

Determinants of Cloud-Based Services adoption and their impact on Collaborative Network Capability of SMEs in Pakistan: A Moderating Role of Innovative Capability

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Abstract

The purpose of this study is to identify different factors for the adoption of cloud-based service and the development of collaborative network capabilities in SMEs by using an integrated model based on the Technology, Organization, and Environment (TOE) framework and Diffusion of Innovation (DOI) theory. The proposed model further explores the impact on the development of collaborative network capabilities and the role of innovative capabilities of Small and Medium Enterprises (SMEs). The primary data was collected using a well-developed questionnaire from the owners and managers of SME sectors in Pakistan (n=400). Generalized Structural Equation Model (GSEM) analysis was conducted to test the conceptual model using Stata. The analysis reveals significant influences on the adoption of cloud-based services and collaborative network capabilities within SMEs in Pakistan. Factors such as technological readiness, top management support, and regulatory support positively drive cloud-based services adoption. Conversely, concerns regarding security and complexity may act as barriers. Furthermore, the study highlights the positive association between cloud-based services adoption and firm's collaborative network capabilities, particularly when innovative features of cloud-based services are aligned with the firm's innovative capability.

Keywords: Cloud-based services, Collaborative Network Capability, Innovative Capability, DOI Theory, TOE Framework, SMEs

1. Introduction

The market competition and continuous variation in the realm of businesses have led firms to adopt several “state-of-the-art” Information Technologies to cascade businesses (Khayr et al., 2020), such as embedded systems, social networks, virtualization technologies, cloud computing, and semantic web (Pierre & Fernandez, 2018). To undertake a business, internet-based hi-tech or cloud computing services are exercised to a significant extent to bring innovation through investment in Information Technology (Armbrust et al., 2010). In addition, persuasive and convenient technological support can be provided to customers via cloud computing facilities to tap into a vast possible demand (Buyya et al., 2009). Cloud computing refers to the digital platform that provides various supplies of products and other business services. It not only weighs the competitiveness of trade but also reduces computing rate, quickens the business operation, and timely supply of the commodity / product to the market (Abolfazl et al., 2015). Companies may make endeavors to grab the new technology that creates a nexus for new strategies and modus-operandi for the smooth running of the business and transformation of business operations too.

Cloud computing offers businesses infinite computing power, cogent storage, and mobility of business information online (Oliveira et al., 2014). The SMEs in Pakistan are deemed a significant sector that escalates the economy to attain lucrative output. SMEs have been playing a crucial role in the economy, constituting around 87 percent of all enterprises, employing 78 percent of the non-farm labor, and contributing 40 percent towards the annual GDP of the country (Akram et al., 2015). However, there are various hurdles restricting the development of SMEs in Pakistan, including financial constraints, resource limitations, lack of technical know-how, and lower rate of latest technology adoption in the production and marketing of products (Keesookpuna & Mitomob, 2011). It is a fact that, unlike large-scale firms, SMEs remain resistant to internal and external financial disturbance, making it harder for them to finance in Information Communication and Technology, dwindling their competitiveness. Nevertheless, SMEs have the benefit of flexibility and quick adoption to modify the business atmosphere, client preferences, and market (Abrahamsem et al., 2023; Ceptureanu & Ceptureanu, 2019).

There are still numerous barriers encountered by cloud computing in the field of SMEs (Hashizume et al., 2013; Khalil et al., 2014) owing to data management and computation that are necessary to figure out (Khan & Al-Yasiri, 2015). In addition, a few technical challenges may evolve with the introduction of technology that includes cloud contracts and cloud knowledge data while some challenges are non-technical, such as security and interoperability. These challenges make SMEs hesitant to implement cloud services because of data privacy, legal jurisdiction, and security laws bound to a global boundary (Tsai & Lin, 2011). SMEs have limited information to handle cloud computing and to improve employee productivity. Furthermore, most Information Technology professionals of SMEs are not fully prepared to convey knowledge to their organization about cloud services (Buyya et al., 2009). The use of cloud-based services will reduce the infrastructural cost and make it affordable for SMEs to adopt cloud computing and collaborate with the stakeholders (Van De Weerd et al., 2016). The influence of Technological, Organization, and Environmental contexts leads to a firm's adoption and implementation of innovative technologies. There are many studies based on the TOE framework to analyze the adoption of information technology in an organization (Low et al., 2011; Ramdani et al., 2009; Tornatzky & Fleischer, 1990). The TOE framework is relatable to the DOI model developed by Rogers (1962) and incorporates the context of organization and technology in analyzing the adoption of technology. In addition, the TOE framework is a unique context of an environment that is not addressed in the DOI theory (Oliveria & Martins, 2011).

To compete with other enterprises, SMEs are required to introduce innovation and creativity in their products and services. This will require to have better understanding of the current innovative technologies in the market which can only be assessed through a strong collaborative network. Cooperation with market players including consumers, suppliers, competitors, and the government is necessary for the development of innovative products and services (Najafi-Tavani et al., 2018). The novelty of combining cloud-based services adoption with collaborative network capability in the SMEs lies in the transition from mere resource efficiency to strategic co-creation and development. Cloud-based service adoption focuses on internal saving and efficiencies while its integration with the collaborative network enables SMEs to develop dynamic alliances by sharing knowledge and participate in value chain (Feiten et al., 2022; Jyoti & Efraxia, 2023). Integration also transforms cloud-based technology from a storage tool to a more dynamic platform and brings all the geographically dispersed stakeholders together. SMEs can also leverage mass collaboration in the development of their products and services (Al-Sharafi et al., 2023).

2. Theory and Literature Review

2.1. Diffusion of Innovation (DOI) Theory

DOI is a theory of how, why, and at what rate new ideas and technology spread through cultures (Rogers, 2003). It highlights the transitional cycle and phases and how these happen with the passage of time. The user perceptions of innovative technology and its diffusion in the system depends on the channels and social system of the adopters. It explains the diffusion of innovation as a function of the characteristics that influence the adoption of innovation. The key determinants in DOI theory are relative advantage “the degree to which an innovation can bring benefits to a firm”; compatibility “the degree to which an innovation is consistent with existing business values, practices and processes”; complexity “the degree to which an innovation is difficult to use”; observability “degree to which the visibility of innovation results to others”; and trialability” degree to which an innovation may be experimented”. This theory focuses on the context of innovation and ignores external factors, i.e. regulatory support and external pressure, that can also play a role in the decision of the organization to adopt new technology. Moreover, it provides a strong theoretical basis for exploring a distinctive pathway for agile businesses (Chemjor & Lagat, 2017). The perception of decision-makers can also be assessed regarding the adoption of cloud technologies by various enterprises through a conceptual model solely developed from DOI theory (Tehrani & Shirazi, 2014). The DOI theory can be combined with other models to investigate the reasons for the reluctance of business owners to adopt new technologies (Mokhtar et al., 2020).

2.2 Technology, Organization, and Environment (TOE) Framework

Tornatzky and Fleisher (1990) elaborated that the firm adopts and implements technological innovation through a process influenced by the technological context, the organizational context, and the environmental context. There are many research models that are based on the TOE framework to analyze and assess the information technology adoption in an organization (Low et al., 2011; Ramdani et al., 2009). The influence of technological, organizational, and environmental contexts leads to a firm’s adoption and implementation of innovative technologies. The technological context is related to the characteristics of technologies that are possible to be adopted in an organization such as technological readiness while the organizational context considers the presence of innovation in an organizational structure to enable the processes such as strategic behavior of top management, information communication, global scope, and the size of the organization. The environmental context focuses on external factors such as regulatory support and competitive pressure (Tornatzky & Fleisher, 1990). The TOE framework provides a very strong basis for the researcher to explore the determinants of the adoption of cloud-based technologies in the SME sector.

The TOE framework can be used to assess the influential factors, such as compatibility, security, support of top management, technology readiness, previous experience regarding information technology, and pressure of competitors, that affected the cloud computing adoption by SMEs (Rababah & Al-Nassar, 2020). The framework is also used to explore adoption in a scientific and systematic way to improve the security concerns of business owners and design a security model to reduce the risk associated with the management of data and ensure the timely transfer of data (Abdulgadr et al., 2017; Rai et al., 2015). The TOE framework is relatable to the DOI model developed by Rogers (1962) and incorporates the context of organization and technology in analyzing the adoption of technology. Moreover, the TOE framework has a unique and additional context of environment, which is not addressed in DOI (Oliveria & Martins, 2011). The combination of the DOE and TOE framework is used to provide insights into the strategies adopted by SME owners, cloud service providers, and the government.

Furthermore, it can help in the identification of factors that are beneficial for organizational capability, like relative favor, quality service, and understanding, rather than risk factors like stability, confidentiality, and versatility (Senarathna et al., 2018). This model can also be employed to investigate the effects of internal and external elements that influence the decisions of SMEs to adopt cloud technology (Sayginer & Ercan, 2020). Moreover, the model is also adapted as the theoretical basis to explore the role of reduction in cost, relative advantages, protection, regulatory support, size of the firm, support of top management, and technical readiness in developing countries (Gide & Sandu, 2015; Nuskiya, 2017). The factors involved in the adoption of cloud-based technologies can be different in developing and developed countries and vary between small and large firms. Furthermore, estimations of figures from developed countries are not comparable to developing countries due to their traditional and environmental differences (Alhammad et al., 2015; Pathan et al., 2017).

The TOE and DOI frameworks are frequently integrated to address different dimensions and allow analysis for the cloud-based services adoption (Faiz et al., 2024). The synergy provides a more holistic view of why SMEs adopt technology and address both “what” is offered by the technology and “how” SMEs will adopt it (Milhem et al., 2025). The TOE framework focuses on the broad contextual domain while DOI theory emphasizes the specific characteristics of the innovation itself (Amini & Javid, 2023; Faiz et al., 2024). DOI theory lacks the “environment” context and omits factors like competitive pressure and regulatory support that is why TOE framework is integrated to fill the theoretical gap and include the missing environment context. On the other hand, DOI theory is integrated to refine the technological pillar by conducting more granular analysis of technology adoption (Milhem et al., 2025; Faiz et al., 2024). TOE includes firm level characteristics while the DOI theory brings human behavior and individual leadership traits that facilitate the adoption of cloud-based services (Abied et al., 2022).

Cloud-based services adoption can be influenced by several factors, namely: technological factors, organizational factors, and environmental factors. This corroborates the suitability of this framework to investigate the adoption issue because with these factors, feasibility and rationality can be justified. Although technological factors might be common, there is a wide variation between the impacts of environmental and organizational factors, as shown by previous studies. This further emphasizes the requirement to elaborate on the study of the cloud-based services adoption paradigm (Chemjor & Lagat, 2017; Kumar et al., 2017; Nuskiya, 2017; Rababah & Al-Nassar, 2020).

2.3 Technology adoptions from SMEs perspective

In Pakistan, SMEs are the backbone of the economy, as they establish approximately 90 percent of all enterprises. According to new estimates, nearly 3.3 million SMEs are playing a pivotal role in the economic development of Pakistan. Moreover, it makes up 80 percent of the non-agricultural labor force. Collectively, SMEs contribute 40 percent to the annual Gross Domestic Product (GDP) and over 30 percent, which is Rs.140 billion to the exports (services are not included). Based on the classification, 53 percent of the SMEs consist of retail and wholesale commerce, industries, restaurants, and hotels while 22 percent are personal, social, and community services and only 20 percent belong to the manufacturing sector (SMEDA, 2023). The adoption level of information technology in general and cloud computing in particular by the SMEs in Pakistan is on the lower side in comparison to developed countries due to the limited budget of the organizations and the dearth of IT assets (Pathan et al., 2017). Furthermore, it is also claimed that the adoption of information technology services in Pakistan is slow and the use of these services by SMEs is sluggish, (Naeem et al., 2017). However, it is growing over time as many firm owners and executives are enthusiastically willing to implement cloud services to smooth their businesses (Pathan et al., 2017).

Cloud solutions are already being used by many large and medium-sized businesses across several industries to support their operations. Businesses have quickly embraced new technology over the past several years, and many have adopted a cloud-first strategy and transformed their operations as a result. Unfortunately, in the case of Pakistan, limited statistics are available and research about cloud adoption by SMEs is negligible. The rapid diffusion of 3G and 4G networks uplifts firms to reconsider their technological needs and implement emerging information communication and technology strategies to support and grow their businesses. Though limited enterprises have adopted cloud computing yet, many SME managers are eager to adopt cloud services to level their business (Pathan et al., 2017).

3. Hypothesis Development

A research model for cloud-based services adoption is developed based on the literature review to explore the impact of various factors of the TOE framework and DOI theory on the adoption of cloud-based services. The following hypotheses are developed for testing in this study.

3.1 Technological context.

Technology context is one of the contexts of the TOE framework and relates to the technological characteristics that can be the possible catalyst for the adoption of cloud-based services in a firm.

3.1.1 Technology readiness:

Technology readiness relates to the availability of information technology infrastructure in an organization. This includes the physical infrastructure as well as the human resources. Physical infrastructure includes network connections and an enterprise resource planning system, which can be used as a platform to build cloud computing applications. Human resources requirement includes the technical skill and knowledge of Information Technology, which can be used in the adoption and implementation of technologies (Dinh et al., 2013). In this regard, SMEs can easily adopt cloud-based services if they have a higher degree of technological readiness. For this analysis, the following hypothesis will be explored.

H1a: Technology Readiness will positively influence cloud-based services adoption in SMEs.

3.1.2 Security concern:

Security concern is the most important point when dealing with cloud computing services. The concern is greater when you have less control over the services provided by the external vendor. This includes external storage, a multi-user environment, and connectivity with multiple domains (Schneiderman, 2010). When the organization transitions to a cloud platform, the complications and security concerns can influence the adoption of cloud-based services. For this analysis, the following hypothesis will be studied.

H1b: Security concerns will positively influence cloud-based services adoption in SMEs.

3.2 Organizational Context.

Organizational context is the second context of the TOE framework and includes the factors related to the organizational structure. This includes the global scope, top management support, and cost reduction in terms of the operation of SMEs. The overall support and resources available during the adoption of innovative technology are crucial for an organization (Lippert & Govindarajulu, 2006).

3.2.1 Global scope:

Global scope related to the expansion of business beyond the borders (Zhu et al., 2004). The World Wide Web brought global outreach to potential international markets (Zhu & Kraemer, 2005). Cloud-based services integrate connections between different infrastructures installed at different locations. For this analysis, the following hypothesis will be studied.

H1c. Global scope is positively associated with cloud-based services adoption in SMEs.

3.2.2 Top management support:

Top management plays a crucial role in the decision to bring innovation to an organization. A favorable and supportive environment is a catalyst in the adoption of new technologies (Low et al., 2011). The acknowledgment of top management can lead to the adoption of cloud-based services in a firm. In a small organization, the decision mostly flows from the top to the bottom. On the other hand, if they do not recognize the benefits of technological advancement in the organization, then it will be a big constraint in the adoption of cloud-based services in an organization. For this analysis, the following hypothesis will be studied.

H1d. Top management support will positively influence cloud-based services adoption in SMEs.

3.2.3 Cost reduction:

It is clearly established that the adoption of cloud-based services will reduce the cost of operation in an organization. The cost savings resulting from technological use will increase the operational efficiency, profit, reliability, and reduction in operational and production processes. (Cervone, 2010; Zhu et al., 2006). For this analysis, the following hypothesis will be studied.

H1e. Cost savings will positively influence cloud-based services adoption in SMEs.

3.3 Environmental Context.

Environmental context is a construct of external forces that may impact the adoption of technology. The environmental context includes the concept of competitive pressure and regulatory support.

3.3.1 Competitive pressure:

Competitive pressure refers to the pressure felt by competitors in the same industry. It is also considered the main reason for the diffusion of technology. The adoption of cloud-based technology will provide a clear assessment of the market, accuracy of data, and efficiency in business operations (Low et al., 2011; Misra & Mondal, 2011; Oliveira & Martins, 2011). For this analysis, the following hypothesis will be studied.

H1f. Competitive pressure will positively influence cloud-based services adoption in SMEs.

3.3.2 Regulatory support:

Regulatory support is another external factor of an environmental context that influences the adoption of cloud-based services. The support provided by the government authorities to encourage the adoption of new technologies falls under regulatory support. This includes the laws and regulations that govern the processes and protection provided to the business organizations to use these services (Naeem et al., 2017). For this analysis, the following hypothesis will be studied.

H1g. Regulatory support will positively influence cloud-based services adoption in SMEs.

3.4 Innovations characteristics.

For the adoption of cloud-based services in SMEs, three main contexts of relative advantage, complexity, and compatibility are considered from the DOI theory.

3.4.1 Relative Advantage:

Rogers (2003) defined relative advantage as “the degree to which an innovation is perceived as being better than the idea it supersedes.” Innovation is quickly adopted when the advantages are clearly described. The relative advantage of the adoption of cloud-based services is described as the accomplishment of tasks efficiently and effectively by reducing costs and increasing sales revenue (Ifinedo, 2011; Oliveira & Martins, 2011; Zhu & Kraemer, 2005). For this analysis, the following hypothesis will be studied.

H2a. Relative advantage will positively influence cloud-based services adoption in SMEs.

3.4.2 Complexity:

Rogers (2003) explains complexity as “the degree to which an innovation is perceived to be relatively difficult to understand and use”. He is of the view that if the technology that is adopted is simple and understandable, it will be easier to implement and adopt. For this analysis, the following hypothesis will be studied.

H2b. Complexity will negatively influence cloud-based services adoption in SMEs.

3.4.3 Compatibility:

Rogers (2003) explains compatibility as “the degree to which innovation fits with the potential adopter’s existing values, previous practices current needs”. Compatibility is one of the main critical determinants that influence technology adoption in an organization. If the proposed technology is not compatible with the organization’s infrastructure, then there will be a lot to be done for the adoption of new technology (Azadegan & Teich, 2010; Thiesse et al., 2011). For this analysis, the following hypothesis will be studied.

H2c. The high compatibility will positively influence cloud-based services adoption in SMEs.

3.5 Innovative Characteristics and Collaborative Network Capability.

There is no prior literature available to investigate the relationship between innovative characteristics of DOI theory with the collaborative network capability of an organization. In this research, I will be testing this relationship with the following hypothesis.

H3a: Relative advantage will positively influence the collaborative network capability of SMEs.

H3b: Complexity will negatively influence the collaborative network capability of SMEs.

H3c: Compatibility will positively influence the collaborative network capability of SMEs.

3.6 Cloud-based Services Adoption and Collaborative Network Capability.

There is limited literature available to explore the impact of the adoption of cloud-based services on the collaborative capability of an organization. Researchers explored the adoption of cloud computing in the education system in India with research collaboration. The research was limited to online research collaboration with other researchers and not explained in the industrial context which involves the consumers, competitors, suppliers, and government entities (Bulla et al., 2016). In this research, we will be exploring it with the following hypothesis.

H4: Adoption of cloud-based services will positively influence the collaborative capability of SMEs.

3.7 Innovative Capability as a Moderator.

Innovation is a process that initiates an idea and leads to the development of new innovative products or services that will be launched in the future (Thornhill, 2006). Capability is the capacity and skills of an organization's internal human resources to achieve goals with the use of integrated resources. It may also include the managerial skill to use external opportunities to create value-added services (Saunila, 2016). Innovative capability is the ability of firms to bring major modifications and improvements in current technologies used in the operational work of the organization. These modifications and improvements will bring profits and a competitive advantage to the organization (Shuman & Twombly, 2010). Innovative capability will be used as a moderator to investigate the moderating roles of innovative capability in the relationship between innovative characteristics and collaborative network capability. The hypothesis to analyze this relationship will be as follows.

H5: Innovative capability will positively moderate the relationship between the Innovative Characteristics and Collaborative Network Capability of SMEs.

3.8 Innovative Capability and Collaborative Network Capability.

Collaborative capabilities develop innovative ideas in an organization with the help of key partners i.e., suppliers, customers, research institutions, and competitors (De Noni et al., 2018). Collaborative networks and capabilities are mainly developed through external resources (Najib et al., 2014). This collaboration also introduces new product development and performance improvement in an organization (Najafi-Tavani et al., 2018; Santoro et al., 2020). There are prior studies showing the strong impact of collaborative capability or networks on the innovative capability of an organization. Innovative capabilities can help develop cooperation with similar firms with high-quality information and innovative ideas. It can also lead to the development of the internal capabilities of the organization which can be helpful in cooperation with other partner entities (Mulyana & Wasitowati, 2021). This study investigated the impact of innovative capability on the development of collaborative network capability in SMEs. The hypothesis to explore this relationship will be as follows.

H6: Innovative capability will positively influence the collaborative network capability of SMEs.

4. Research Methodology

4.1 Research Framework

TOE framework and DOI theory were used to propose a complex framework to investigate the key factors that influence the adoption of cloud-based services in SMEs. Moreover, the model will further explore the moderating role of innovative capabilities between innovative characteristics and collaborative network capability of SMEs as well as the direct relationship between innovative capabilities and collaborative network capability of SMEs.

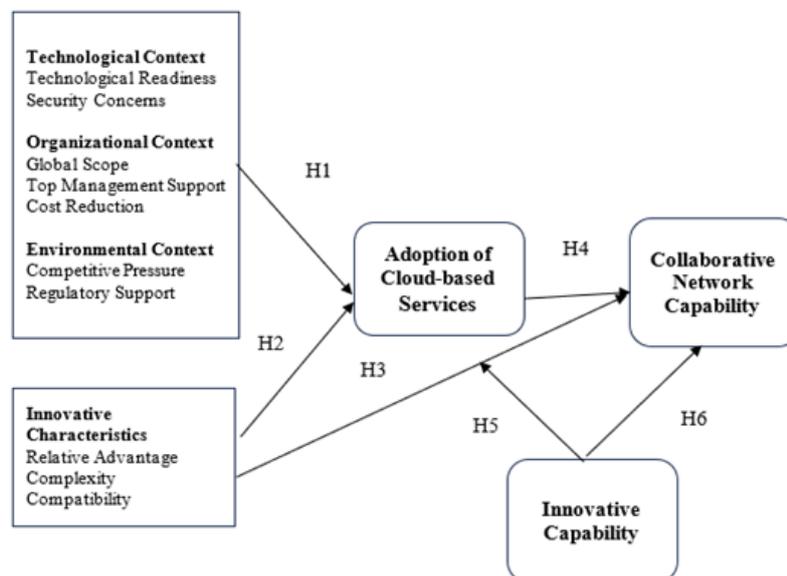


Figure 1: The Conceptual Model

4.2 Measurement Development

This study is carried out through quantitative analysis, and a well-organized questionnaire is developed based on the factors identified through the literature review to elaborate the various contexts of the research. All the factors will be measured by using the five-point Likert scale [69]. The measurement range will be from 1 to 5, 1 being as “Strongly Disagree” to 5 as “Strongly Agree”. There will be additional items in the questionnaire which will determine relevant characteristics of the SME to have a better understanding of SMEs demographics. The technological characteristics are further divided into Technological Readiness (TR) and

Security Concern (SC). The organizational context is further categorized into Global Scope (GS), Top Management Support (TM), and Cost Reduction (CR). The environmental context includes dimensions of Competitive Pressure (CP) and Regulatory Support (RS). There are three dimensions of Relative Advantage (RA), Complexity (CX), and Comparability (CO) in the context of innovative characteristics. Innovative Capability (IC) will be used as a moderator to understand the moderating roles of innovative capability in the relationship between innovative characteristics and Collaborative Network Capability (CNC).

4.3 Data Collection and Sampling

This study is conducted in Khyber Pakhtunkhwa province of Pakistan, and the unit of analysis is SMEs. There is no precise information available on how many SMEs have already adopted cloud-based services, therefore, a convenient sampling technique is used in this study for the sample selection of SMEs from different economic zones. The sample respondents are the owners, managers, or any personnel who are involved in the decision-making body on the adoption of cloud-based services in their respective SMEs. The primary data is collected from the owner or manager of the SMEs through face-to-face interviews, telephone calls, or via other online communication channels, i.e. Microsoft Teams, WhatsApp, Skype, and Facebook Messenger. The data collection presented unique contextual challenges, including infrastructure deficits such as inconsistent internet connectivity and power outages which mostly disrupted online interviews. The sample size is determined through Taro Yamane's (1967) formula at a 95% significance level, which translates into a sample size of 490 participants out of a target population. The reliability and validity tests were conducted (n=50) during the pilot study. The alpha coefficients, a measure of internal consistency, range from 0.72 to 0.83 across the different factors. These values indicate good to excellent levels of internal consistency, suggesting that the items measuring each capability dimension are highly correlated with each other. Furthermore, the H coefficients, which estimate the scalability or discrimination of items within each factor, range from 0.41 to 0.67.

5. Research Findings

The main objective of this study was to investigate the adoption of cloud-based services in SMEs in the Khyber Pakhtunkhwa province of Pakistan. The adoption of cloud-based services (CBS) and its association with the firm's collaborative network capabilities (CNC) were investigated for 400 SMEs. Table 1 and 2 provides the characteristics of respondents and SMEs, respectively.

Table 1: Respondent characteristics

Item	Measurement	Frequency	%
Age	Below 30 years	81	20.25%
	30-39 years	85	21.25%
	40-49 years	61	15.25%
	50-59 years	82	20.50%
	60 years and above	91	22.75%
Gender	Male	400	100.0%
	Female	0	00.00%
Education	Less than 10 years	16	04.00%
	10-12 years	107	26.75%
	13-14 years	83	20.75%
	15-16 years	101	25.25%
	Above 16 years	93	23.25%
Experience	Less than 5 years	52	13.00%
	5-10 years	106	26.50%
	11-15 years	102	25.50%
	Above 15 years	140	35.00%

There were 600 questionnaires distributed among the owners/ managers of the SMEs, and 443 responses were received, showing a response rate of 74 percent. After the screening exercise, 400 questionnaires were identified as usable and included in the data analysis. The comprehensive overview of the demographic, educational, and experiential profiles of managers within SMEs offer important details on the leadership composition and their preparedness to embrace technological advancements such as cloud-based services. The distribution of managers across various age groups reveals a diverse representation, with significant proportions in each category. Notably, managers aged 60 years and above constitute the largest segment, accounting for 22.75% of the total sample, followed closely by those aged between 30-39 years and 50-59 years, each representing approximately 20-21% of the sample. This distribution highlights the presence of both experienced and younger professionals in managerial positions within SMEs. However, gender diversity among SME managers is notably lacking, with all 400 managers being male, indicating a prevailing gender disparity in leadership roles. This underscores the importance of initiatives aimed at promoting gender inclusivity and equality in the workplace. Educational attainment among managers varies, with a significant proportion having completed 10-16 years of schooling. Managers with 10-12 years of schooling form the largest segment, constituting 26.75% of the sample, followed closely by those with 15-16 years of schooling at 25.25%.

Table 2: Characteristics of the SMEs

Item	Measurement	Frequency	%
Working Period	Less than 5 years	80	20.00%
	5-10 years	82	20.50%
	10-15 years	60	15.00%
	15-20 years	82	20.50%
	Above 20 years	96	24.00%
Industry Type	Agro-based	72	18.00%
	Business	82	20.50%
	Food	88	22.00%
	Manufacturing	72	18.00%
	Processing	86	21.50%
Number of Employees	1-10 workers	71	17.75%
	11-20 workers	98	24.50%
	21-30 workers	124	31.00%
	31-40 workers	93	23.25%
	40 plus workers	14	03.50%
Market Operation	City level	80	20.00%
	District level	98	24.50%
	Province level	99	24.75%
	Country Level	98	24.50%
	International	25	06.25%
CBS adopted	Not adopted	165	41.25%
	Adopted 1 service	89	22.25%
	Adopted 2 services	47	11.75%
	Adopted over 2 services	70	17.50%
	Will adopt in future	29	07.25%

6. Hypothesis Testing

A generalized structural equation model (GSEM) analysis was conducted with an ordered logistic link function for the adoption of cloud-based services "CBS" and a Gaussian link function for the firm's collaborative network capability "CNC" (Barus & Roodman, 2014). The GSEM estimated results for the adoption of cloud-based services are given in Table 9. Most of the factors carry positive significant coefficients. Technological Readiness (TR) shows a positive coefficient of 0.758, Global Scope (GS) has a positive coefficient of 0.397, Top

Management Support (TM) with positive coefficient of 0.372, Cost Reduction (CR) with a positive coefficient of 0.442, Competitive Pressure (CP) with a positive association 0.252, Regulatory Support (RS) with substantial positive coefficient 0.519, Relative Advantage (RA) with a positive coefficient of 0.275. The negatively associated latent factors included Security Concerns (SC) with a negative coefficient of -0.442 and Complexity (CX) with a negative coefficient of -0.234 suggests that SMEs perceiving cloud adoption as complex are less inclined to adopt these services. The estimated coefficient for Compatibility (CO) is statistically insignificant at 0.044.

The GSEM estimated results for collaborative network capability are also presented in Table 9. The factors examined include the adoption of cloud-based services (CBS), firm's innovative capability (IC), and the interaction factor between innovative characteristics of DOI theory and SME's collaborative network capability (CNC). All factors demonstrate positive and statistically significant associations with the firm's collaborative network capability (CNC). Adoption of Cloud-based Services (CBS) shows a positive and highly significant coefficient (0.238) while the Firm's Innovative Capability (IC) shows a significance of (0.316) with the firm's collaborative network capability. Lastly, the innovative characteristics of DOI theory showed a mixed results as determinants of collaborative network capability.

Relative Advantage (RA) is showing a significant (0.249) direct interaction with CNC while Complexity (CX) is showing a low-level significance (0.063) and Compatibility (CO) is negatively related to collaborative network capability with coefficient value of -0.204. The moderating effect of innovative capability on the relationship between the innovative characteristics of DOI theory with the collaborative network capabilities of SMEs showed unique results with coefficient values of 0.061, -0.077 and 0.038 for Compatibility (CO), Relative Advantage (RA) and Complexity (CX) respectively. The details of other parameters are provided in the table below followed by a figure to summarize the regression results of hypothesis

Table 3: Hypothesis test results

Hypothesis	Relationship	Co-efficient	Std. error	z	P	Decision
H1a	TR > CBS	0.758	0.156	4.860	0.000	Sig.
H1b	SC > CBS	-0.442	0.123	-3.580	0.000	Sig.
H1c	GS > CBS	0.397	0.116	3.430	0.001	Sig.
H1d	TM > CBS	0.372	0.132	2.820	0.005	Sig.
H1e	CR > CBS	0.442	0.132	3.360	0.001	Sig.
H1f	CP > CBS	0.252	0.107	2.350	0.019	Sig.
H1g	RS > CBS	0.519	0.107	4.840	0.000	Sig.
H2a	RA > CBS	0.275	0.115	2.400	0.016	Sig.
H2b	CX > CBS	-0.234	0.115	-2.040	0.041	Sig.
H2c	CO > CBS	0.044	0.120	0.360	0.717	Not Sig.
H3a	RA > CNC	0.249	0.118	2.100	0.036	Sig.
H3b	CX > CNC	0.063	0.041	1.560	0.119	Not Sig.
H3c	CO > CNC	-0.204	0.105	-1.950	0.051	Not Sig.
H4	CBS > CNC	0.238	0.026	9.100	0.000	Sig.
H5a	IC - RA > CNC	-0.077	0.035	-2.190	0.028	Sig.
H5b	IC - CX > CNC	0.038	0.062	0.620	0.533	Not Sig.
H5c	IC - CO > CNC	0.061	0.034	1.820	0.069	Not Sig.
H6	IC > CNC	0.316	0.118	2.100	0.036	Sig.

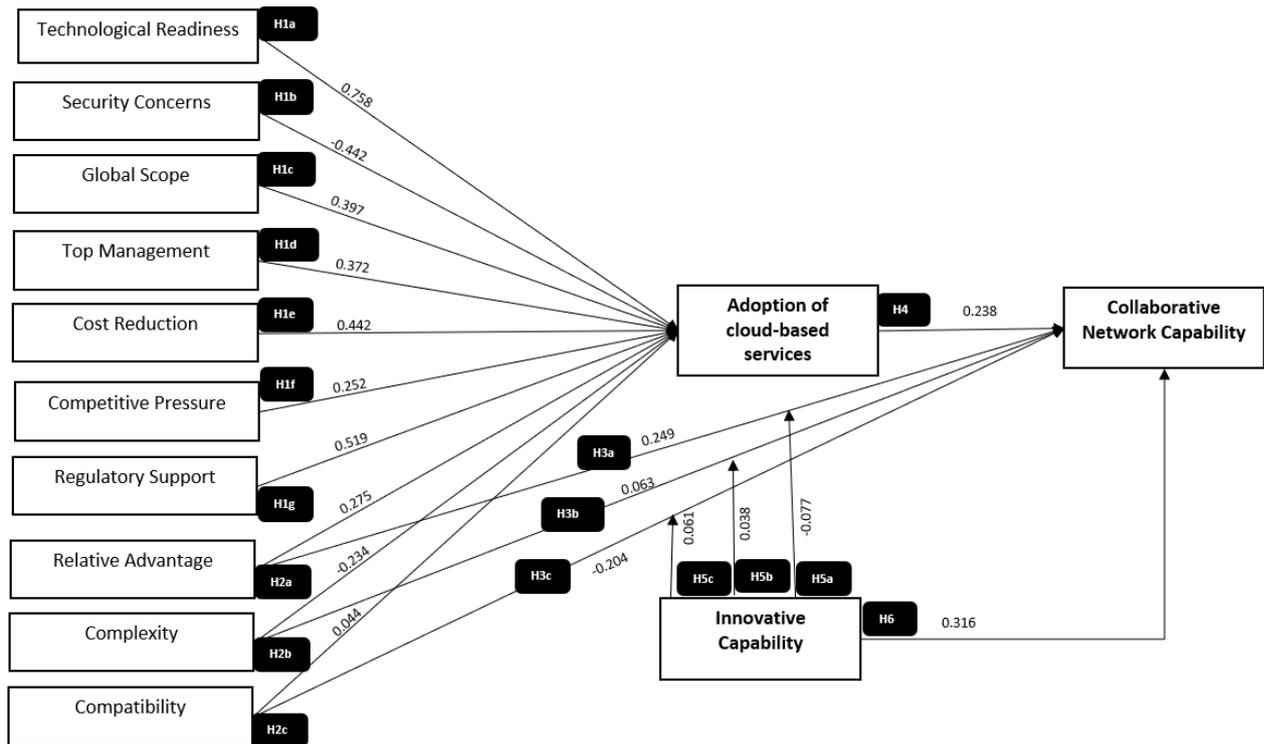


Figure 2: Summary of Hypothesis results

In summary, the analysis reveals significant influences on the adoption of cloud-based services and collaborative network capabilities within SMEs in the Khyber Pakhtunkhwa province of Pakistan. Factors such as technological readiness, top management support, and regulatory support positively drive cloud-based services adoption. Conversely, concerns regarding security and complexity may act as barriers. Furthermore, the study highlights the positive association between cloud-based services adoption and a firm's collaborative network capabilities, particularly when innovative features of cloud-based services align with the firm's innovative capability. These findings offer valuable understanding for policymakers, practitioners, and service providers aiming to promote cloud-based service adoption and collaborative networking practices among SMEs in the region.

7. Discussion and Contributions

7.1 Discussion

The main areas of the study is to examine the influence of key determinants of TOE framework and DOI theory on the adoption of cloud-based services in SMEs; examine the impact of the adoption of cloud-based services in the development of collaborative network capability of SMEs; examine the moderating role of innovative capability of SMEs on the development of collaborative network capability; and provide policy recommendation for government institutions to encourage the adoption of cloud-based services in SMEs. Technological Readiness (TR) has a positive influence on the adoption of cloud-based services, which means that SMEs perceive themselves as being more technologically ready, and the likelihood of adopting cloud-based services has increased significantly. This implies that having the necessary infrastructure and expertise in place enhances the propensity for cloud-based services adoption. These findings are aligned with the research of Yoo & Kim, 2019 is aligned with the study SMEs with robust technological capabilities may find it easier to integrate cloud-based services into their existing systems and processes, driving adoption forward.

Recent studies expand this by arguing that TR acts as a fundamental digital scaffold (Kaldaras et al., 2024) and increasingly depends on the technical agility of employees (Hanelt et al., 2021). Similarly, SMEs with better Global Scope (GS) are more inclined to adopt cloud-based services. This could be attributed to the perceived benefits of accessing data and services from anywhere, which aligns with the globalized nature of business operations. This is proved with another study by Milhem et al. (2024) that cloud platform serves as a vital tool for SMEs aiming to global market expansion through inclusive practices and expands talent pools across geographical boundaries. Enhanced global access enables SMEs to leverage cloud solutions for collaboration, data sharing, market expansion, thereby driving adoption of innovative cloud-based technologies. The global scope also provides a clear perspective of inputs and outputs required and ensures global outreach to potential international market (Al-Isma'ili, 2017).

Moreover, Top Management Support (TM) underscores the importance of top management support in driving cloud-based services adoption within SMEs, which supports the prior studies (Kaldaras et al., 2024; Milhem et al., 2024). The ability of top management to deploy strategic resources can navigate through market turbulence and maintain a competitive edge through cloud-based technologies (Hanelt et al., 2021). The role of top management has evolved from providing passive support to driving proactive cloud technologies initiatives ensuring deep integration in operational processes (Sadeeq et al., 2021). The strong leadership in SMEs is also another important factor for the implementation of cloud-based initiatives (Al-Isma'ili, 2017). SMEs perceiving cloud-based services adoption as a means of Cost Reduction (CR) are more likely to adopt cloud-based services. Cost reduction is a significant motivation for many organizations compared to traditional IT infrastructure (Al-Isma'ili, 2017). There is an alignment shift from capital to operational expenditure to cover the cost of technologies (Kaldaras et al., 2024). The high scalability ensures that SMEs only pay for the resources they consume and avoid physical server cost (Hanelt et al., 2021).

SMEs are influenced by Competitive Pressure (CP) in their decision to adopt cloud services, possibly to keep pace with industry rivals or to gain competitive advantages. Cloud-based technology is a requirement for market survival rather than secondary advantage (Kaldaras et al., 2024). Research indicates that SMEs use cloud technologies to achieve data accuracy and operational efficiency (Hanelt et al., 2021). SMEs perceive cloud-based services adoption as necessary to enhance efficiency, innovation, and responsiveness in the face of market dynamics and competitive threats. SMEs are aware of the technological adoption by the competitor in the industry and understand the competitive advantage with its usage (Al-Isma'ili, 2017). SMEs perceive Regulatory Support (RS) as a significant factor in their decision to adopt cloud-based services. Regulatory frameworks that encourage or mandate cloud adoption may drive SMEs to embrace these services to ensure compliance and security. Clear guidelines and standards promote trust and confidence in cloud solutions, addressing concerns related to data protection, privacy, and legal compliance. Incentives and facilitation from the government can boost the adoption of cloud-based services.

An adequate regulatory framework and protection of user's data of SMEs will promote the service adoption (Njenga et al., 2019). Relative Advantage (RA) is also considered by respondents a preference in adopting cloud-based services compared to traditional methods. This could include perceived benefits such as improved scalability and efficiency offered by cloud solutions. It is also an efficient and effective way of reducing the cost and increasing the sales revenue (Tashkandi & Al-Jabri, 2015). Cloud-based services also improve the quality of work and reduce time to accomplish a task, which can further increase the productivity of the SMEs (Al-Isma'ili, 2017). The adoption of cloud-based services will bring new business opportunities for the organization to expand and acquire market share (Njenga et al., 2019).

The negatively associated latent factors included Security Concerns (SC) and Complexity (CX) of the cloud-based services. Security Concerns (SC) of SME owners and managers will discourage them from adopting cloud-based services. Research proves that cyber security is the primary deterrent for SMEs to adopt cloud services (Kaldaras et al., 2024). Concerns about data breaches, unauthorized access, and data loss may deter SMEs from migrating sensitive or critical information to the cloud. In the same way, Complexity (CX) of cloud-based service will result in the same response from SMEs. Complexity in implementation, integration, and management of cloud solutions could deter adoption, emphasize the importance of user-friendly interfaces and streamline processes (Gutierrez et al., 2015). The complex technologies diminish “perceive ease of use” leading to a direct reluctance in adoption (Milhem et al., 2025). Compatibility (CO) is the only factor that showed a weak association with the adoption of cloud-based services in SMEs. This suggests that while compatibility with existing systems may play a role, it might not be as influential as other factors in driving cloud-based services adoption among SMEs (Azadegan & Teich, 2010; Thiesse et al., 2011).

Recent research often ranks compatibility lower than other determinants such as complexity, cost saving and top management support (Hanelt et al., 2021). There is some emphasis on importance of technical congruence for long term integration, but many SMEs bypass the compatibility concerns in favor of scalability and rapid innovation of cloud services (Al-Sharafi et al., 2023). In cases of non-compatibility, SMEs prefer restructuring and digital transformation to meet the requirements (Holler & Westner, 2025). Consequently, the lower demand for legacy hardware may explain why compatibility no longer serves as a primary predictor of adoption (Sichoongwe, 2024). The relationship between cloud-based services and collaborative network capability is both complex and multifaceted, involving several dimensions that highlight how cloud technologies enhance organizational collaboration. First, cloud platforms provide essential tools—such as shared workspaces, video conferencing, and cloud-based document management systems—that facilitate real-time collaboration.

These tools address traditional barriers like time lags and geographic constraints, allowing teams to collaborate seamlessly regardless of location (Gutierrez et al., 2015). This capability is particularly valuable in a globalized business environment, where coordination across multiple time zones and locations is essential. The findings of this study demonstrate that the positive relationship exists between the cloud adoption and the collaborative network capabilities of the SMEs, suggesting that cloud technologies act as a critical equalizer (Khayer et al., 2020). This relationship also indicates that the cloud-based service adoption facilitates fundamental shift from traditional vertical business model toward the horizontal collaborative model. This capability is novel for SMEs, as it spurs “mass collaboration” among stakeholders (Feiten et al., 2022; Jyoti & Efraxia, 2023). This integration also leads to the sustainable performance of SMEs by enabling seamless communication among stakeholders and optimization of supply chain management (Al-Sharafi et al., 2023). Contemporary data suggests that cloud-based collaboration is a primary driver for innovation among the virtual teams for rapid response to market shift. Cloud is no longer viewed as a storage solution but as an active collaborative engine for sustainable internal and external network capabilities for modern SMEs (Merlo et al., 2025)

7.2 Research Contributions

This study showed that importance of key determinants of Technology, Organizational, Environmental and innovative characteristics which have significant implications for the adoption of cloud-based services. This gave an outlook on the areas which can enhance the adoption of cloud-based services in SMEs and help vendors/suppliers of these technological solutions. There is a prospective area to develop technological solutions to develop collaborative network capabilities and improve the networking among the consumers,

suppliers, peer organizations and government institutions. These solutions can help SMEs in enhancing their business opportunities and bring innovation in their operations. On the other hand, this study has indicated various areas of improvement for government institutions to encourage the adoption of cloud-based solutions and implement robust data protection measures with a strong emphasis on data security and legal compliance in SMEs. Creating awareness campaigns that highlight the value of data protection and potential risk associated with data breach. Lastly, the characteristics of respondents and SMEs show different areas of improvement where government, policy makers and SMEs owners can focus to enhance the development of SMEs. These areas include gender diversity, understanding educational and experiential dynamics is crucial for direct interventions to support professional development and skill enhancement initiatives.

8. Limitations and Future Research

This study is subject to several limitations. First, it is based on two theories of technology adoption within organizations and does not include other relevant adoption theories that could have provided additional perspectives on the adoption of cloud-based services. Moreover, certain elements of these two theories were deliberately excluded to limit the number of questions posed to respondents, which may have resulted in a narrower scope of inquiry. While the data is concentrated in Khyber Pakhtunkhwa, the findings remain highly generalizable because SMEs in the province mirror the resource-constrained environment prevalent across Pakistan and other emerging economics. Technological innovation in SMEs is driven by market survival and competitive pressure of digitization rather than gender specific traits (Alam et al., 2022). Studies on the innovation and collaboration link in developing nations indicate that firm size and technological readiness are more significant predictors of network capability than the gender of the manager (Tsakalerou et al., 2025). Moreover, SME sector is overwhelmingly male led, understanding their specific interaction with innovative tools provides a necessary baseline for national economic strategies. This study has the potential to expand its scope to examine the impact of collaborative network capability on the performance of SMEs. The moderating role of innovative capability in the context of collaborative network capability could also be further tested to assess its effect on the adoption of cloud-based services using the same conceptual framework.

References

- Abdulgadr, A. B. A., Basir, N., & Jali, M. Z. (2017). Factors affecting the adoption of cloud computing in small medium enterprises (SMEs) in Malaysia. *Advanced Science Letters*, 23(5), 4672-4675.
- Abied, O., Ibrahim, O., Kamal, S. N.-I. M., Alfadli, I. M., Binjumah, W. M., Ithnin, N., & Nasser, M. (2022). Probing determinants affecting intention to adopt cloud technology in e-government systems. *Sustainability*, 14(23), 15590.
- Abolfazli, S., Sanaei, Z., Tabassi, A., Rosen, S., Gani, A., & Khan, S. U. (2015). Cloud adoption in Malaysia: Trends, opportunities, and challenges. *IEEE Cloud Computing*, 2(1), 60-68.
- Abrahamsen, M. H., Halinen, A., & Naudé, P. (2023). The role of visioning in business network strategizing. *Journal of Business Research*, 154, 113334.
- Akram, A., Hye, A., & Ahmed, I. (2015). Cloud computing implementation in SME's in Pakistan: An empirical study. *International Journal of Scientific & Engineering Research*, 6(7), 1629-1634.
- Alam, K., Ali, M. A., Erdiaw-Kwasie, M. O., Murray, P. A., & Wiesner, R. (2022). Digital transformation among SMEs: Does gender matter? *Sustainability*, 14(1), 535.

- Alhammadi, A., Stanier, C., & Eardley, A. (2015). The determinants of cloud computing adoption in Saudi Arabia. *Computer Science & Information Technology (CS&IT)*, 137-152.
- Al-Isma'ili, S. Z. (2017). A multi-perspective framework for modelling and analysing the determinants of cloud computing adoption among SMEs in Australia. (Doctoral dissertation, University of Wollongong).
- Al-Sharafi, M. A., Iranmanesh, M., Al-Emran, M., Alzahrani, A. I., Herzallah, F., & Jamil, N. (2023). Determinants of cloud computing integration and its impact on sustainable performance in SMEs: An empirical investigation using the SEM-ANN approach. *Heliyon*, 9(5), 16299.
- Amini, M. & Javid, N. (2023). A multi-perspective framework combining Diffusion of Innovation (DOI) theory and TOE framework for cloud computing adoption in SMEs. *International Journal of Information Technology and Innovation Adoption*, 11(8)1217-1234. SSRN.
- Armbrust, M., Fox, A., Griffith, R., Joseph, A. D., Katz, R., Konwinski, A., Lee, G., Patterson, D., Rabkin, A., Stoica, I., & Zaharia, M. (2010). A view of cloud computing. *Communications of the ACM*, 53(4), 50-58.
- Azadegan, A., & Teich, J. (2010). Effective benchmarking of innovation adoptions: A theoretical framework for e-procurement technologies. *Benchmarking: An International Journal*, 17(4), 472-490.
- Bulla, C., Hunshal, B., & Mehta, S. (2016). Adoption of cloud computing in education system: A survey. *International Journal of Engineering Science and Computing*, 6(6), 6375-6381.
- Buyya, R., Yeo, C. S., Venugopal, S., Broberg, J., & Brandic, I. (2009). Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering computing as the 5th utility. *Future Generation Computer Systems*, 25(6), 599-616.
- Ceptureanu, E. G., & Ceptureanu, S. I. (2019). The impact of adoptive management innovations on medium-sized enterprises from a dynamic capability perspective. *Technology Analysis & Strategic Management*, 31(10), 1137-1151.
- Cervone, H. F. (2010). An overview of virtual and cloud computing. *OCLC Systems & Services: International Digital Library Perspectives*, 26(3), 162-165.
- Chemjor, E. M., & Lagat, C. (2017). Determinants of level of cloud computing adoption in small and medium enterprises in Nairobi County, Kenya. *International Journal of Economics, Commerce and Management*, 5(4), 248-265.
- De Noni, I., Orsi, L., & Belussi, F. (2018). The role of collaborative networks in supporting the innovation performances of lagging-behind European regions. *Research Policy*, 47(1), 1-13.
- Dinh, H. T., Lee, C., Niyato, D., & Wang, P. (2013). A survey of mobile cloud computing: Architecture, applications, and approaches. *Wireless Communications and Mobile Computing*, 13(18), 1587-1611.
- Faiz, F., Le, V., & Masli, E. K. (2024). Determinants of digital technology adoption in innovative SMEs: Combining TOE framework and Roger's diffusion of innovation theory. *Journal of Innovation & Knowledge*, 9(4), 100610.
- Feiten, G., Setti, D., Schenatto, F. J. A., Trentin, M. G., & Tortorella, G. L. (2022). Innovation adoption in SMEs: Cloud-based collaborative design. *SSRN Working Paper*. SSRN.
- Gide, E., & Sandu, R. (2015). A study to explore the key factors impacting on cloud based service adoption in Indian SMEs. In *2015 IEEE 12th International Conference on e-Business Engineering*, 387-392.
- Gutierrez, A., Boukrami, E., & Lumsden, R. (2015). Technological, organisational and environmental factors influencing managers' decision to adopt cloud computing in the UK. *Journal of Enterprise Information Management*, 28(6), 788-807.

- Hanelt, A., Bohnsack, R., Marz, D., & Antunes Marante, C. (2021). A systematic review of the literature on digital transformation: Insights and implications for strategy and organizational change. *Journal of Management Studies*, 58(5), 1159–1197
- Hashizume, K., Rosado, D. G., Fernández-Medina, E., & Fernandez, E. B. (2013). An analysis of security issues for cloud computing. *Journal of Internet Services and Applications*, 4(1), 1-13.
- Holler, N., & Westner, M. (2025). Factors influencing cloud computing adoption in small and medium-sized enterprises: A systematic review. *Informatica*, 49(1), 39–52.
- Ifinedo, P. (2011). An empirical analysis of factors influencing internet/e-business technologies adoption by SMEs in Canada. *International Journal of Information Technology & Decision Making*, 10(04), 731-766.
- Jyoti, C., & Efraxia, Z. (2023). Understanding and exploring the value co-creation of cloud computing innovation using resource-based value theory: An interpretive case study. *Journal of Business Research*, 164, 113970.
- Kaldaras, L., Wang, K. D., Nardo, J. E., Price, A., Perkins, K., Wieman, C., & Salehi, S. (2024). Employing technology-enhanced feedback and scaffolding to support the development of deep science understanding using computer simulations. *International Journal of STEM Education*, 11, 30.
- Keesookpun, C., & Mitomo, H. (2011). Cloud computing and prospective business and economic impacts in developing country: A case study of Thailand. In *22nd European Regional Conference of the International Telecommunications Society (ITS)*.
- Khalil, I. M., Khreishah, A., & Azeem, M. (2014). Cloud computing security: A survey. *Computers*, 3(1), 1-35.
- Khan, M. K., & Afsar, B. (2021). Determinants of innovation capability: Knowledge sharing perspective in SMEs of Pakistan. *Journal of Managerial Sciences*, 15(3), 1–18.
- Khan, N., & Al-Yasiri, A. (2015). Framework for cloud computing adoption: A road map for SMEs to cloud migration. *International Journal on Cloud Computing: Services and Architecture (IJCCSA)*, 5(5/6).
- Khayer, A., Talukder, M. S., Bao, Y., & Hossain, M. N. (2020). Cloud computing adoption and its impact on SMEs' performance for cloud supported operations: A dual-stage analytical approach. *Technology in Society*, 60, 101225.
- Kumar, D., Samalia, H. V., & Verma, P. (2017). Factors influencing cloud computing adoption by small and medium-sized enterprises (SMEs) in India. *Pacific Asia Journal of the Association for Information Systems*, 9(3), 1-26.
- Lippert, S. K., & Govindarajulu, C. (2006). Technological, organizational, and environmental antecedents to web services adoption. *Communications of the IIMA*, 6(1), 14.
- Low, C., Chen, Y., & Wu, M. (2011). Understanding the determinants of cloud computing adoption. *Industrial Management & Data Systems*, 111(7), 1006-1023.
- Merlo, T. R., Fard, F., & Hawamdeh, S. (2025). Cloud computing's impact on the digital transformation of the enterprise: A mixed-methods approach. *Sustainability*, 17(13), 5755.
- Milhem, M., Ayyash, M. M., Ateeq, A., Alzaghal, Q., Alzoraiki, M., Almuraqab, N. A. S., & Almeer, S. (2025). An integrated adoption model of cloud computing-based human resource management by SMEs in developing countries: evidence from Bahrain. *Frontiers in Sustainability*, 6, 1503423.
- Ming, C. F., On, C. K., Rayner, A., Guan, T. T., & Patricia, A. (2018). The determinant factors affecting cloud computing adoption by small and medium enterprises (SMEs) in Sabah, Malaysia. *Journal of Telecommunication, Electronic and Computer Engineering (JTEC)*, 10(3-2), 83-88.

- Misra, S. C., & Mondal, A. (2011). Identification of a company's suitability for the adoption of cloud computing and modelling its corresponding return on investment. *Mathematical and Computer Modelling*, 53(3-4), 504-521.
- Mokhtar, S. S. S., Mahomed, A. S. B., Aziz, Y. A., & Rahman, S. A. (2020). Industry 4.0: The importance of innovation in adopting cloud computing among SMEs in Malaysia. *Polish Journal of Management Studies*, 22(2). 278-291.
- Mulyana, M., & Wasitowati, W. (2021). The improvement of collaborative networks to increase small and medium enterprises (SMEs) performance. *Serbian Journal of Management*, 16(1), 213-229.
- Naeem, A., Shaikh, A. A., & Sarim, M. (2017). Critical success factors plays a vital role in ERP implementation in developing countries: An exploratory study in Pakistan. *International Journal of Advanced Computer Science and Applications*, 8(10). 21-29.
- Najafi-Tavani, S., Najafi-Tavani, Z., Naudé, P., Oghazi, P., & Zeynaloo, E. (2018). How collaborative innovation networks affect new product performance: Product innovation capability, process innovation capability, and absorptive capacity. *Industrial Marketing Management*, 73, 193-205.
- Najib, M., Dewi, F. R., & Widyastuti, H. (2014). Collaborative networks as a source of innovation and sustainable competitiveness for small and medium food processing enterprises in Indonesia. *International Journal of Business and Management*, 9(9), 147-160.
- Njenga, K., Garg, L., Bhardwaj, A. K., Prakash, V., & Bawa, S. (2019). The cloud computing adoption in higher learning institutions in Kenya: Hindering factors and recommendations for the way forward. *Telematics and Informatics*, 38, 225-246.
- Nuskiya, A. F. (2017). Factors influencing cloud computing adoption by SMEs in eastern region of Sri Lanka. *Journal of Information Systems & Information Technology*, 2(1), 1-12.
- Oliveira, T., & Martins, M. F. (2011). Literature review of information technology adoption models at firm level. *Electronic Journal of Information Systems Evaluation*, 14(1), 110-121.
- Oliveira, T., Thomas, M., & Espadanal, M. (2014). Assessing the determinants of cloud computing adoption: An analysis of the manufacturing and services sectors. *Information & Management*, 51(5), 497-510.
- Pathan, Z. H., Jianqiu, Z., Akram, U., Khan, M. K., Latif, Z., & Tunio, M. Z. (2017). Innovation-diffusion determinants of cloud-computing adoption by Pakistani SMEs. *Human Systems Management*, 36(3), 197-209.
- Pierre, A., & Fernandez, A.-S. (2018). Going deeper into SMEs' innovation capacity: An empirical exploration of innovation capacity factors. *Journal of Innovation Economics & Management*, 25(1), 139-181.
- Rababah, K. A., & Al-Nassar, B. A. (2020). Factors influencing the adoption of cloud computing in small and medium enterprises in Jordan. *International Journal of Cloud Applications and Computing*, 10(3), 96-110.
- Rai, R., Sahoo, G., & Mehruz, S. (2015). Exploring the factors influencing the cloud computing adoption: A systematic study on cloud migration. *Springerplus*, 4, 197.
- Ramdani, B., Kawalek, P., & Lorenzo, O. (2009). Predicting SMEs' adoption of enterprise systems. *Journal of Enterprise Information Management*, 22(1-2), 10-24.
- Santoro, G., Bresciani, S., & Papa, A. (2020). Collaborative modes with cultural and creative industries and innovation performance: The moderating role of heterogeneous sources of knowledge and absorptive capacity. *Technovation*, 92-93, 102040.
- Saunila, M. (2016). Performance measurement approach for innovation capability in SMEs. *International Journal of Productivity and Performance Management*, 65(2), 162-176.

- Sayginer, C., & Ercan, T. (2020). Multi-perspective decision-making cloud computing adoption model for small and medium enterprises (SMEs). *Emerging Science Journal*, 4(Special issue), 1-13.
- Schneiderman, R. (2010). For cloud computing, the sky is the limit. *IEEE Signal Processing Magazine*, 28(1), 15-144.
- Senarathna, I., Wilkin, C., Warren, M., Yeoh, W., & Salzman, S. (2018). Factors that influence adoption of cloud computing: An empirical study of Australian SMEs. *Australasian Journal of Information Systems*, 22, 1-21.
- Shuman, J., & Twombly, J. (2010). Collaborative networks are the organization: An innovation in organization design and management. *Vikalpa*, 35(1), 1-14.
- Sichoongwe, K. (2023). Adoption behaviour of digital technologies by firms: Evidence from South Africa's manufacturing sector. *Global Business Review*, 25(2_suppl), S244-S264.
- SMEDA. (2023). SMEDA annual report 2022-23. Small and Medium Enterprises Development Authority, Government of Pakistan.
- Tashkandi, A. N., & Al-Jabri, I. M. (2015). Cloud computing adoption by higher education institutions in Saudi Arabia: An exploratory study. *Cluster Computing*, 18(4), 1527-1537.
- Tehrani, S. R., & Shirazi, F. (2014). Factors influencing the adoption of cloud computing by small and medium size enterprises (SMEs). In S. Yamamoto (Ed.), *Human Interface and the Management of Information. Information and Knowledge in Applications and Services (8522)*, 631–642. Springer.
- Thiesse, F., Staake, T., Schmitt, P., & Fleisch, E. (2011). The rise of the “next-generation bar code”: An international RFID adoption study. *Supply Chain Management: An International Journal*, 16(5), 328-345.
- Thornhill, S. (2006). Knowledge, innovation and firm performance in high-and low-technology regimes. *Journal of Business Venturing*, 21(5), 687-703.
- Tornatzky, L. G., & Fleischer, M. (1990). The process of technology innovation. Lexington Books.
- Tsai, C.-L., & Lin, U.-C. (2011). Information security of cloud computing for enterprises. *Advances in Information Sciences and Service Sciences*, 3(1), 132-138.
- Tsakalerou, M., Abil, A., Ribiere, V., Likhmanov, Y., & Tynybayeva, N. (2025). *The innovation capability equation: A systematic review of global determinants of SME's success*. *Journal of Innovation & Knowledge*, 10(4), 100757.
- Van De Weerd, I., Mangula, I. S., & Brinkkemper, S. (2016). Adoption of software as a service in Indonesia: Examining the influence of organizational factors. *Information and Management*, 53(7), 915-928.
- Yoo, S.-K., & Kim, B.-Y. (2019). The effective factors of cloud computing adoption success in organization. *The Journal of Asian Finance, Economics and Business*, 6(1), 217-229.
- Zhu, K., & Kraemer, K. L. (2005). Post-adoption variations in usage and value of e-business by organizations: Cross-country evidence from the retail industry. *Information Systems Research*, 16(1), 61-84.
- Zhu, K., Kraemer, K. L., & Dedrick, J. (2004). Information technology payoff in e-business environments: An international perspective on value creation of e-business in the financial services industry. *Journal of Management Information Systems*, 21(1), 17-54.
- Zhu, K., Kraemer, K. L., & Xu, S. (2006). The process of innovation assimilation by firms in different countries: A technology diffusion perspective on e-business. *Management Science*, 52(10), 1557-1576.