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The Role of Absorptive Capacity and Technological Innovation Capabilities in IT Project Success: Does Strategic Agility Matter?

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ABSTRACT

This study aims to explore the role of absorptive capacity (AC) on project success (PS) through the mediating roles of technological innovation capabilities (TIC) and the moderating role of strategic agility (SA). A convenience sampling technique was used to collect data from 225 respondents working as project managers in small- to medium-sized Pakistani software companies in Islamabad and Rawalpindi. Data was collected from and distributed on several online channels (Gmail, LinkedIn, WhatsApp). Smart PLS-SEM, version 4, was used for data analysis. The results obtained suggested that AC has a direct positive effect on PS and an indirect impact through the mediating role of TIC. However, the moderating role of SA showed an insignificant impact on the relationship between TIC and PS. The current study's findings highlight the importance of various factors to achieve sustainable performance for small-medium software enterprises, which are the backbone of developing economies in today's highly turbulent economic conditions.

Keywords: Absorptive capacity, IT industry, Technological Innovation Capabilities, Project success, Strategic agility.

INTRODUCTION

Environmental risks and uncertainty compound the challenges of navigating the modern-day IT industry, hindering the successful execution of projects (Gurca et al., 2021). IT projects require complex business processes involving effective stakeholder management (Moraveck, 2013) (Huijgens et al., 2017), interoperability of diverse systems, and integration issues (Legris & Collerette, 2006) (Madni & Sievers, 2014; Zafar et al., 2011). Furthermore, the time and budget constraints faced by small-medium software enterprises (SMSEs) notwithstanding (Ghoddousi et al., 2013; Kosztyán & Szalkai, 2020; Larsen et al., 2016), complexities of IT projects are further exacerbated by market volatility and rapidly evolving customer preferences and technological advancements (Foltean & Van Bruggen, 2022; Khuan et al., 2023; Olorunyomi Stephen Joel et al., 2024; Srivastava & Bag, 2023; Wilden & Gudergan, 2015). While much has been documented concerning the management of internal challenges such as budgetary limitations (Bardhan et al., 2010; Gopal, 2023) and knowledge-management challenges (Bosch-Sijtsema & Henriksson, 2014); managing the rapidly evolving external environments requires swift responsiveness. To this end, successful IT project execution entails SMSEs use external knowledge to grow and survive in the dynamic IT environment. Prior studies underscore the significance of acquiring and managing knowledge to realize firms' competitive goals and enhance their performance . (Alegre et al., 2013; Flor et al., 2018; Mohamad & Mat Zin, 2019; Ortiz et al., 2017)

The IT sector is a crucial component of the service industry, playing a significant role in the growth of both the service sector and GDP (Aleksandrova & Khabib, 2022), offering substantial developmental benefits for developing and least-developed countries. The IT software and service sectors have significantly contributed to GDP growth in developing countries (Ahmadi & Ahmadi, 2022). With the contributions of the IT industry to the national GDP reaching $2 trillion in the United States, to estimates of its contribution to the GDP estimated to reach $20 billion in Pakistan, the tech industry is the largest source of growth and employment globally (Niebel, 2018). With over 10,000 IT & IT registered companies engaged in software development, BPO and freelancing in the country (Pakistan Software Export Board, 2020), the success of IT projects is becoming increasingly crucial to the growing IT industries. Coupled with rapid technological growth, and the accompanying challenges to IT projects, rapid responsiveness in the form of absorptive capacity is crucial to IT projects.

As the ability to acquire, assimilate, and exploit external knowledge in realizing their competitive goals, SMSEs' absorptive capacity (AC) enables them to achieve organizational objectives successfully (Dávila et al., 2018; Khan, 2022). According to (Lyu et al., 2022), the AC is a dynamic capability of an organization that comprises four key elements: acquisition, assimilation, transformation, and exploitation of external knowledge. Acquisition and assimilation are collectively referred to as potential AC, while transformation and exploitation are termed realized AC. AC is said to be the critical element in enhancing organizational innovativeness (Chen et al., 2009). Therefore, technology innovation is considered a central pillar of

organizations' efforts to improve productivity and growth. As to the findings of Accenture's innovation survey, 84% of organizations recognize the importance of innovation in boosting their long-term business plans (Brav et al., 2018). Consequently, it becomes imperative for organizations in the long run to manage, create, and build technological innovation capabilities (TIC) and create innovative environments in SMSIs in developing countries. A reasonable amount of literature is available in the context of absorptive capacity and TIC. However, there is a notable gap in literature regarding SMSEs in developing countries.

This study aims to explore how absorptive capacity (AC) helps improve the success of IT projects in the context of developing Asian countries, with a specific focus on small and medium-sized software enterprises (SMSEs) in Pakistan. Although AC, technological innovation capability (TIC), and strategic agility (SA) have been studied in countries like India and China (Boamah et al., 2023; Cohen & Levinthal, 1990; Bindra et al., 2023), there is limited research on how these concepts apply to Pakistani firms. Pakistan's IT sector operates under unique conditions, including limited infrastructure, economic instability, and a lack of strong innovation networks. Most existing research in Pakistan has concentrated on leadership styles, investment decisions, risk management, and employee behavior (Ince et al., 2016; Javaid & Aslam, 2021), but has largely ignored how dynamic capabilities like AC, TIC, and SA can affect project outcomes. This lack of attention creates a clear gap in understanding what drives project success in Pakistan's software industry. Therefore, this study will investigate how AC supports TIC, and how both AC and SA influence project success, offering insights that can help improve performance in Pakistan's growing but underperforming IT sector.

This study contributes to project management literature in several ways. First it investigates how the business processes involving AC and TIC affect IT PS within the context of SMSEs in a developing economy. In doing so, it offers promising potential for business process literature by explicating how business processes, enhanced by a firm's AC, enhance its performance. Specifically, it emphasizes the role of TIC in influencing PS. Furthermore, it aims to identify the role of SA and explores how SMSEs in developing economies can benefit from strategically agile systems that respond to dynamic and challenging IT environments. Finally, by proposing and testing the role of enhanced firm's capabilities towards PS, this paper offers practical and theoretical implications for practitioners and scholars. \

LITERATURE REVIEW

Absorptive Capacity

The AC theory emphasizes an organization's ability to gain, integrate, and utilize external knowledge to enhance innovation (Cohen & Levinthal, 1990). This theory has been extensively applied in project management, strategic management, innovation management, and organizational learning (Cohen & Levinthal, 1990). As per the theory, organizations with higher AC demonstrate superior skills in recognizing valuable external knowledge and effectively incorporating it into their current capabilities, which results in enhanced performance (Ahn et al., 2016; Harvey

et al., 2015). This theory underscores the significance of an organization's ability to identify and obtain external technological insights. Organizations with higher AC enable the integration of new information into existing structures and its transformation into usable insights. In the context of our study, AC theory suggests that AC should improve SMSEs' business processes of enhanced TIC. By fostering enhanced innovative processes, SMSEs' AC should further hold implications for heightened rates of PS. Moreover, in line with the theory, SA should further amplify success of IT projects through the enhanced technological innovative processes, as strategically agile firms are more aptly positioned to harness external knowledge (Kohtamäki et al., 2020; Mao et al., 2021), resulting in notably enhanced PS (Mata et al., 2024).

Absorptive Capacity and Project Success

The AC is defined as recognizing the importance of external knowledge and assimilating and applying that information to enhance innovation (Cohen & Levinthal, 1990; Zahra & George, 2002). It is a dynamic capability involving the generation and application of knowledge, enhancing the ability of a company to achieve and maintain a competitive benefit (Zahra & George, 2002). AC has also been shown to improve efficiency in multi-step projects (Müller et al., 2021). According to Spithoven et al. (2011) and Duchek (2013), AC includes the dimensions acquisition, assimilation, transformation, and exploitation. Acquisition capacity explains how well a company can acquire and understand external information essential for its operations. Assimilation involves plans and processes to work with and makes sense of the data the company collects. Transformation denotes the capacity of an organization to create and implement strategies that merge its existing knowledge with recently gained new knowledge. Finally, exploitation refers to an organization's capacity to incorporate actual data into its daily operations efficiently. The emphasis is on converting that data into new procedures.

The first two dimensions, potential AC, illustrate how proficient a business is in gaining external knowledge and making a project successful. Moreover, the remaining two capacities are realized AC (Lyu et al., 2022). There is still a lack of literature regarding the effective application of AC in an organization to achieve PS (Lane et al., 2006). Therefore, the concept of AC in a project's success remains a topic of ongoing research, particularly true in the software industry. So, it is necessary to examine the impact of AC on PS, especially for the SMSEs of Pakistan.

Comparatively, businesses with higher AC are more likely to identify market opportunities, gather market data, and comprehend client needs. As a result, they carry out development operations effectively, boost business success, and expand chances for projects with high success rates. Accordingly, we intend to replicate earlier findings regarding the impact of AC on PS.

H1: AC has a positive effect on PS.

Absorptive Capacity and Technological Innovation Capability

Scholars have emphasized the pivotal role of AC in promoting and sustaining TIC. By offering a flexible strategy, organizations are able to adapt and amend their organizational operations (Dávila et al., 2018). Zahra and George (2002) also

emphasize that the continuous inflow of new knowledge fills the organization's knowledge base, introducing new ideas and procedures that promote TIC.

TICs are the ability of an organization to adapt to changes quickly, acquire novel technologies, and produce new ideas. Technologically innovative organizations can quickly adapt to changes and improve new strategies, products, and procedures, enabling responsiveness to market changes (Ince et al., 2016). As per the resource-based view, by acquiring external knowledge, enhanced AC, should enhance business processes through enhanced TIC, i.e., process and organizational innovation. Organizations with a strong foundation of knowledge obtained through adequate AC improve the PS rate and promote and sustain TIC through a continuous flow of new knowledge, ideas, and procedures (Gölgeci et al., 2017). Accordingly, AC is likely to positively influence firms' TIC, i.e., process and organizational innovation. The following hypothesis is proposed (Figure 1):

H2: AC has a positive effect on TIC.

Technological Innovation Capabilities as a Mediator

Existing literature suggests that innovation capabilities not only benefit the firm but also the key to improving the performance of the firm (Kmieciak et al., 2012). Therefore, it impacts the PS of the firm (Yuan et al., 2010). Additionally, to achieve PS and strengthen its competitive advantage, it is essential for an organization to integrate its innovative capabilities for developing and commercializing new technologies and to facilitate the creation and dissemination of technological innovations. Many scholars have also conducted comprehensive investigations into how these innovation capabilities affect the growth and success of the company (Hanaysha et al., 2022)). Prior research consistently indicated that among the seven dimensions of innovative capabilities, the effectiveness of the internal perspective dimensions, which are process and organizational innovativeness, positively influences PS (Bahrami et al., 2022).

Previous literature on AC demonstrated that the organization's learning process is necessary for acquiring outside information (Kesidou & Szirmai, 2008). In addition, AC is an organizational process that helps businesses reorganize existing resources to create new knowledge or inventive capability, giving them a new competitive advantage (Zahra & George, 2002a). Furthermore, there is evidence for the argument in studies that identify that companies with a high capacity for absorbing new market information and comprehending customer needs perform better (Zhai et al., 2018). These companies are able to engage in innovative activities and enhance their performance. Several studies suggested that an organization with effective AC correlates to how well TIC-based projects come out (Ali et al., 2021; Tsai, 2001; Vicente-Oliva et al., 2015). The potential for AC produces a potent synergy that eventually benefits the project's success through enhanced innovation capabilities. However, since AC is a crucial component of inventive potential, in order to promote innovation activities, their efforts must be intensified so that absorptive capability would be more successful in increasing the export market (Pennings & Harianto, 1992). In other words, absorptive capability alone does not significantly affect organizational performance; instead, TIC acts as a mediating factor between it and

organizational project performance (Fosfuri & Tribo, 2008).

TIC are a comprehensive set of features of a firm that facilitates and assists its strategies to innovate (Lang et al., 2012). A firm with high TICs can effectively facilitate and support its strategy to create innovation. Given that innovation requires the reconfiguration of existing resources or the creation of new ones, TICs are part of the firm's dynamic capabilities. Therefore, organizations are increasingly focused on absorbing external knowledge and creating internal knowledge to foster innovation and enhance performance in the dynamic business landscape. In a technological context, the active function of absorptive ability is essential for stimulating innovation and creating value (Pisano, 2016). Researchers such as Zahra et al. (2009) and Zahra & George (2002a) highlight the significance of absorptive capacity in promoting and sustaining technological innovation. TICs are the primary source of a company's competitive advantages, enabling businesses to expand their capacity for innovation broadly and perform better (Teece, 1996).

Additionally, TICs are frequently advised to assist and promote an innovation plan to increase competitiveness continuously (Dodgson et al., 2022). Firms with well-developed technologically innovative capabilities can effectively perform in volatile scenarios to enhance project performance compared to those with lower TICs (Rahim & Zainuddin, 2019). Other studies also show that absorptive capacity boosts organizational performance and innovation (Filippetti et al., 2016; Xie et al., 2018). According to the theory of dynamic capability, it is clear that the TIC of an organization mediates the relationship between AC and organization performance. Therefore, TICs appear to be a good mediator in this framework in exploring the link between AC and PS. Therefore, based on the above arguments, we formulate the following hypotheses (Figure 1):

H3: TICs have a positive effect on PS.

H4: TICs mediate the relationship between AC and PS.

Strategic Agility as a Moderator

Dunlop-Hinkler et al. (2011) define SA as the ability of the company to react quickly to rapid changes in technology (such as changes in the internal environment), which is endorsed by dynamic capability theory. The organization needs to be agile enough to react quickly to the changes in the business environment, adapt to them, and take action in order to control uncertainty and attain the business' strategic goals. SA is instrumental towards organizational performance (Dunlop-Hinkler et al., 2011).

Moreover, SA is described by three key elements: strategic awareness, unified leadership, and adaptability. Strategic awareness involves the capacity of an organization to adapt to shifts in outside and internal strategic factors, ensuring high-performance outcomes. At the same time, a unified leadership framework is a collection of principles, behaviors, and proficiencies that serve as a roadmap to guide leaders about different contexts, responsibilities, and levels. It helps align an organization's vision, values, and goals and fosters collaboration, learning, and innovation. Moreover, adaptability involves the skills that allow an organization to adjust to environmental changes. Adaptability implies that an organization can swiftly respond to shifts in ideas, responsibilities, expectations, trends, strategies, and other

processes (Tarba et al., 2023).

Alahyari et al. (2017) highlighted that better management of SA organizations can enhance their internal and external performance. Others affirm that "SA is a charismatic capability that can improve the performance of any organization" (Queiroz et al., 2018). Finally, others report that SA is significant in reorganizing and boosting organizational performance (Ashrafi et al., 2019). Furthermore, when SA is linked with the ability to innovate using technology, the company has a broader variety of valuable, unique products, resulting in improved performance. Therefore, SA plays a pivotal role in PS, and its impact is magnified when coupled with TIC, which allows organizations to respond swiftly to evolving technological landscapes and drive better project outcomes.

Numerous studies document the role of SA in influencing organizational performance either directly or as an intervening mechanism across manufacturing organizations (Vickery et al., 2010), telecommunications sector (Ade Oyedijo & Lagos, 2012), and private banks (Tabe Khoshnood & Nematizadeh, 2017). These studies in diverse environments, including Nigeria and Iran, point out the direct impact of SA on improving organizational performance. Similarly, others also report the role of SA in enhancing performance outcomes in organizations (Al-Omoush et al., 2020; Laodicéia et al., 2018). For example, in a recent study conducted in Ukraine, SA influenced organizational performance of IT sector firms (Khraim, 2022). Perhaps SA enables organizations to leverage enhanced business process capabilities, including TIC. Accordingly, as strategically agile companies swiftly adapt to emerging technologies through flexibility and rapid decision-making, they can leverage their enhanced business processes as a result of their improved innovation capabilities. Hence, based on the above arguments, the following hypothesis is formulated (Figure 1):

H5: SA moderates the relationship between TIC and PS.

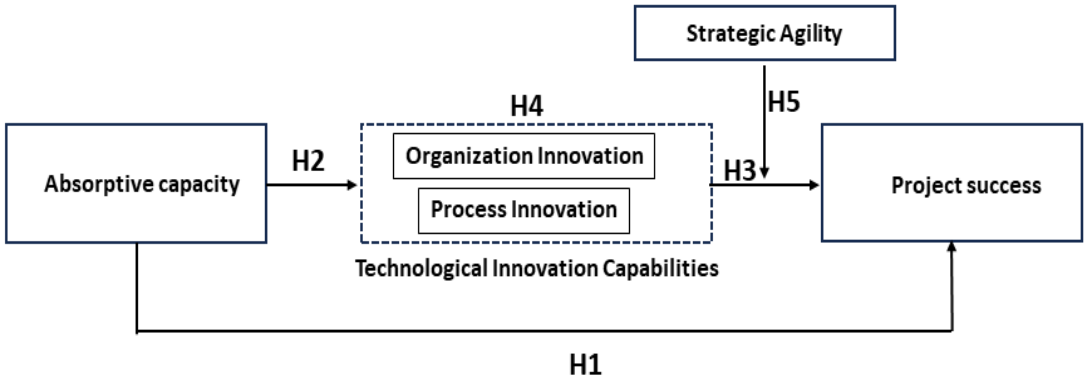

Fig. 1 Conceptual model

RESEARCH METHODOLOGY

The current study focuses on Pakistan's SMSIs. The software industry is an essential sector of economic systems that substantially affects the world's economy and business trade (Santoro et al., 2018). USA's software houses contribute approximately 18.7% to the GDP, indicating a mature and influential sector

(Nicholson et al., 2023). In contrast, the software houses in Pakistan only contribute around 1% to the GDP (Shahzad et al., 2017), reflecting a minor but growing trend that may be increased by adopting a modern business model. Data were collected from SMSEs in two major Pakistani cities, i.e., Rawalpindi and Islamabad.

A convenient sampling technique was used to examine the collection and information (Colbert et al., 2023). This means participants were selected based on how easily they could be reached and their willingness to take part. Given the limited time and resources, and the difficulty of accessing a complete list of employees from various software-based small and medium-sized enterprises (SMSEs) in Pakistan, this approach was the most practical. It allowed the researcher to gather insights from those who were readily available, such as employees from firms willing to participate. The data was collected over five months, from October 2023 to February 2024, from software firms registered with the Pakistan Software Export Board (PSEB). The data was gathered through questionnaires generated through Google and distributed to Project Managers of SMSEs through online mediums, including Gmail, LinkedIn, Facebook, and WhatsApp. This enabled maximum participation of individuals. Of the 280 questionnaires initially circulated, 225 responses were received. After analyzing the responses, 175 surveys were eligible for further analysis, resulting in a response rate of 78%. The respondents were between 25 to 50 years old, of which 21.5% were female and 78.5% were male.

The questionnaires were in English, which is the official language in the country. As it is commonly used for formal communication and documentation, studies frequently use it as the language for data collection. For the current study as well, it did not present comprehension challenges for respondents.

Absorptive Capacity was measured through the 21-item scale by Albert et al. (2017). Responses varied from 1 to 7, where 1 represents completely disagree, and 7 represents completely agree. Sample item: “We quickly recognize the usefulness of new external knowledge for existing knowledge”.

We measured strategic agility through the 9-item scale adopted from Clauss et al. (2021). Responses were sought on a 7-point Likert scale, where 1 = strongly disagree, and 7 = strongly agree. Sample item: “Our top management team is able to make bold and fast strategic decisions”.

Technological innovation capability was measured using the two subscales of organizational innovation and process innovation, organizational innovation scale was adopted from (Camisón & Villar-López, 2014) which employs 8 items. Anchor points, where 1 = never and 7 = very often, Respondents indicated the extent to which their organization used the indicated instruments. Sample item “Use of methods for integration with suppliers”. Process innovation was assessed through 11 items. Anchor points were 1 much worse and 7 = much better. Sample item “My firm continually develops programs to reduce production costs”.

We measured project success using the 14-item project success scale (Mir & Pinnington, 2014). Responses were on a 5-point Likert scale where 1 = very dissatisfied, and 5 = very satisfied Sample item: “The project has made a visible positive impact on the target beneficiaries”.

RESULTS

The results from the research survey were analyzed using Partial Least Squares Structural Modelling (PLS-SEM), which is divided into two components. The first is the Measurement Model, which presents the discriminant and convergent validity results that are used to evaluate the reliability and validity of the research, and the second is a structural model, which involves the evaluation of the formulated hypothesis to confirm the existence of a significant connection between the predictive constructs and dependent variable. Smart PLS-SEM 4.0 was used for the analysis. The measurement model as shown in Table 1 was evaluated through indicator loadings, composite reliability (CR), and discriminant validity (HTMT). Structural model was assessed through the coefficient of determination (R^2), predictive relevance (Q^2), and beta values (Sarstedt et al., 2019).

Table 1 Measurement model

Constructs/items	Factor loadings	a	CR	AVE	Source
Absorptive capacity		0.965	0.969	0.677	(Albort-Morant et al., 2018)
We have frequent interactions with top management to acquire new knowledge	0.790				
Employees regularly visit other units or project teams	0.845				
We collect information through informal means	0.872				
Members do not visit other units or project teams	0.826				
We periodically organize special meetings with clients, suppliers, or third parties to acquire new knowledge.	0.829				
Members meet regularly with external professionals, such as advisers, managers, or consultants.	0.798				
We are slow to recognize shifts in our market (competitors, laws, demographic changes, etc.)	0.828				
New opportunities to serve our clients are quickly understood.	0.601				
We quickly analyze and interpret changing client demands.	0.806				
We regularly consider the consequences of changing market	0.773				

demands, in terms of new ways to provide services.					
Employees record and store newly acquired knowledge for future reference.	0.822				
We quickly recognize the usefulness of new external knowledge for existing knowledge.	0.865				
Employees hardly share practical experiences	0.882				
We laboriously grasp opportunities for our unit from new external knowledge	0.857				
We periodically meet to discuss the consequences of market trends and new service development.	0.904				
Technological Innovation Capabilities		0.970	0.973	0.664	(Camisón & Villr-López, 2014)
Organization innovation					
Implementation of practices for employee development and better worker retention	0.745				
Decentralization in decision-making	0.693				
Use of inter-functional working groups	0.809				
Flexible job responsibilities	0.876				
Collaboration with customers	0.837				
Use of methods for integration with suppliers	0.835				
Outsourcing of business activities	0.805				
Process innovation capabilities					
My firm is able to create and manage a portfolio of interrelated technologies	0.838				
My firm is able to master and absorb the basic and key technologies of business	0.788				
My firm continually develops programs to reduce production costs	0.809				
My firm has valuable knowledge for innovating manufacturing and	0.861				

technological processes					
My firm has valuable knowledge on the best processes and systems for work organization	0.841				
My firm organizes its production efficiently	0.816				
My firm assigns resources to the production department efficiently	0.827				
My firm is able to maintain a low level of stock without impairing service	0.885				
My firm is able to offer environmentally friendly processes	0.788				
My firm manages production organization efficiently	0.821				
My firm is able to integrate production management activities	0.772				
Strategic agility		0.882	0.904	0.515	(Hock et al., 2016)
We are very sensitive to external changes and integrate these into the strategic planning of our company.	0.517				
We utilize different mechanism to become aware of strategic development early.	0.557				
Requirement for strategic adaption are communicated fast and comprehensively through the organization.	0.711				
Our top management team is able to make bold and fast strategic decisions	0.764				
Our management board collaborates for strategic decision	0.712				
Strategic questions are collectively solved by our management without being bogged down in top-level win-lose politics	0.699				
We are able to reallocate and utilize capital resources fluidly	0.871				
Our people and their competencies are highly mobile within our organization.	0.809				
Our organization structure allows to	0.752				

flexible redeployment of our resources.					
Project success		0.965	0.969	9.677	(Mir & Pinnington, 2014)
The project was completed on time.	0.780				
The project was completed according to the budget allocated	0.833				
The outcomes of the project are used by its intended end users	0.831				
The outcomes of the project are likely to be sustained	0.819				
The outcomes of the project have directly benefited the intended end users, either through increasing efficiently or effectiveness	0.769				
Given the problem for which it was developed, the project seems to do the best job of solving that problem	0.746				
I was satisfied with the process by which the project was implemented	0.789				
Project team members were satisfied with the process by which the project was implemented	0.844				
The project had no or minimal start-up problems because it was readily accepted by its end users	0.895				
The project has directly led to improved performance for the end users / target beneficiaries	0.838				
The project has made a visible positive impact on the target beneficiaries.	0.826				
Project specifications were met by the time of handover to the target beneficiaries	0.826				
The target beneficiaries were satisfied with the outcomes of the project	0.770				
Our principal donors were satisfied with the outcomes of the project implementation	0.868				

Abbreviations: Cronbach's Alpha (a), Composite Reliability (CR); Average Variance Extracted (AVE).

The reliability/validity of the explicit indicators is evaluated by analyzing their outer loadings (Figure 2). According to Hair et al. (2020), factors exhibiting a loading greater than 0.50 are considered significant. As shown in Table 1, the study instruments and items were all valid and effectively measured in their respective constructs. The convergent validity of a variable is confirmed when its average variance extracted (AVE) exceeds 0.5 while ensuring that the composite reliability exceeds 0.6, as suggested by Ahmad et al. (2016). Based on these criteria, the proposed measurement model demonstrates convergent validity and ensures that different measures intended to assess the same construct are consistent and converge towards the same underlying concept. Hair et al. (2017) proposed a method advocating for removing items with loadings between 0.40 and 0.70 from assessments under the condition that eliminating these observed variables enhances the reliability of the reflective scale composite. Therefore, all factor loadings, composite reliability (CR), and estimated average variance extracted (AVE) values surpass the proposed cutoff criteria.

According to Henseler et al. (2015), we employed the Heterotrait-Monotrait (HTMT) method in two ways to assess discriminant validity. Firstly, we evaluated the HTMT values against a specified threshold to gauge the extent of discrimination. A value surpassing this threshold suggests insufficient discrimination. However, determining the precise threshold becomes challenging when correlations approach unity. Some experts advocate for a threshold of 0.85, while others suggest 0.90 (Voorhees et al., 2016). Secondly, we evaluated discriminant validity by examining HTMT values with confidence intervals excluding one. This approach empirically confirms the distinctions among variables. Table 2 demonstrates HTMT values below 0.85, establishing discriminant validity.

Table 2 Heterotrait-Monotrait (HTMT) Analysis

	AC	PS	TIC	SA	SA x TIC
AC					
PS	0.445				
SA	0.406	0.770			
TIC	0.808	0.241	0.252		
SA x TIC	0.282	0.091	0.125	0.476	

The structural model was assessed after the measurement model. The techniques proposed by Sarstedt et al. (2017) were used to examine the moderating role results. Three specific criteria were used to find SEM's direct and indirect effects (Hair, Jr. et al., 2016). First, the variance of variables was determined by calculating the R^2 level for dependent components. Hair Jr et al. (2014) concluded that the value of R^2 varies from study to study and depends on the specific study context, R^2 values of 0.26, 0.13, and 0.09 were evaluated as high, moderate, and low, respectively. However, in the current study context, the direct effect model showed a TIC value of 1.66 for dependent variables, reflecting that AC and SA predicted a 16.6% change in TIC. Moreover, the R^2 value for PS is 0.607, implying that AC, SA, and TIC can predict

a 60.7% change in PS. The SEM model analysis showed a high predictive accuracy, as shown in Table 3.

Table 3 Determination coefficient in the PLS method.

	R^2	R^2 Adjusted	Q^2
PS	0.607	0.599	0.6
TIC	0.166	0.161	0.5833

Figure 2 and Table 4 shows the effect of variable AC on PS with respective β coefficients of 0.250 and p=0.000, which showed a positive association and was highly significant. However, the effect of AC on TIC with respective β coefficients of 0.407 showed positive associations but less significant (p=0.035). However, the effect of TIC on PS is positive and highly significant (p=0.000). Table 4 also shows the results of TIC and SA interaction effects. The results showed that the interaction of SA and TIC has a statistically insignificant effect, (p=0.928), while TIC, demonstrates a significant positive effect on PS (p=0.000).

Table 4 Result of Structural Equation Model.

	β	Sample Mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
AC → PS	0.250	0.217	0.118	2.112	0.035
AC → tic	0.407	0.413	0.075	5.454	0.000
SA → PS	-0.116	-0.074	0.098	1.188	0.235
tic → PS	0.690	0.692	0.061	11.264	0.000
SA X TIC → PS	-0.004	-0.020	0.050	0.090	0.928
AC X TIC→PS	0.280	0.281	0.051	5.466	0000

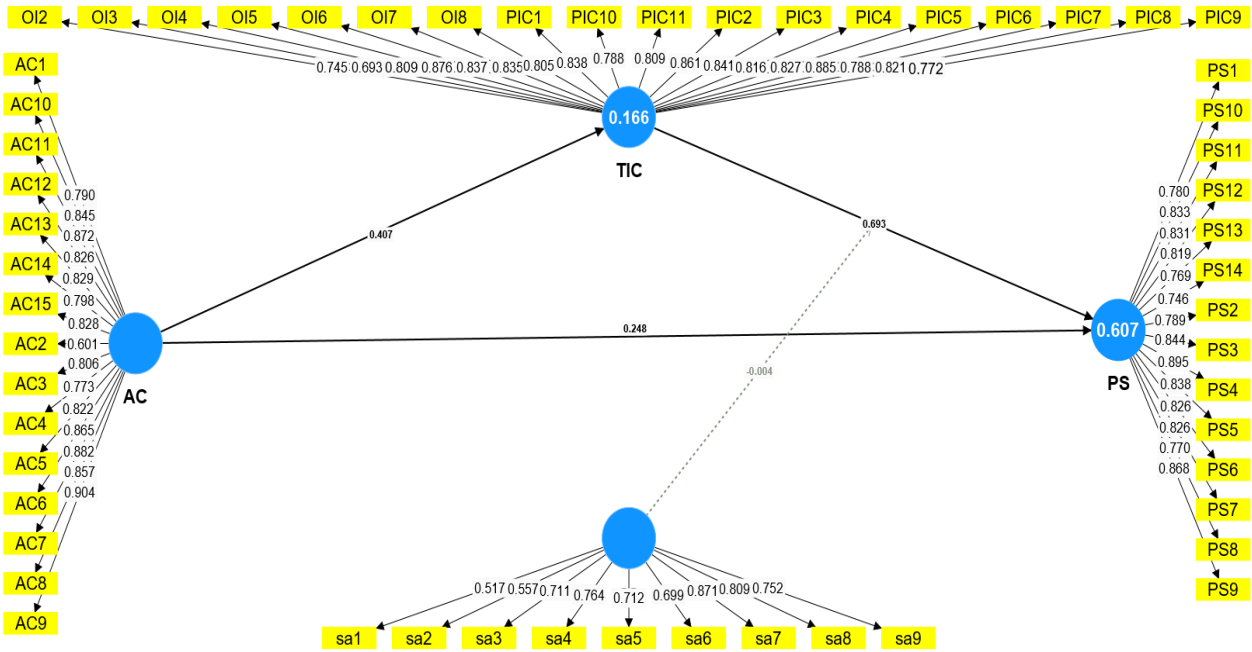

Fig. 2 Measurement model analysis.

DISCUSSION

This study examines the influence of AC on PS within the context of Pakistani IT organizations, emphasizing the mediating role of TICs. Findings support the tested hypotheses for the direct impact of AC on the success of IT projects. Furthermore, the findings also indicate that this improved rate of success is brought about as a result of enhanced business processes through enhanced TICs.

As an organization's capacity to recognize the value of recognizing the value of external information, assimilating and applying it to commercial ends, AC enables firms to adapt and pivot in response to market changes and emerging opportunities. It is crucial for PS in the rapidly evolving IT and project environment. Aligned with prior literature (Cohen & Levinthal, 1990), findings of the study demonstrate that AC positively affects PS in Pakistani IT organizations. This suggests that agile organizations are better positioned to navigate the complexities and uncertainties associated with dynamic and challenging environments such as the IT sector. This responsiveness should ensure they are adaptive to external changes, ensuring projects meet their objectives and deliver the clients value (Doz & Kosonen, 2010). AC may be particularly vital in competitive and challenging environments such as in the context of Pakistani IT sector, due to the rapidly evolving technological landscape and the competitive nature of the global IT market. Furthermore, these findings are all the more important for a developing economy, considering the quest for working with limited resources and the margin of error become more restricted. For Pakistani IT firms to be competitive at a global scale, they must be adept at recognizing and responding to shifts in technology and market demands to ensure PS. As Pakistani IT industry frequently takes up projects from global clients, it has become a major player in the global outsourcing market. This makes it more essential that Pakistani IT firms, including web, software, and mobile-app development companies, as well as IT consulting firms, remain strategically agile.

A significant finding of the study is the identification of technological enhancement which enhances business processes to achieve higher rates of PS. TIC, through enhanced organizational capabilities to develop, adopt, and implement new technologies effectively, contribute to project success. Aligned with the dynamic capability's theory (Teece, 2007), the ability to innovate and adapt technologically, is essential for maintaining competitive advantage and superior project performance. In Pakistani IT organizations, where technological advancements have become rapid over time, fostering enhanced business processes through enhanced technological capabilities is essential for success. Given that technological advancements and innovation are critical for maintaining competitive edge, Pakistani IT organizations may benefit greatly as a result of these enhanced capabilities.

Theoretical and Practical Implications

Integrating AC and TICs within the context of PS, this study extends the relevant literature on strategic management and project management. By elaborating the enhanced capabilities of improved business processes brought about by TICs, it provides a nuanced understanding of the mechanisms through which AC influences

PS. This integrative perspective and the intermediary role of TICs, contributes to a more comprehensive understanding of how dynamic capabilities facilitate organizational performance. For IT managers and professionals in Pakistan, this study highlights the importance of developing stronger technological innovation (ICT) capabilities by first improving the absorption capacity (AC) of their organization. In simple terms, this means creating a work environment where learning is encouraged, new ideas are welcome and knowledge is actively shared and applied. IT Pakistani companies can take practical measures to strengthen the CA, for example, organizing regular knowledge exchange sessions, encouraging teams to discuss recent technological trends and support continuous training through platforms such as Coursera or local institutions. Managers can also introduce internal systems to capture and disseminate knowledge between the equipment, such as the use of the notion or confluence. Opening to external knowledge is equally important: this may include participating in technological events, getting involved with open source communities or collaborating with universities in research projects. On the side of innovation, companies should consider assigning small budgets to experiment with new tools or execute internal hackathons to inspire creative solutions. By promoting a culture of IT promoted by learning, agile and open, IT companies in Pakistan can significantly improve their ability to innovate and, ultimately, increase the success rate of their IT projects. Cultivating these capabilities may enable Pakistani IT firms to become globally competitive, deliver higher quality, and achieve more success; ultimately enhancing their global competitiveness. These may be achieved through utilizing improved knowledge management systems, investing in continuous learning and employee development programs, and establishing innovation and R&D hubs or labs inside organizations. While acquiring external information may not directly ensure company success, it is an initial step in the AC process.

Limitations and Directions for Future Research

While the study offers valuable insights, it is not without its limitations. First, the study adopted a cross-sectional nature. Such data restricts the ability to infer causality, and longitudinal studies might help explain the relationships studied herein, over time. Future studies, in addition to adopting a longitudinal approach, could also identify the tested relationships across various industries. For example, given that the finance industry in developing economies is facing an altogether different set of challenges, perhaps study can identify how and if absorptive capacity and strategic agility may enhance their performance. These additional studies should explore whether these findings are generalizable to other industries and across wider similar and varying geographical and economic contexts. In doing so, cross cultural comparative studies could also elaborate on specific differences within socio-economic factors as well as cultural factors, in which the tested relationships are tested differently.

CONCLUSIONS

This study investigates how AC affects PS in Pakistan's IT sector. In developing countries, it's crucial to understand why projects often fail and how organizations can

achieve success. AC allows organizations to enhance their technological capabilities and overall performance by effectively utilizing external knowledge. The study concludes that improving internal capabilities through AC leads to more successful projects. It highlights that, particularly in emerging economies, leveraging external expertise can significantly enhance an organization's internal skills, thereby boosting project performance. The results indicate a strong relationship between AC and PS, showing that an organization's internal innovation capabilities also play a critical role. By effectively harnessing external knowledge, organizations can transform it into valuable resources. Additionally, the findings suggest a positive correlation between AC and PS, emphasizing the importance of internal innovation in achieving favorable outcomes. However, the study notes that SA does not moderate the relationship between TIC and PS.

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