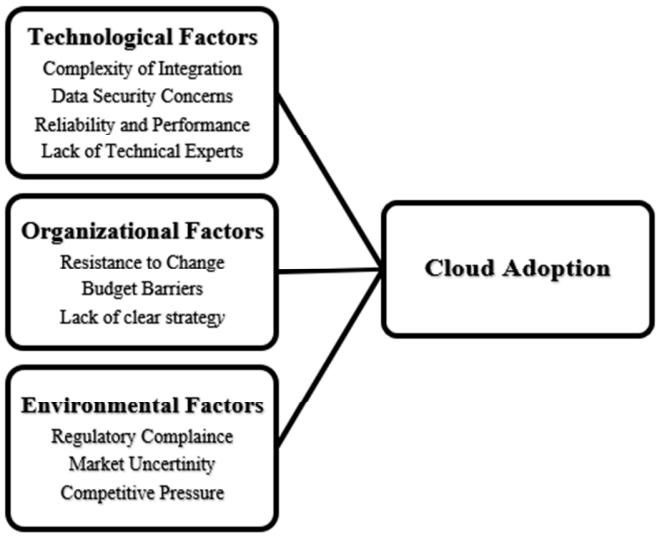

Fig. 1. TOE framework of SME adoption of cloud computing.

III. METHOD

A. Research Design

This study adopted an inquiry approach to investigate the use of cloud computing within the KSA e-commerce sector. The purpose is to analyze the impacting factors of the adoption process and investigate their potential ranges. A qualitative approach was chosen to explore the nuances of cloud adoption and find concrete examples of cloud implementation in the real world. A qualitatively oriented design was used, where the primary discussions focused on interviews with key players to understand their experiences, impressions, and decision-making processes during the use of cloud computing. The interview framework was structured to explore the aspects of cloud adoption, such as organization readiness, the pros and cons perceived, the processes used for decision-making, and the implementation tactics. Then, expert opinions were quantified to develop a risk matrix to understand different perspectives and challenges and their severity in the adoption process.

B. Data Collection and Method

The main instrument of the qualitative research was semi-structured interviews, as they provide a balance between exploring participants' perspectives and the need for a single data collection method. Managerial personnel from e-commerce IT and business, cloud providers, government officials, and decision-makers were interviewed, as shown in Table I. Through interview transcription, the collected data were coded and thematically analyzed to obtain emerging patterns, themes, and viewpoints concerning cloud adoption in the KSA e-commerce context. The objectives to be achieved by interviewing experts were the following.

- Assess the current status of cloud computing adoption in KSA: Collect information from officials, service providers, and SME owners to understand the current rate of cloud adoption in e-commerce activities in KSA. Factors such as the level of cloud computing infrastructure usage, typical cloud service models, and the primary push factors toward the adoption of cloud technologies were considered.
- Review the impediments and barriers to the acceptance of cloud computing in e-commerce in KSA. Research roadblocks and barriers by getting experts' opinions on problems such as security issues, regulatory compliance, data privacy, cultural resistance, and technological limitations on implementing cloud technologies. These factors can affect the full integration of cloud solutions within the industrial sector.

C. Sampling

The sampling strategy aimed to represent selected dimensions that affect cloud computing in KSA as follows: Government regulations, SME owners, and cloud service providers. The experts invited to participate were from professional networks and recommendations from industry experts. Data collection was iterative, with subsequent interviews to explore themes and variations within the data, trying to ensure the understanding of cloud technology adoption dynamics in the e-commerce sector in KSA.

TABLE I. EXPERTS PARTICIPATING IN THE STUDY

No.	Category	Position
Expert1	Gov. regulatory	Cloud computing partnerships' team leader
Expert2	Gov. regulatory	Software engineer
Expert3	Gov. regulatory	Cloud application delivery professional
Expert4	Service provider	Programmer
Expert5	Service provider	Cloud computing expert
Expert6	Service provider	Cloud computing engineer
Expert7	Service provider	Cloud computing expert
Expert8	Business owner	SME owner
Expert9	Business owner	SME owner
Expert10	Business owner	SME owner

IV. RESULTS AND DISCUSSION

A. Governmental Perspective on the Future of Cloud Computing

1) Market Projections and Sector Adoption

According to Expert 1, SMEs rank fifth in the sectors that are expected to be the top users of cloud services in 2023, adding that the global cloud market is expected to reach $17 billion by the end of 2024. According to Expert 1's projection, by 2027, the Saudi cloud market will have moved from $170 million in 2021 to $454 million. In line with this, the government is targeting 80% of commerce to be performed over the Internet by 2027. Most probably, this will trigger an inclination toward cloud services by SMEs for cost-effectiveness versus large companies. Expert 2 emphasized that cloud adoption among SMEs follows very closely the global trends toward digital transformations, more so in the retail space [27]. However, the promise of the country's cloud market is still in its formative days compared to a global outlook, and its potential has to be delivered by the country developing capabilities that will assist the industry achieve international standards (Experts 2 and 3).

2) Challenges in Cloud Adoption

Another point mentioned was that SMEs not only have financial difficulties but lack technical know-how and have issues regarding regulatory compliance, especially regarding the data localization that financial tech SMEs need to have by 2026. Furthermore, large companies are always given priority in terms of service delivery by service providers, which disadvantages SMEs. The current regulation, while it may be supportive of SMEs, is far from being stringent compared to those imposed on big companies. For example, the Personal Data Protection Law (PDPL) complicates the possibility of integration with such rigorous localization requirements that it imposes on KSA [28].

The concept is that organizational resistance and cloud solution technologies, which are to a great extent unfamiliar to conventional business staff, can slow the pace of organizational change. According to Expert 2, the strong factors determining or, in other words, influencing cloud architecture and choice of the solution are concerns about data security, strong compliance, and regulatory complexity of integration. The other major challenge is the lack of local technical expertise. Therefore, expensive outsourcing of human resources is required to implement cloud solutions. Cloud technologies call for a commensurate upgrade of local infrastructure (Experts 2 and 3).

3) Comparison of Local and Global Providers

Expert 1 was of the view and concern that local service providers are oriented toward large enterprises and their prices are high. In addition, local companies usually only provide dedicated account management and operational support to SMEs. On the other hand, the services are self-manageable, with often very nice incentives and promotions accompanying them from the global providers. Experts 3 and 1 pointed out that in terms of the quality of services offered and the level of competition with worldwide service providers, the locals were quite low.

B. Service Providers' Perspective on the Future of Cloud Computing

1) Market Projections and Sector Adoption

Cloud service providers are seeing many applications across different industries, whether in the regions spearheading digital transformation or not. The sentiment is indeed bullish because the results of the digital strategy that is articulated in projects such as Vision 2030 are expected to cause robust growth (Experts 4 and 5). Significant business sectors, such as finance, healthcare, and government, tend to adopt public cloud services to meet their enterprises' IT demands of scalability and security (Expert 6). As providers are now also confident that they can easily jump on board the novel cloud services that are designed to suit the exclusive needs of these industries, they can manage to smooth their transition to the cloud and elevate their operation efficiency (Experts 5 and 6). Clearly, the move to hybrid and multi-cloud environments shows the companies' willingness to shape a robust and universally effective cloud strategy leading to flexibility and balanced risk management.

2) Challenges in Cloud Adoption

The prognosis for accelerating market growth and sector participation is upbeat for service providers. However, they are also aware of the challenges that could delay the rate of cloud adoption (Expert 7). The main challenges are related to data security and privacy, which are at the top of the list, especially in areas such as healthcare and home banking. Regulatory compliance requires additional effort for companies because they should be able to navigate the complex environment of laws on data use monitoring and protection among countries (Experts 4, 5, and 7). Furthermore, besides the few problems that come with migrating to the cloud, there are more logistical and technical problems that cannot be overcome. These, in turn, consist of compatibility problems with other IT and the need to address IT infrastructure issues by allocating a large amount of money from the very start and having experienced and knowledgeable staff to manage and optimize cloud resources [29]. Service providers describe the single goal of the challenges, improving the educational and training programs, ambiguous types and easier-to-migrate cloud solutions, and supporting regulatory frameworks (Experts 4 and 6).

3) Comparison of Local and Global Providers

When comparing cloud service providers, it can be observed that various characteristics appear. Achieving mass cloud adoption today comes largely from global vendors, which provide investors with much more extensive and sophisticated cloud solutions with high standards of reliability and security, backed by a substantial level of research and development and a global network of data centers (Experts 5 and 7). However, local organizations can provide their services to the local market and be more flexible in dealing with market needs or special reproductions and cultures (Experts 4 and 5). Similarly, local providers can respond quickly to regulatory changes and satisfy the growing needs of customers by offering them reliable and prompt customer service [30]. Local data centers would result in reduced data latencies and improved service speeds to support real-time applications in e-commerce and other verticals. However, healthcare services may be of a lower type and higher cost due to the limited scale and capacity of local providers in providing such services compared to their global counterparts (Experts 6 and 7).

C. SME's Perspective on the Future of Cloud Computing

1) Market Projections and Sector Adoption

Today, the growth of cloud computing is the basis for e-commerce businesses across the world, as in KSA. The advent of cloud technology is the main driver for e-commerce businesses to adopt it (Experts 8 and 9). This is the case, especially in the fintech sector in KSA. The leading forces for cloud computing are its cost-effectiveness, scalability, and flexibility of the resource pool, which serve cloud-based startups to cut capital spending on data centers and maintenance as well as raise staff efficiency (Expert 10). In addition, local cloud computing providers in KSA are increasing their number, which is now 31 providers, showing that there is a real boom in this area. Apart from the supportive government measures such as the "Regulatory Framework for Cloud Computing" that helps create a conducive regulatory environment, organizations are heavily adopting cloud platforms.

2) Challenges in Cloud Adoption

Although KSA e-commerce companies have a digitally growing ecosystem, cloud adoption faces several implementation challenges. One of the key challenges comes from the infrastructure scarcity in this market, as local competent cloud providers are outnumbered by those lacking professional skills and reputation (Experts 9 and 10). As a result, there is a need for more qualified workers. Furthermore, compliance imposes a challenge to the fact that data containing Personally Identifiable Information (PII) must be stored at the local level in secure data centers (Experts 8 and 10). These guidelines, which are safety-oriented at the same time, make the adoption of the cloud a more complicated procedure. First, many businesses lack the necessary skills to differentiate their specific cloud needs and select appropriate cloud service providers. In addition to data safety and regulations, the level of technical knowledge to operate in the cloud also imposes great obstacles.

3) Comparison of Local and Global Providers

Local providers, compared to global cloud service providers, offer significant advantages that support the adoption of cloud computing. These include free tiers, major discounts to rank higher in the early years, proactive initiatives, and a strong business relationship network. This encouragement fosters an environment in which cloud adoption is more welcomed by local businesses (Experts 9 and 10). However, the main problem is the limited capacity of local providers, given the large number of underserved areas and the scarcity of reliable providers. In contrast, international suppliers can offer more sophisticated services and maintain reliable provisioning (Expert 8). However, they may struggle to meet local or national legal standards related to personal data security and storage. Ultimately, businesses can choose either local or global providers based on the need to balance compliance with advanced features and reliability [31].

D. Risk Assessment Matrix

The analysis of the risk assessment matrix focuses on three primary dimensions: Technological, Organizational, and Environmental. Every characteristic edges all the other interconnected components that affect the risk exposure of the entire system. Data are classified into three risk levels: Low, Medium, and High (see Table II and Figure 2).

- High risk indicates a high impact on adoption decisions, which can lead to significant disruptions or failures if not managed properly.
- Medium risk indicates a moderate impact on adoption decisions, with manageable disruptions that may require adjustments but not necessarily severe measures.
- Low risk indicates minimal impact on adoption decisions, with little or no disruption expected, allowing standard operations to proceed without significant changes.

1) Technological Dimension

The complexity of integration is a moderate risk according to eight experts and a significant risk according to two others. Despite the challenges involved in management strategies and resource allocation, this issue can be addressed. However, it is important to consider that certain integration aspects can pose serious obstacles, requiring additional resources or customized solutions, such as software compatibility issues, data migration difficulties, and the need to transform existing workflows. Such integration often requires substantial time, resources, and expertise to avoid disrupting overall productivity [23, 26, 32, 33]. Balancing the introduction of new technologies with maintaining established production standards requires careful planning and step-by-step implementation to minimize unexpected complications.

High-risk issues were prevalent, with nine cases identified, compared to only one medium-risk case for the data security aspect. This high-risk ranking signifies a critical alert in the risk management process, indicating the potential for significant problems if not addressed promptly. The emphasis on data security underscores the need for robust measures to ensure data protection, compliance with data protection laws, and

continuous monitoring to maintain a trustworthy system. Data security is a critical concern, especially with the increasing use of cloud technology in sectors such as e-commerce, where customer confidential information is at risk. Protecting data involves advanced encryption techniques, strict access controls, and robust security protocols to defend against unauthorized access, data breaches, and data loss during transmission and storage [26, 34, 35]. Reliability and performance issues fall mostly into the medium safety class or importance, with seven cases belonging to this category and three qualified to be high risk. The reliability and performance obstacles are significant. The sheer number of critical situations in the databases reveals other workable areas, where custom-made solutions and performance improvement techniques could be enforced to prevent further crashes and maintain the high availability of the system. Reliability and performance are key factors for cloud services, particularly in tech-focused e-commerce companies, where customer experience depends on seamless online interactions. Continuous monitoring of performance metrics, including speed, response time, and scalability, is crucial to maintaining high service levels [21, 25, 36, 37]. Service providers' guarantees, such as 24/7 availability and adherence to Service Level Agreements (SLAs), play a vital role in ensuring business continuity. The lack of technical specialists shows a variegated distribution of risks, where two cases were rated low risk, six cases medium risk, and two cases high risk. Hence, it can be said that technical competence is one of the most common problems in most cases. However, some manageable key issues remain with enough expertise on others, which at the same time may pose problems from medium to high levels of risk, implying strategic hiring, modular training programs, and perhaps even partnerships with specialized consultancies to reduce possible risks and ensure the needed technical assistance for system implementation. Organizations often struggle to find and retain personnel with the necessary skills in cloud computing, data security, and system administration [26, 38]. To address this, companies may invest in training programs, hire external consultants, or collaborate with managed service providers to enhance their ability to effectively adopt and use new technologies.

2) Organizational Dimension

The second perspective is the organizational dimension, where the aspect of resistance to change receives attention. Risk levels toward resistance to change are found at different ends of the spectrum, with three cases coded as low risk, four as medium risk, and three as high risk. Employee resistance to changes can be due to uncertainties, job security concerns, and a lack of involvement in decision-making, as highlighted by Lewin's change management model [26, 31, 39]. Overcoming this resistance requires effective change management practices, clear communication, stakeholder participation, and leadership support to foster a culture of openness and innovation. Budget barriers also hinder cloud adoption. Tight budgets often prevent necessary investments in infrastructure upgrades, software licenses, training, and maintenance, as organizations struggle with competing priorities and concerns about Return On Investment (ROI) [22, 23, 25]. Addressing these budget constraints requires careful financial planning, cost-benefit analysis, and exploring alternative funding sources such as grants and partnerships [40]. Lastly, a lack of a clear strategy can derail cloud implementation, as it was ranked moderate to high risk and can have a significant impact on the success of cloud adoption. Without a well-defined technology roadmap, organizations can experience misalignment between technology investments and business goals, inefficient resource utilization, and difficulty in success [36, 41, 42]. Strategic planning should involve evaluating existing capabilities, market dynamics, and future trends to create actionable plans, as suggested by Mintzberg's strategic management model [43].

3) Environmental Dimension

The mentioned factors alone do not necessarily reveal the components of the framework related to the environmental factor. In general, this includes any aspect outside of an organization, such as regulatory compliance, market trends, and the organization's reliance on third-party services. The experts highlighted and ranked several environmental aspects that could significantly influence adoption decisions, which require a primary focus for study. Regulatory compliance is a critical concern for e-commerce businesses using cloud computing, as they must adhere to strict privacy and data protection regulations, such as GDPR in Europe and CCPA in California. Experts ranked it as a significant indicator of cloud success. Failure to comply with regulations can lead to legal repercussions and loss of client trust, making it essential for businesses to align their cloud strategies with regulatory requirements to avoid penalties and risks [36, 44, 45]. Market uncertainty impacts cloud adoption in e-commerce. Experts ranked this element as low to moderate risk. Companies may hesitate to invest in cloud technologies during times of market volatility due to concerns about future technological advancements, consumer preferences, and competitive pressures. Flexibility, adaptability, and agility are crucial to survive in uncertain market conditions [25, 45, 46]. Competitive pressure drives the adoption of cloud technologies as businesses strive to maintain or enhance their competitive advantage. Experts believe that competitive pressure is a low to moderate risk in the cloud adoption process. Cloud technology enables companies to streamline operations, increase flexibility, and promote innovation, which are essential to remain competitive in a rapidly evolving market [47].

The analysis issues some crucial themes related to the technological, organizational, and environmental risks of system deployment. Data security appears as the ultimate battle to be fought within any SME adopter, with nine high-risk ratings, driving toward the following need for strong security systems, protective strategies, and a leading position in fighting against cyber threats. The evaluations of integration and reliability complexes reflect appropriate levels of manageable but sizable challenges, where satisfactory ratings are assigned in most cases. These areas require meticulous planning, resource allocation, and gradual introduction to ensure successful integration and maximum performance. Organizational readiness, which can be observed in resisting change, is presented through different levels of risk, indicating more and more best practices in change management. Transparent communication and employee participation are delicate issues that must be handled so that the risks associated

with the transition are reduced and the way is paved for a smooth transition. The issue of expertise is a high risk, indicating that there may be a gap in skills and knowledge involved. This is the best way to achieve success in running a program by training and hiring new staff, as well as working with partners. Additionally, budget concerns are a significant issue, particularly for SMEs. While cloud services are generally considered cost-effective, experts point out hidden costs, such as maintenance and service management, that can become overwhelming. Furthermore, a lack of strategy can lead to distractions and an unclear vision of future service needs. Similarly, regulatory compliance can create bottlenecks for SMEs, necessitating additional efforts to comply with and adhere to laws. On the other hand, market uncertainty and competitive pressure impose limited risks on SMEs, as the market is evolving and growing with more opportunities emerging, as explained by experts. Risk analysis through the risk assessment matrix provides major impacts on technological, organizational, and environmental actions that remain to be taken. Data security is an important issue. Integration complexity, performance, and organizational readiness are rather significant but not outstanding risks, as shown in Figure 2.

TABLE II. EXPERT RISK ASSESSMENT OF FACTORS INFLUENCING CLOUD ADOPTION

Experts		Technological Factors				Organizational Factors			Environmental Factors		
		Complexity of integration	**Data security concerns**	**Reliability & performance**	**Lack of technical experts**	**Resistance to change**	**Budget barriers**	**Lack of clear strategy**	**Regulatory compliance**	**Market uncertainty**	**Competitive pressure**
Government officials	Expert 1	Medium Risk	High Risk	High Risk	High Risk	Medium Risk	High Risk	Low Risk	Medium Risk	Low Risk	Low Risk
	Expert 2	Medium Risk	High Risk	Medium Risk	Low Risk	High Risk	Low Risk	High Risk	Low Risk	Medium Risk	Medium Risk
	Expert 3	Medium Risk	High Risk	Medium Risk	Medium Risk	High Risk	Medium Risk	High Risk	High Risk	Medium Risk	Low Risk
Service providers	Expert 4	Medium Risk	High Risk	Medium Risk	Medium Risk	Medium Risk	Medium Risk	High Risk	High Risk	Low Risk	Low Risk
	Expert 5	High Risk	High Risk	Medium Risk	Medium Risk	High Risk	High Risk	Medium Risk	High Risk	Low Risk	High Risk
	Expert 6	Medium Risk	High Risk	Medium Risk	Low Risk	Low Risk	High Risk	High Risk	Medium Risk	Low Risk	Medium Risk
	Expert 7	Medium Risk	High Risk	Medium Risk	Medium Risk	Medium Risk	Medium Risk	Medium Risk	Medium Risk	Low Risk	Low Risk
Business owners	Expert 8	Medium Risk	High Risk	High Risk	Medium Risk	Low Risk	Low Risk	Medium Risk	High Risk	Medium Risk	Medium Risk
	Expert 9	Medium Risk	High Risk	High Risk	Medium Risk	Low Risk	Low Risk	Medium Risk	High Risk	Medium Risk	Medium Risk
	Expert 10	High Risk	Medium Risk	Medium Risk	High Risk	Medium Risk	High Risk	High Risk	Medium Risk	Low Risk	Low Risk

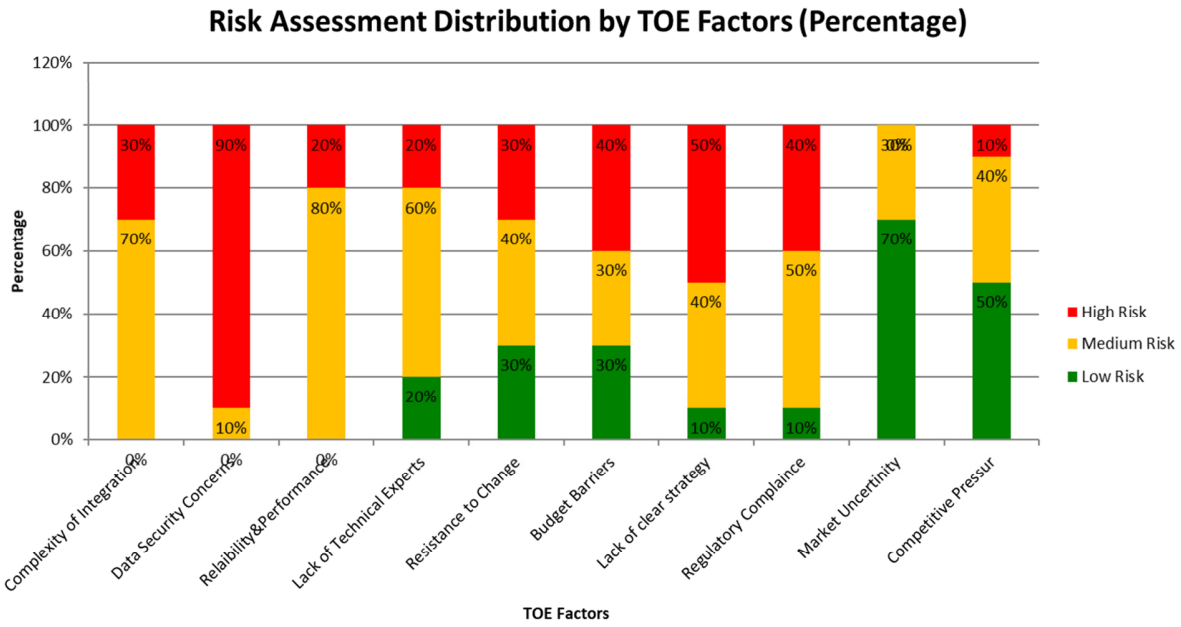

Fig. 2. Risk assessment chart based on TOE.

4) Government Officials

Among government officials, two issues, namely data security and regulatory compliance, stand out as the biggest risks. As government services are a primary target for ransom demands, security measures and permanent surveillance are required. On the other hand, government bodies must follow strict rules that could lead to huge legal and financial entanglements. It is also difficult to integrate the newest systems with the current infrastructure, as it can cause accidental compatibility breaks. The right and ranked approach to planning and implementation is very important in dealing with these difficulties, as shown in Figure 3.

5) Service Providers

Reliability and performance-minded service providers need to face a myriad of different challenges. Providing highly available, scalable, and optimized software systems is essential for modern organizations to provide high-quality services and great customer experience. This is considered to be a moderate risk factor. On the other hand, the eighth risk, requesting an updated field of staff knowledge, is considered to be the highest risk factor. Service providers should dedicate funds to regular training and, depending on the nature of the services, seek alliances with specialized companies to stay up-to-date. This poses a medium risk that must be addressed through thorough user training, support, and change management to achieve seamless changes that are adopted without resistance, as shown in Figure 4.

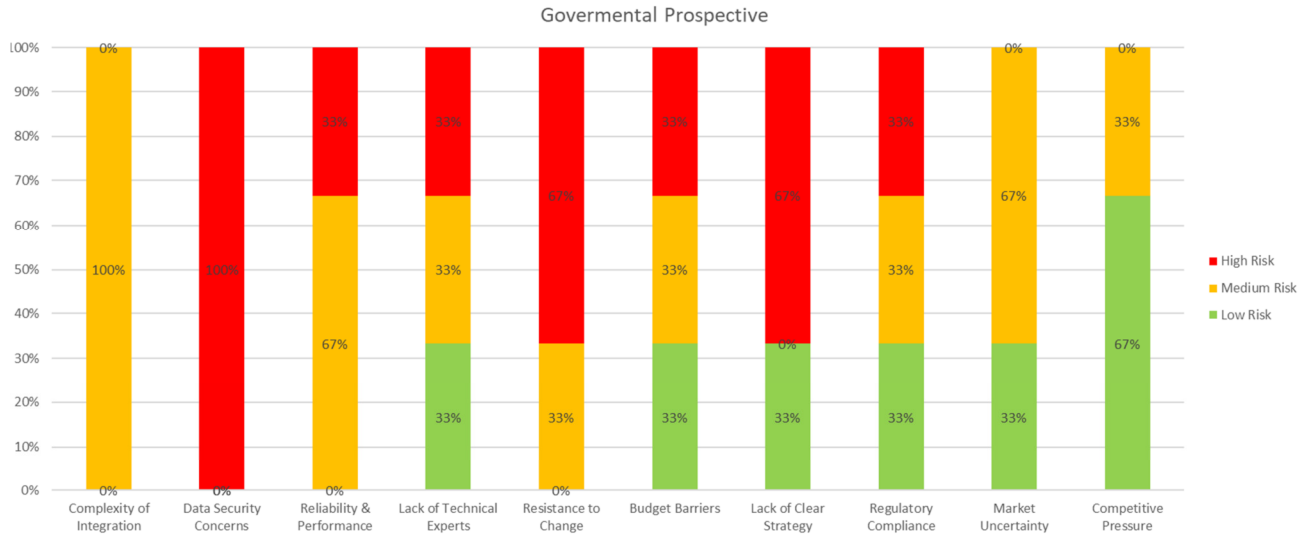

Fig. 3. Governmental perspective.

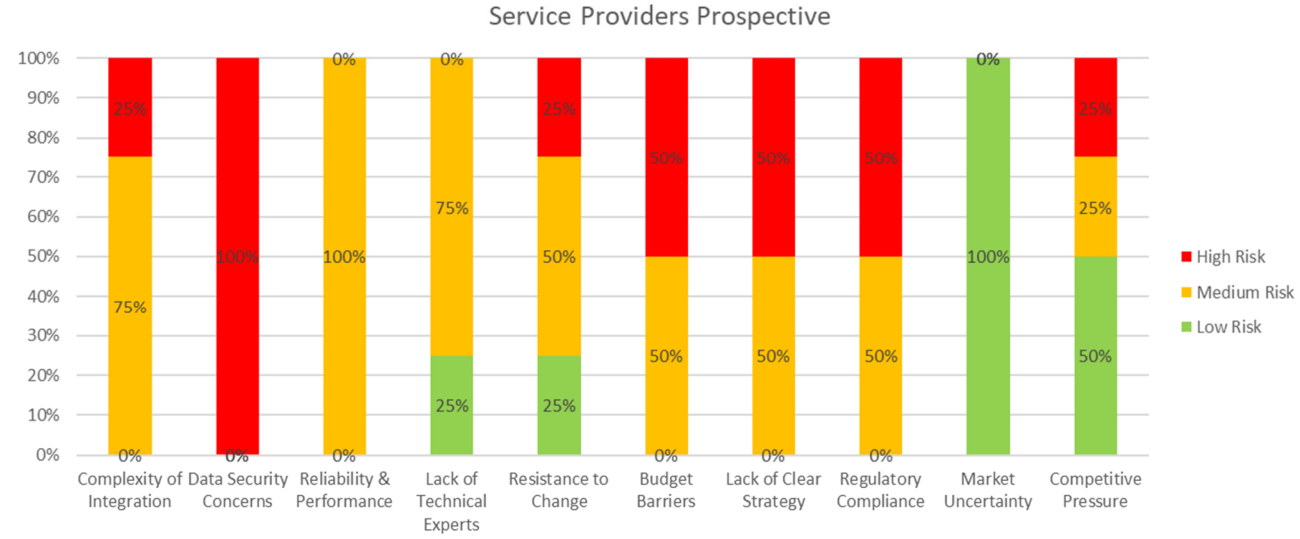

Fig. 4. Service providers' perspective.

6) SME Owners

For SMEs, fast-growing businesses and the difficulty in developing financial capabilities constitute a major threat. However, data protection and security is a great challenge. Being limited in budget, they may not be able to adopt high-end technologies or fully functional security protocols, so both financial and operational limitations act as high risks. Consequently, a situation of scarcity dictates economizing on investments and settling for costs that are as low as possible. Additionally, the data security risk due to the restricted human and financial capital for implementing and sustaining the undertaking of best security practices increases. SMEs must focus on cheap purchasing of a secure server, and additional services of professionals can prevent data security and confidentiality. Furthermore, change and transition management have a moderate risk level, of which the establishment of effective communication, training, and engagement with stakeholders to smoother adoption of improved technologies and processes is mandatory, as shown in Figure 5.

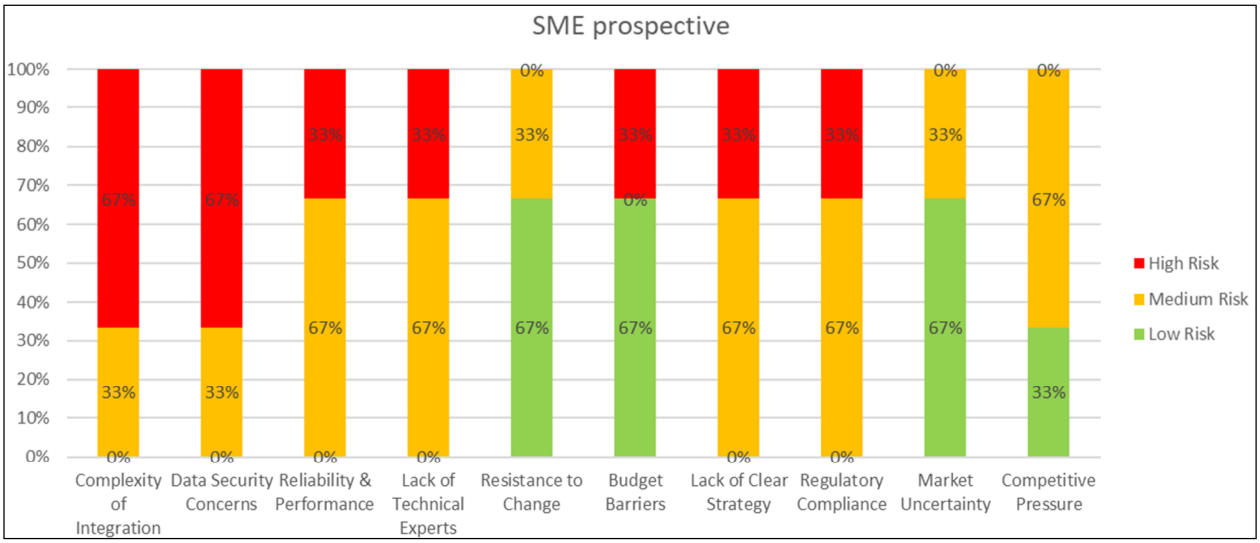

Fig. 5. SMEs' perspective.

E. Insights from Government, Service Providers, and SMEs on Cloud Computing Adoption

The governmental view focuses on cloud services as a key factor for economic growth and digitalization, anticipating considerable market growth, and stressing the need for legal compliance and data protection. Likewise, service providers expect strong growth in the coming years from sector-specific requirements in the financial, healthcare, and government sectors, but they also point out issues such as data security and regulatory compliance. Both perspectives agree that more technical skills and resources are required to achieve integration and manage the risks involved. However, SMEs are interested in the cost, the possibility of usage for more than one company, and the flexibility of cloud services, acknowledging the role of cloud computing for e-commerce and fintech. While dealing with similar issues as larger entities on data protection and compliance with regulations, SMEs have to also struggle with financial limitations and the fact that they are considered a low-priority by service providers. Although global providers provide highly advanced and reliable services, local providers can better understand local regulations and provide immediate assistance, but they are often inferior in service quality and capacity. Thus, it is crucial to focus on specific strategies and investments that can help unleash the potential of cloud computing for different stakeholders, taking into account their alignment and divergence.

V. CONCLUSIONS

This study aimed to investigate the level of adoption of cloud computing among SMEs in KSA, especially within the e-commerce industry, and to determine the overall perceptions of its potential benefits and challenges. Benefits include increased efficiency in operations, flexibility, and increased effectiveness in the delivery of services. The main hurdles identified and ranked by experts were data security, ensuring data regulatory compliance, and lack of specialized personnel, which were considered key threats to cloud adaptation. The use of a mixed-method approach ensured that the study provided a balanced and comprehensive understanding of the current and future state of cloud computing in KSA by offering both qualitative and quantitative data. This knowledge is therefore important, particularly to stakeholders who may desire to take advantage of cloud technologies.

A. Contribution

This study discusses the adoption of cloud computing in KSA, which has been much less researched. The study is timely and very significant because it addresses a research gap by focusing on the specific context of SMEs and the e-commerce industry. The findings are of great importance to policymakers, business managers, and cloud service providers to learn more about the KSA market and the peculiarities related to the use of cloud services. With this knowledge, communication tools can be employed to encourage companies

to adopt cloud services, thus accelerating the process of digitization and economic development in the country. In addition, this study presents a model that can be used to provide a theoretical basis for other fast-growing markets experiencing similar conditions to achieve growth and development.

B. Limitations

Despite the comprehensive approach, this research has some limitations. The authors had limited access to locally available professionals in the industry and the feedback that they may provide. Furthermore, the ever-growing pace of advances in the fields of cloud technologies and regulatory standards that affect the studied area made it difficult to provide or update the study findings accurately and in line with the real picture. The future should have longitudinal studies to depict the evolving stage of cloud adoption over time. In addition, future studies should focus on more stakeholders to obtain a more diversified perspective.

C. Future Research

Future research should focus specifically on the issues identified as the highest concerns, most notably the issue of security for the information shared. Further research should also be conducted on the development of competency, as well as the training incentives in the local workforce that supports cloud computing. More research is needed on the supply and the effects of government incentives in encouraging the transition to the cloud of commerce, which might also help guide policymakers and business managers.

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