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Environmental and technological factor diffusion with innovation and firm performance: Empirical evidence from manufacturing SMEs

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The adoption of e-commerce is essential in today's dynamic business environment to optimize the overall firm performance of manufacturing SMEs. This research investigates the influence of environmental and technological factors to promote e-commerce adoption and subsequent firm performance in manufacturing SMEs. Technology usage for sustainable production is becoming a global phenomenon, though it seems less prevalent in emerging economies. Fewer studies address technology adoption issues to enhance corporate performance in Pakistani manufacturing SMEs. The present study adopted a resource-based view with the diffusion of innovation theory to formulate a research framework. We chose a stratified proportionate random sampling method to collect data by selecting four heterogeneous strata. Out of 800 distributed questionnaires, 368 top- and middle-level managers of textile, leather, sports, and surgical SMEs of Pakistan returned the questionnaire. This study employed PLS-SEM for empirical analysis. The results showed that both the technological factors' relative advantage and technology readiness have a significant positive relationship with the use of e-commerce. However, environmental factors, i.e., competitive pressure, have an insignificant effect on e-commerce usage. Nevertheless, the government support has a significant positive effect on e-commerce usage in SMEs. Overall, e-commerce adoption depicts a positive association with firm performance.

KEYWORDS

resource-based view, e-commerce adoption, technology readiness, environmental factors, technological factors, firm performance

1 Introduction

Despite many existing pieces of technology research, there is a research gap to link technology and innovation usage with the firm performance of SMEs (Chege and Wang, 2020). Although scholars have tested ERP adoption (Aremu, Shahzad, and Hassan, 2020), social media adoption (Ahmad and Ahmad, 2019), social commerce adoption (Braojos, Benitez, & Llorens, 2019), and the role of entrepreneurial competencies in e-commerce adoption (Hussain et al., 2022). Nevertheless, the mediating influence of e-commerce between environmental technological factors and business performance is still a missing link.

In addition to the compelling body of literature, organizations concerned with environmental factors have not incorporated technology innovation into their long-term strategy and vision. However, technology adoption needs to align with the firm's overall objective to enhance performance. Scholars explain that there are several types of innovation (e.g., business model, product, and service innovation); each one has different consequences for the business world (Dost et al., 2016).

However, the question about the association between innovation, the environment, and performance remains unanswered since the adoption of information technology (IT) across the globe. As the primary purpose, performance has historically been the most frequent measure to assess the success of an enterprise (Bellucci et al., 2020). Today, companies are recognizing environmental factors as influencing stakeholders. As a result, entities are reshaping their long-term policies with the influence of environmental factors like government support and industry pressure. In this domain, the role of large-scale organizations is encouraging (Biggeri et al., 2018) in comparison to small and medium (SMEs).

Business classifications such as small and medium-sized companies (SMEs) effectively categorize firms into groupings that range between micro and large-scale organizations. In Pakistan, small and medium-sized enterprises (SMEs) dominate companies, which account for 90 percent of all businesses. Approximately 3.2 million small and medium-sized companies (SMEs) are currently officially registered and operating in the United States of America (SMEDA, 2018). SMEs (small and medium-sized firms) in Pakistan, which account for around 40% of the country's gross domestic product (GDP), are playing a significant role in strengthening the entire economy as a consequence (Economic Survey of Pakistan, 2018). Thus, the manufacturing sector is a substantial source of tax revenue generation. It also contributes considerably to the growth of a diverse variety of career opportunities for semi-skilled and skilled workers. Therefore, Pakistan's government has placed a great emphasis on the success and development of large-scale industrial companies while placing less attention on the

progress and development of small and medium-sized businesses (SMEs). In Pakistan, small and medium-sized enterprises (SMEs) manufacture goods in four primary categories: textiles, leather, medical instruments, and sports equipment (Nisar, 2019b).

Digital technology has changed the number of games for global businesses. Currently, the business environment has become more complex as organizations are moving towards creativity and innovation to grab the new opportunities to increase sustainable performance (Luthra, Garg, and Haleem, 2016). Currently, the world is moving towards industrial revolution 4.0, and it is also getting the attention of businesses (Bousdekis, Apostolou, & Mentzas, 2019). Among the various benefits of industry 4.0, this will lead to higher product quality by reducing manufacturing costs by having technologies such as robots, 3D printing, the internet of things (IoT), and artificial intelligence (AI) technologies into industrial value (Bousdekis et al., 2019), which eventually increases firm performance. Consequently, several scholars have found that cutting-edge technologies improve firm performance in terms of productivity and performance (DeStefano, Kneller, and Timmis, 2018; Jenab, Staub, Moslehpour, and Wu, 2019). Several scholars (Badewi, Shehab, Zeng, and Mohamad, 2018; Catherine and Abdurachman, 2018) have concluded that it lowers operational expenses by improving efficiency and effectiveness with technology usage. In a similar vein, technology adoption like e-commerce may create a competitive advantage, ultimately increasing firm performance. There have been rare studies available in emerging countries on the use of e-commerce (Amornkitvikai and Lee, 2020).

Theoretically, few studies focused on the environmental and technological dimensions of the TOE model (Depietro, Wiarda, and Fleischer, 1990) in combination with DOI and RBV theories. Moreover, e-commerce usage as a mediating variable with environmental and technological factors by using RBV and DOI theories is a unique combination. Therefore, based on the previously mentioned practical and several theoretical gaps, the present research aims to ascertain the role of environmental and technological factors in the usage of e-commerce to attain the performance of manufacturing SMEs. Specifically, it explored the indirect impact of e-commerce on firm performance, government support, relative advantage, competitive pressure, and technology readiness.

After answering the stated research objectives, this article is further categorized into five parts. Section 2 elaborated on the brief review of the compelling literature and the theoretical framework. Section 3 describes the method and development of scale. Section 4 describes the results of structural equation modeling (SEM). Lastly, Section 5 provides concluding remarks and holistic differentiation from previous publications.

2 Literature review

2.1 Firm performance

Several firm specific factors are considered to influence firm performance (Akbar A. et al., 2021; Akbar M. et al., 2021). Firm performance as a concept has been discussed broadly in academic and organizational research and is equally important for large and small enterprises. In literature, firm performance has been investigated in terms of non-financial and financial performance (Schneider, Yost, Kropp, Kind, and Lam, 2018; Han and Hong, 2019). From a broader perspective, performance is measured by investment, productivity, and export participation (Seck, 2020). Similarly, the performance of an enterprise can be elaborated as a “comparison of the value created by a firm with the expected value received from the firm” (Larcker, 1983). Likewise, SMEs’ performance has been used as an indicator and considered an engine to access an economy’s growth and economic development (Arshad, Ahmad, Ali, and Khan, 2020). Moreover, the performance of SMEs is another momentous problem and plays a significant role in the management field as well as in new research areas (Nasuredin and Shamsudin, 2016).

2.2 Electronic commerce

Electronic commerce, a dynamic idea and a course of action that has fundamentally changed the way companies portray themselves (Nanehkaran, 2013), occurs through the telecommunication infrastructure, specifically the “internet.” It is also claimed that e-commerce encompasses the full system of electronically based institutional acts that support a company’s market interactions, including business records (Rayport and Jaworski, 2002). Moreover, e-commerce is continuously growing and comes with benefits missing in conventional offline business practices. In this regard, the rapid increase of the electronic market globally and the neighboring countries of Pakistan create stimuli to investigate e-commerce usage in Pakistan.

2.3 Competitive pressure

Competition Pressure implies the “degree of pressure resulting from a threat of losing a competitive advantage.” The threat of losing business firms to implement technology in their processes (Y.-H. Lin and Chen, 2017). The role of managers in the organization is a trend to move towards technology innovation, and even the new technology is inconsistent with the organization’s current resources. In literature, competitive pressure, it is mainly described as the pressure caused by competitors in the same industry (Oliveira and Martins, 2010a). Likewise, Competitive impact on the Use of

the knowledge system and assist SMEs to take advantage of close rivals (Ruivo, Oliveira, and Neto, 2014; Ocloo et al., 2018). It has been considered the key factors in many studies to accept new technologies to enhance the firm’s performance (Bayo-Moriones and Lera-López, 2007; Sila, 2013).

2.4 Government support

Two major types may be separated when it comes to government help in developing nations. The first is the provision of direct support. Although the first half of the indicator is related to government facilities, it is also associated with government support and assistance in encouraging small and medium-sized enterprises (SMEs) to embrace electronic commerce as a tool for growth. Several academics have published articles supporting the idea that government financing and policies positively influence the encouragement of technological innovation. The government policies are a well-known factor for the sustainable development of a country (Manning, Boons, Von Hagen, and Reinecke (2012), as well as organizational innovativeness, are a well-established factor for the sustainable development of a country (Manning, Boons, Von Hagen, and Reinecke (2012) is unassailable (Manning, Boons, Von Hagen, and Reinecke, 2012). 2016; Bamgbade et al., 2016; Bamgbade et al., 2016). Governments in countries such as China have formed several government subsidiaries to promote enterprises at various levels in order to provide greater benefits and assistance from the government to the firms. However, because government subsidiaries are primarily focused on the innovation of major corporations (Lin and Luan, 2020), it is reasonable to look at the government’s help for small and medium-sized firms in greater depth than is currently the case.

2.5 Relative advantage

The DOI theory considers relative advantage as a more consistent predictor of technology usage (Ahmad et al., 2019; Luong and Wang, 2019). The literature reveals that organizations have identified that innovation adoption provides benefits such as the solution to the current problem or presents a new opportunity regarding production like improved operational efficiency and enhanced organizational productivity (Zhu and Kraemer, 2005). Relative advantage has been considered as an essential predictor of different technology adoption (Wang, Wang, and Yang, 2010; Almoawi and Mahmood, 2011). However, adoption studies have explained the importance of technology’s relative advantage over its rivals in achieving the strategic vision of the enterprise. Consequently, it is a more consistently used predictor in e-commerce adoption studies (Oliveira and Martins, 2010b; Awiagah, Kang, and Lim, 2016;

Sin et al., 2016; Hussein, Baharudin, Jayaraman, and Kiumarsi, 2019).

2.6 Technology readiness

Technology readiness is described as “the combination of IT infrastructure and IT human resources” (Zhu and Kraemer, 2005), and both assets are required if an organization would like to use e-commerce in their small business (Oliveira and Martins, 2010b; Caputo, Cillo, Candelo, and Liu, 2019). Likewise, technology readiness is among the first issues businesses should address before adoption (Zaidi, 2017). Similarly, (Zhu and Xu 2003) found that information technology and the human skills of employees are two significant factors that can affect the technological level of an organization. In a similar context, the internet skills of the employees and IT infrastructure are also considered as the significant predictor in e-commerce usage (Kuan and Chau, 2001; Gale and Abraham, 2005). Therefore, the influence of IT infrastructure and IT human resource expertise as a combination on the use of e-commerce.

2.7 Theoretical foundation and framework

The resource-based view (RBV) theory placed a high focus on the relevance of resources in terms of increasing the performance of businesses (Penrose, 1959). In the study of Chandler (1990) and Barney (1991), RBV theory analyses corporate success in terms of resources that are diversified rather than market dominance, as opposed to traditional market dominance theory (Chen and Li, 2019). First and foremost, Barney (1991) provided a more detailed description of RBV, which included articulating two fundamental assumptions about the model. The first and foremost points of differentiation between the firm and its rivals are the assets, capabilities, processes, features, and information that it holds (heterogeneity). For the second time, the gap may continue for an extended amount of time, implying that the resources’ inertia may be sustained for an extended period.

Must-have organizational capabilities and useful assets to apply to long-term change and innovation. Thus, the success of the innovation largely depends on available resources to execute the innovation (Zhang, Sun, Yang, and Wang, 2020). Therefore, an enterprise must focus on environmental pressure and technological capacities before implementing innovations like the use of e-commerce. Moreover, Barney (1991) classified physical resources as tangible while organizational and human resources were intangible resources. According to Hwang and Min (2013), intangible resources are further categorized into internal resources (technology readiness and relative advantage) and external resources (government support and competitive pressure). Therefore, internal as technological and external as

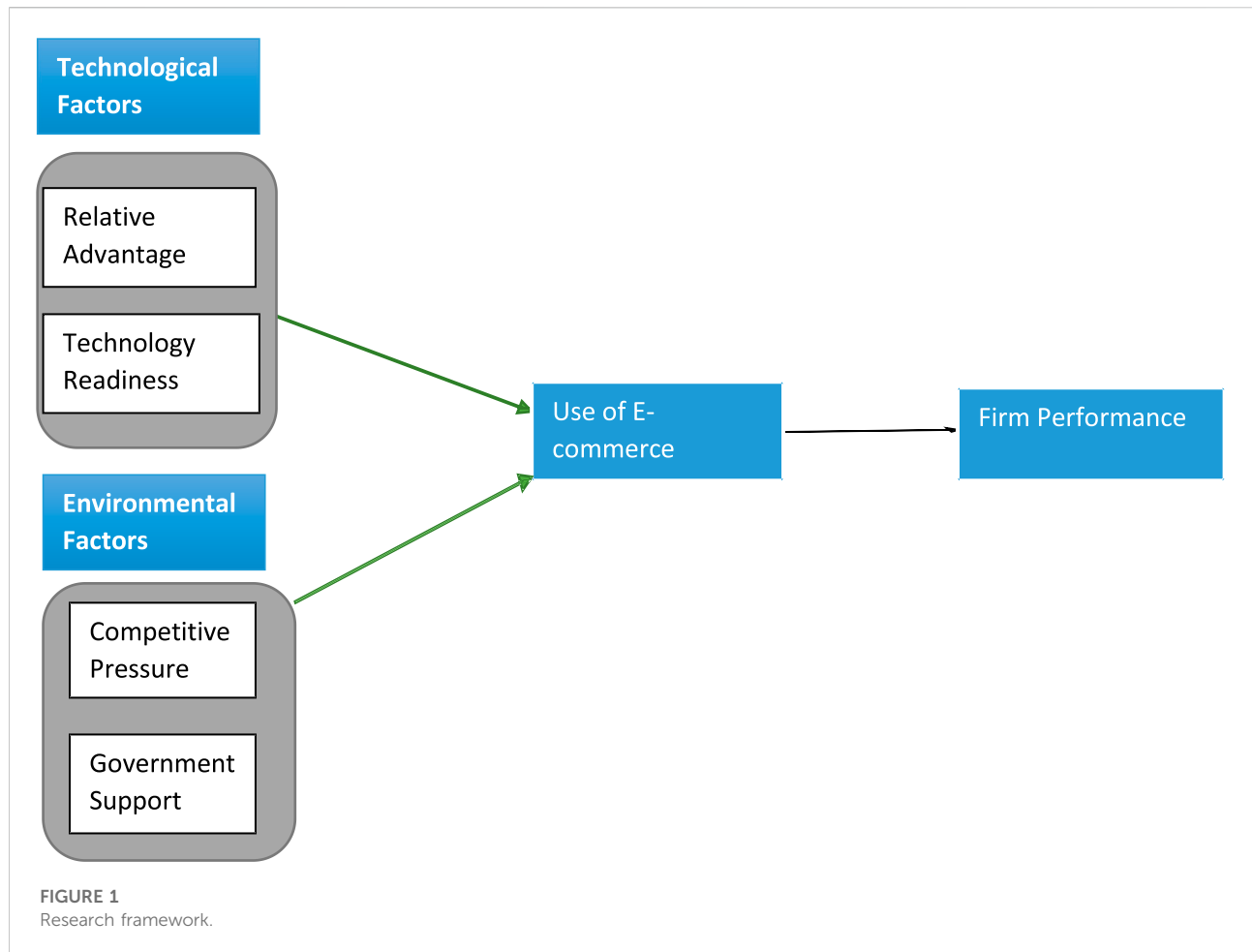
environmental resources are needed for the usage of e-commerce.

From a Diffusion of Innovation (DOI) perspective by Rogers (1995), the TOE framework investigates the environmental and technological factors (Tornatzky and Chakrabarti, 1990). The theory of DOI has been tested with several studies related to information system adoption on mobile applications, and e-learning using mobile banking apps (Mohtaramzadeh, Ramayah, and Jun-Hwa, 2018; Luong and Wang, 2019; Sheffield et al., 2019). As described by Thong and Yap (1995), technology “use” is defined as “the use of this technology to sustain company operations”. However, according to Bving and Bdker (2000), technology adoption is defined as “the utilization of innovations” as planned by the adopters (Boving and Bodker, 2003). The TOE model is also used to adopt inside a company’s internal environment (Zhang et al., 2020). To explain the adoption of new technologies in a range of contexts in the past, scientists relied on broad innovation models that were customized to specific environmental and technical factors. As a result, in the current research, innovation (in this case, the use of e-commerce) was assessed by examining two parts of the TOE model and the DOI theory to improve the efficiency of a firm’s operations and, ultimately, to gain a competitive advantage over their rival firms (Figure 1).

2.8 Hypotheses development

2.8.1 Competitive pressure relationship with the use of e-commerce

Practically, pressure from competitors resulted in losing market share, which ultimately lost the competitive advantage. Also, through competition pressure, firms are managing the faster response to customer demand, improving lead time to placing orders, and more customization will eventually lead towards performance (Zhu and Kraemer, 2005). In information communication and technology (ICT) literature, competitive pressure served as external support in the adoption process (Taylor, 2019). Likewise, e-commerce adoption/usage is regarded by many organizations as an innovation process that can accomplish a competitive advantage (Yao and Zhu, 2012). Moreover, firms should re-configure their external environment to meet the desires of the rapidly changing competition. Among the several drivers of the external environment for technology adoption, the intensity of industry pressure, the progress of the industry, and customer demand are the key factors that are beyond the firm’s control (Reynolds, Cotrino, Ifedi, and Donthu, 2020). However, an individual firm can establish a strong relationship with upstream and downstream partners to adopt technology like e-commerce (Shan et al. 2019; Sila, 2013). Since the introduction of technology usage, organizations have aggressively implemented technologies for combating the challenges of the



competitive environment. Also, quite a few studies have examined competitive pressure as an influencing predictor for new technology usage (Al-Qirim, 2007; Oliveira and Martins, 2010b; Amornkitvikai and Lee, 2020).

H₁: CP is positively significant to the UEC.

2.8.2 Government support relationship with the use of e-commerce

The government pushes the usage of technology by providing incentives, making laws and policies, and creating IT infrastructure for skilled workers (Merhi and Ahluwalia, 2017; Mohtaramzadeh et al., 2018). Previously, several publications consider environmental regulations like government support an essential means to adopt technology, which has resulted in positive, negative, and non-significant factors for a firm's technology adoption (Fu, Kok, Dankbaar, Ligthart, and Riel, 2018). However, in technology adoption literature, government support is an initial endeavor in both developed and underdeveloped regions of the globe. Based on research by Govinnage and Sachitra (2019), results showed that government support has a positive effect on SMEs in Sri Lanka. However, the government

of Pakistan has developed policies for a large organization but is less focused on SMEs; thus, the influence of government support on performance is addressed in the following hypothesis:

H₂: GS is positively significant to the UEC.

2.8.3 Relative advantage relationship with the use of e-commerce

DOI literature considers relative advantage as a more consistent predictor of adoption (Alatailat, et al., 2019; Luong and Wang, 2019). Moreover, previous studies on relative advantage are considered as a significant predictor for the adoption of innovation in developed countries' SMEs, such as Turkey (Sürer and Mutlu, 2015), the United States (Grandon and Pearson, 2004; Trainor, Rapp, Beitelspacher, and Schillewaert, 2011), and Taiwan (Chen, 2004). Although the results obtained from the study conducted in developed countries cannot be implemented in developing countries because of economic, environmental, and social differences (Rahayu and Day, 2015). However, there are very few studies found in SMEs of developing countries related to relative advantage, such as Malaysia (Mohammed, Almsafir, and Alnaser, 2013; Sin et al., 2016),

Indonesia (Setiowati, Daryanto, and Arifin, 2015; Ramdansyah and Taufik, 2017), India (Sharma, 2009), Kenya (Rowe, Truex, and Huynh, 2012), UAE (Ahmad, Abu Bakar, et al., 2019). Consequently, it is considered a critical factor in e-commerce adoption studies, specifically for Pakistan (Oliveira and Martins, 2010b; Hussein et al., 2019). The discussion leads to the following hypothesis:

H₃: RA is positively significant to the UEC.

2.8.4 Technology readiness relationship with the use of e-commerce

Technology readiness is explained by Colby and Parasuraman (2001) as a manager's propensity to use the latest technologies to accomplish goals. The current study combines IT infrastructure and IT skills as the definition of technology readiness to use e-commerce. The value of technological resources (IT infrastructure and IT human resources) is determined by how they work to facilitate technology adoption, like e-commerce usage (Zhang et al., 2020). Similarly, Oliveira and Martins (2010b) found technology readiness as a dominant factor in the European Union (EU) countries, particularly for the usage of e-businesses. Likewise, Ramdani et al., 2013, Chevers, and Williams (2013) found TR as a substantial measure of e-commerce use in SMEs in England. Moreover, Zhu, Kraemer, and Xu (2006) point out TR as a significant and positive relationship in electronic business adoption by organizations in Germany, France, Mexico, Brazil, China, and the United States. Therefore, it is reasonable to study the influence of technology readiness on e-commerce adoption for Pakistani SMEs.

H₄: TR is positively significant to the UEC.

2.8.5 Use of e-commerce relationship with firm performance

Technology adoption like e-commerce needs some essential technology resources. Furthermore, this study will test the use of e-commerce as a mediating variable (Hassen, Rahim, and Shah, 2019). In addition, a study investigated whether a company can increase its year-to-year sales by implementing an e-commerce website. Likewise, electronic businesses also positively affect organizational performance (Sahu, 2016; Ajao, Oyeibisi, and Aderemi, 2019). Additionally, it is claimed that the usage of e-commerce has a significant and positive influence on firm performance, which includes better sales, increased efficiency, productivity, and improved coordination and collaboration (as opposed to traditional methods) (Kraemer, Gibbs, and Dedrick, 2005; John and Vikitset, 2019). On the other hand, there is no relation between communication, technology, and performance (DeStefano et al., 2018). In light of the data's discrepancy, further investigation was conducted, which led to the formation of the following hypothesis:

H₅: UEC has a significantly positive relationship with FP.

2.8.6 Use of e-commerce with environmental factors and firm performance

Firms compete with their competitors industries and deal with governments (Tornatzky and Chakrabarti, 1990). Furthermore, the environmental factors include the regulatory environment, technology service providers, and industry structure (Baker, 2011). The following are the two factors (government support and competitive pressure) that have been highlighted in literature to explore their effects on technology usage.

Similarly, technology usage may affect the competitive landscape and overall business environment (Zhu and Kraemer, 2005; Al-Qirim, 2007; Oliveira and Martins, 2010b). Likewise, competitive pressure is considered an inciter to implement modern technology (Vargas-Hernández and Rosas, 2019). Thus, e-commerce usage enhances the efficient coordination of transactions, which improves firm performance.

In addition, (Zhu and Kraemer 2005) found that restrictive policies of governments cause lower IT adoption. On the other hand, it is also evidenced in previous studies that government support and incentives were found as a positive determinant factor in deciding to use technology (Elahi and Hassanzadeh, 2009; Zhu and Thatcher, 2010; Govinnage and Sachitra, 2019). Likewise, government support also positively influences e-business (Gibbs and Kraemer, 2004; Zhu and Kraemer, 2005). Similarly, Scupola (2003) concluded that internet commerce concerning government support positively relates to Italian SMEs. Therefore, the present study postulates the following hypotheses:

H₆: UEC mediates the relationship between CP and FP.

H₇: UEC mediates the relationship between GS and FP.

2.8.7 Mediating effects of e-commerce usage with technological factors and firm performance

In recent studies, it has been found that there is also a weak influence of technology adoption factors on firm performance (Hyung and Dedahanov, 2014; Jameel, Abdul-Karem, and Mahmood, 2017; Ali et al., 2020; Wang et al., 2020). However, several studies have suggested a need for further testing, so the current research has been investigated empirically to verify the results (Siepel et al., 2019) Zhu and Kraemer, 2002). Moreover, in the literature, the mediating effect of technological innovation like the use of e-commerce and business strategy (Tippins and Sohi, 2003; Anning-Dorson, 2018; Aydiner, Tatoglu, Bayraktar, and Zaim, 2019), also discussed a significant role of technological capabilities on firm performance (Poudel, Carter, and Lonial, 2019). Also, the relative advantage is found to be a significant predictor in taking e-commerce adoption decisions (Ifinedo, 2011; Luong and Wang, 2019; Saleem et al., 2019; Shah Alam et al., 2019 Mohd. Jani, 2011; Venkatesh and Bala, 2012; Zhu et al., 2006). Precisely, the previous literature concluded that the association fit in between information technology like

TABLE 1 Sample size calculation based on stratified proportionate sampling.

Stratum	Population (N)	Proportionate fraction	Sample size (S)
Textile SMEs	1304	1304/6,561 = 0.198	800*0.198 = 158
Leather SMEs	1540	1540/6,561 = 0.234	800*0.234 = 188
Sports SMEs	2071	2071/6,561 = 0.315	800*0.315 = 253
Surgical SMEs	1646	1646/6,561 = 0.250	800*0.250 = 201
Total	6,561		800

Bold values showed the total value.

e-commerce and firm performance depends on the business process, systems, and value. Thus, to understand the expressed and latent needs of the customers, allow firms” to integrate electric commerce which firm performance in following hypotheses:

H₃: UEC mediates the relationship between RA and FP.

H₅: UEC mediates the relationship between TR and FP.

3 Materials and methods

3.1 Research design, measurements, and methods

According to the government, more than 3.8 million listed businesses in Pakistan; approximately 90 percent of these organizations fall into the category of small and medium-sized enterprises (SMEDA, 2018). The SME's share in total manufacturing is much higher and contributes 70 percent of the entire value-added products generated by manufacturing units (Nisar, 2019a). The study concluded that manufacturing SMEs in Pakistan are taking part in the country's exports. According to the Pakistan export directory, the significant number of manufacturing SMEs registered in Pakistan is 6,561. The study population is further divided into four major manufacturing SMEs: textile SMEs, leather SMEs, sports goods SMEs, and surgical SMEs. The strata of the SMEs are listed in Table 2, which represents the industry-wise population of the current study.

The study used stratified proportionate random sampling. In this probability sampling technique, sampling units are drawn from every selected stratum (Eriksson and Kovalainen, 2015). In the present study, four strata of manufacturing SMEs are selected based on their participation in exports of the country, as shown in Table 1.

3.2 Measures

The survey involves questionnaire items that observe phenomena by using a 7-point Likert scale from 1 as “strongly disagree” to 7 as “strongly agree”. The performance scale has been combined from two sources, which are Jaworski

and Kohli (1993) and (Deshpandé and Farley 1998); the mediator construct is assessed by seven (07) items from Gibbs and Kraemer (2004). In measuring environmental factors, to measure competitive pressure, a six (06) items scale is adapted from Jaworski and Kohli (1993). Likewise, (Looi, 2005) scale items were adapted to analyze government support influence. The relative advantage and technology readiness were measured in technological factors by adapting scales from Premkumar, Ramamurthy, and Nilakanta (1994) and Molla and Licker (2005).

3.3 Data analysis and results

3.3.1 Respondent's profile

To explain respondents' profiles; in demographic, 23.9% of the respondents belonged to 20–30 years, the majority of the respondents belonged to the age bracket of 30–40, which were 38.5%, while 21.1% were between the age of 40–50 years, and 16.5% were above 50 years. In the gender factor, respondents from males and females are 78.2 and 21.8%, respectively. Likewise, another factor, “experience of using e-commerce,” reveals that 58.9% had an experience of 1–3 years, while 41.1% had more than three (03) years of experience. Concerning educational background, 73.5% of the respondents had a Master's degree, while 26.5% were qualified for their graduation. Similarly, firm demographics include the industry of manufacturing SMEs. Types of SMEs belong to textile SMEs (28.8%), leather SMEs, (21.2%), sports SMEs (32.8%), and 17.2% SMEs were surgical SMEs of the manufacturing industry. Lastly, the position in the organization's hierarchy resulted in 67.3% being held in middle-level positions while the remaining 32.7% of the respondents were from top management positions.

3.4 Multivariate skewness and kurtosis

Multivariate skewness and kurtosis analysis of available data were calculated by using web power software suggested by (Sarstedt and Hair 2017) and Cain, Zhang, and Yuan (2017). The Mardia's multivariate skewness ($\beta = 3.025$, $p < 0.01$) and kurtosis ($\beta = 61.259$, $p < 0.01$) results are showing multivariate normality issue. Therefore, in the current study, the researchers used PLS-SEM by smartPLS software.

TABLE 2 Industry-wise sample size based on population proportionate.

SME	Sample
Textile SMEs	158
Leather goods SMEs	188
Sports goods SMEs	253
Surgical instrument SMEs	201
Total	800

Bold values showed the total value.

3.5 Assessment of the measurement model in SmartPLS

This research uses the structural equation model (SEM) with the PLS approach using SmartPLS software version 2.0 M3 Beta (Ringle et al., 2015). To assess the measurement and structural model, specifically SmartPLS 3.2.7.0 and bootstrap resampling

(5,000 resamples) were used. Furthermore, all other necessary criteria of the measurement model were tested, i.e., convergent validity, discriminant validity, and measurement invariance discussed in Table 2 and Table 3.

3.6 Discriminate validity

Discriminant validity refers to “the extent to which the constructs are different from one another empirically” (Ab Hamid, Sami, and Sidek, 2017). Discriminate validity can be accessed by applying three criteria: cross-loading, the Fornell and Lacker method, and a new method of Heterotrait–Monotrait ratio of correlation (HTMT). Fornell and Larker’s discriminate validity criteria propose that variables are not explaining a similar trend. Thus, Table 6 indicates that all the diagonal values are higher than the values of latent variables. Likewise, to assess the HTMT values, the two commonly used criteria are given by Kline (2015) and Gold, Malhotra, and Segars (2001), with the cut-off points HTMT.85 and HTMT.90, respectively. As indicates that

TABLE 3 Factor loading/cross-loading.

Item	Competitive pressure	Firm performance	Government support	Relative advantage	Technology red_	Use of e-commerce
CP1	0.865	0.153	0.221	0.103	0.486	0.129
CP2	0.720	0.074	0.099	0.163	0.316	0.119
CP3	0.587	0.031	0.042	0.027	0.213	0.013
CP4	0.650	0.042	0.136	0.065	0.422	0.059
CP5	0.703	0.073	0.129	−0.029	0.379	0.045
CP6	0.745	0.139	0.248	−0.032	0.452	0.106
FP1	0.152	0.720	0.075	0.393	0.138	0.541
FP2	0.136	0.860	0.165	0.370	0.137	0.710
FP3	0.119	0.870	0.169	0.411	0.135	0.707
FP4	0.003	0.642	0.128	0.371	0.015	0.388
FP5	0.145	0.846	0.118	0.297	0.142	0.658
FP6	0.039	0.645	0.114	0.424	0.020	0.433
GS1	0.160	0.061	0.741	0.039	−0.031	0.067
GS2	0.107	0.193	0.891	0.067	−0.082	0.138
GS3	0.363	0.113	0.732	0.029	0.144	0.078
GS4	0.084	0.064	0.690	0.017	−0.055	0.019
RA2	0.168	0.248	−0.005	0.765	0.094	0.310
RA3	0.049	0.493	0.081	0.838	0.015	0.492
RA4	0.077	0.401	0.010	0.807	0.040	0.452
TR1	0.355	0.083	−0.156	0.004	0.695	0.072
TR4	0.383	0.043	−0.068	0.007	0.769	0.068
TR6	0.540	0.161	0.069	0.060	0.949	0.178
UE1	0.101	0.543	0.119	0.491	0.107	0.860
UE2	0.121	0.571	0.048	0.473	0.152	0.893
UE3	0.105	0.592	0.056	0.521	0.145	0.901
UE4	0.102	0.582	0.108	0.478	0.093	0.840
UE6	0.129	0.857	0.171	0.373	0.139	0.706

Bold values show the higher value.

TABLE 4 Assessment result of a measurement model.

Construct	Item	Cross-loading	Cr	Ave
Competitive pressure	CP1	0.865	0.862	0.514
	CP2	0.720		
	CP3	0.587		
	CP4	0.650		
	CP5	0.703		
	CP6	0.745		
Government support	GS1	0.741	0.85	0.589
	GS2	0.891		
	GS3	0.732		
	GS4	0.69		
Relative advantage	RA2	0.765	0.864	0.614
	RA3	0.838		
	RA4	0.807		
Technology readiness	TR1	0.695	0.85	0.658
	TR4	0.769		
	TR6	0.949		
Use of e-commerce	UEC1	0.860	0.924	0.711
	UEC2	0.893		
	UEC3	0.901		
	UEC4	0.840		
	UEC6	0.706		
Firm performance	FP1	0.720	0.896	0.593
	FP2	0.860		
	FP3	0.870		
	FP4	0.642		
	FP5	0.846		
	FP6	0.645		

identified values in Table 4 and Table 5 are below the threshold (Figure 2).

3.7 Assessment of the structural model

The structural model profoundly relies on the underlying characteristics of multiple regression to analyze an inner model of the study, which connects latent variables, as shown in Figure 3. Providently, Table 9 shows a direct relationship between constructs, four (04) out of the five (05) hypotheses

were supported in the present research. Hypothesis H_1 is not supported, i.e., the direct influence of competitive pressure on the use of e-commerce ($B = 0.012$; $T = 0.232$; $p < 0.408$). The result demonstrates that government support positively affects e-commerce usage ($B = 0.095$; $T = 1.848$; $p < 0.033$), and therefore, H_2 is supported. Next, relative advantage has a significant direct impact on the use of e-commerce ($B = 0.545$; $T = 15.005$; $p > 0.000$), and therefore, H_3 is supported. Likewise, H_4 is supported. Technology readiness has a direct positive impact on the use of e-commerce ($B = 0.138$; $T = 2.570$; $p < 0.05$). Lastly, H_5 is supported, as use of e-commerce has a positive direct impact on firm performance ($B = 0.766$; $T = 36.541$; $p < 0.000$).

3.7.1 Assessment of coefficient of determination (R^2), effect size (f^2), and predictive relevance (Q^2)

Cohen (1988) points out specific ranges like 0.02, 0.13, and 0.27, indicating that the coefficient of determination (R^2) is showing weak, moderate, and substantial effects, respectively. Table 6 explains that the calculated values of R^2 are 0.229 and 0.336, which reach moderate and substantial standards, respectively (Cohen, 1988). Moreover, the study has calculated the effect size to find out the impact on latent endogenous variables by omitting exogenous variables (Hair and Sarstedt, 2013). Likewise, Table 7 exemplifies the study's large and small effect sizes. Also, the predictive relevance (Q^2) has been measured by employing a blindfolding procedure to predict path model accuracy (Stone, 1974). The rule of thumb for the acceptance level of (Q^2) the value should be higher than 0 (Hair and Gudergan, 2017). In the present study, all the values of (Q^2) are greater than 0, which shows that variables have sufficient predictive relevance.

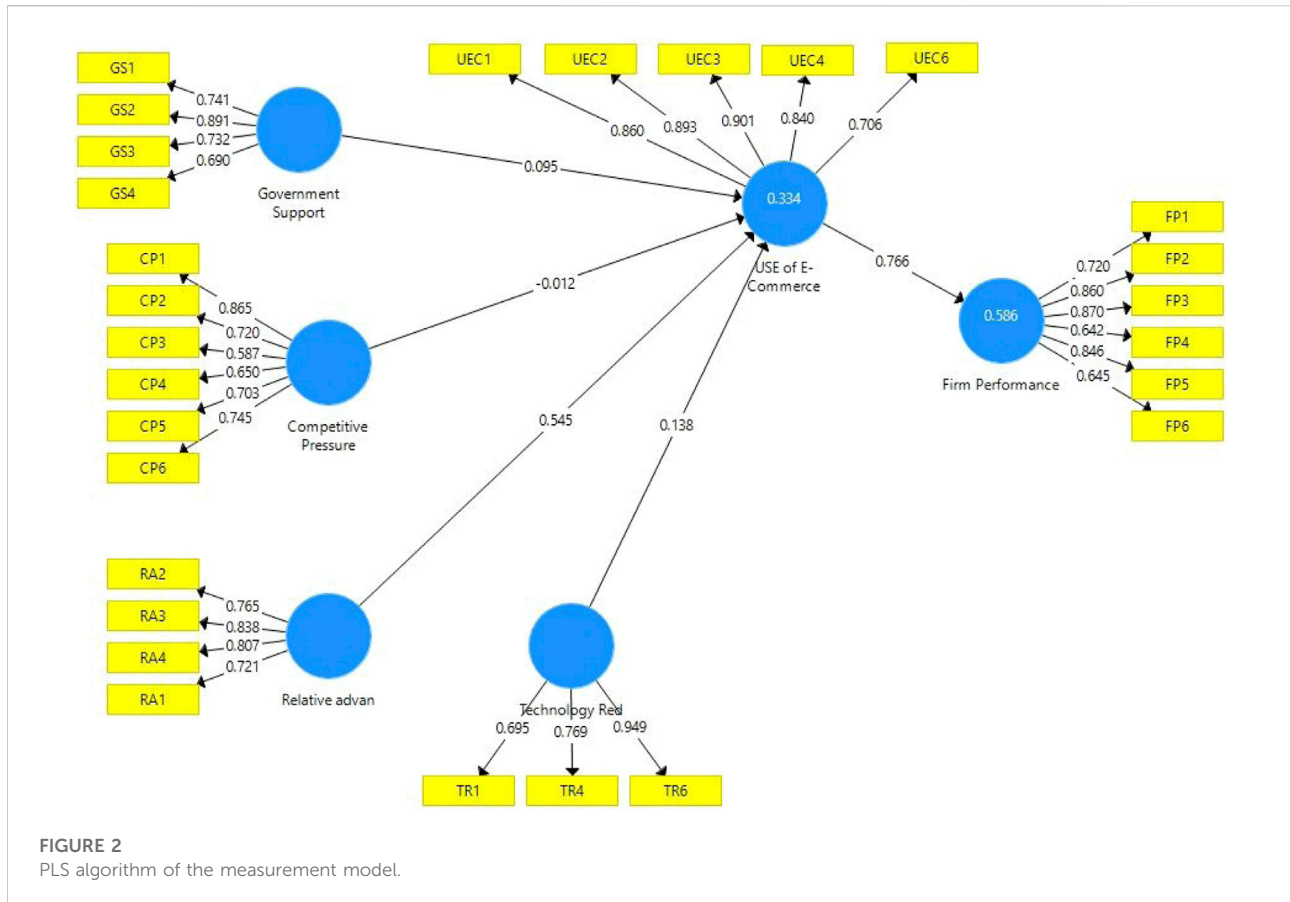
3.8 Mediation analysis

In the recent past, indirect effect or mediation analysis methods have become more popular. Previously, the most

TABLE 5 Discriminate validity matrix.

	Competitive pressure	Firm performance	Government support	Relative advantage	Tech-readiness	Use of e-commerce
Competitive pressure	0.717					
Firm performance	0.139	0.770				
Government support	0.228	0.168	0.767			
Relative advantage	0.091	0.477	0.060	0.784		
Tech-readiness	0.545	0.139	-0.013	0.042	0.811	
Use of e-commerce	0.135	0.766	0.123	0.555	0.153	0.843

Bold values show the higher value.



commonly applied method was given by Baron and Kenny (1986) in social sciences research to analyze the mediating effect. This technique was referred to as the Sobel Test. Presently, the indirect effect (mediation) is applied by using a new method called bootstrapping (Preacher and Hayes, 2008). Likewise, the bootstrapping method (5,000 subsamples) was applied to calculate indirect effect t-values. Several scholars have pinpointed that bootstrapping is a “non-parametric resampling procedure”, that has sufficient ability to identify the required effect (Preacher and Hayes, 2008).

Consequently, Table 8 presented the results of the indirect effect of e-commerce usage in relations to competitive pressure, government support, relative advantage, and technology readiness with firm performance. Thus, it is identified that the mediation effect with $\beta = 0.073$ and a t-value of 1.718 is significant with government support. Similarly, the mediation of the use of e-commerce with relative advantage and technology readiness is explained by the significant mediation by having $\beta = 0.417$, t-value of 12.784, and $\beta = 0.106$, t-value of 12.671, respectively. However, the mediating effect of competitive pressure is insignificant with $\beta = -0.009$ and a t-value of 0.243.

4 Results and discussion

The study linked technology innovation usage with firm performance. This has been achieved through the two aspects of the TOE model. Thus, the first contribution was the introduction of mediation (use of e-commerce) combined with the TOE model and firm performance. The study clearly states that two distinct factors, i.e., environmental and technological, are needed to adopt the technology. The study also established a theoretical framework through the mediation effect of competitive pressure, government support, relative advantage, and technology readiness on Pakistan’s performance of manufacturing SMEs. This research shows a different mediation effect that leads to firm performance. The former studies are focused on underlying drivers that directly influence the usage of technological innovation.

However, competitive pressure does not appear to influence the use of e-commerce directly. One interesting finding is that the competitive pressure construct does not seem to have a positively significant effect on firm performance. However, the results are inline with the previous research (Oliveira and Martins, 2010b; Merhi and Ahluwalia, 2017; Mohtaramzadeh et al., 2018; Caputo et al., 2019; Luong and Wang, 2019). Notably, the research findings also have limits in the effect of competitive pressure and the

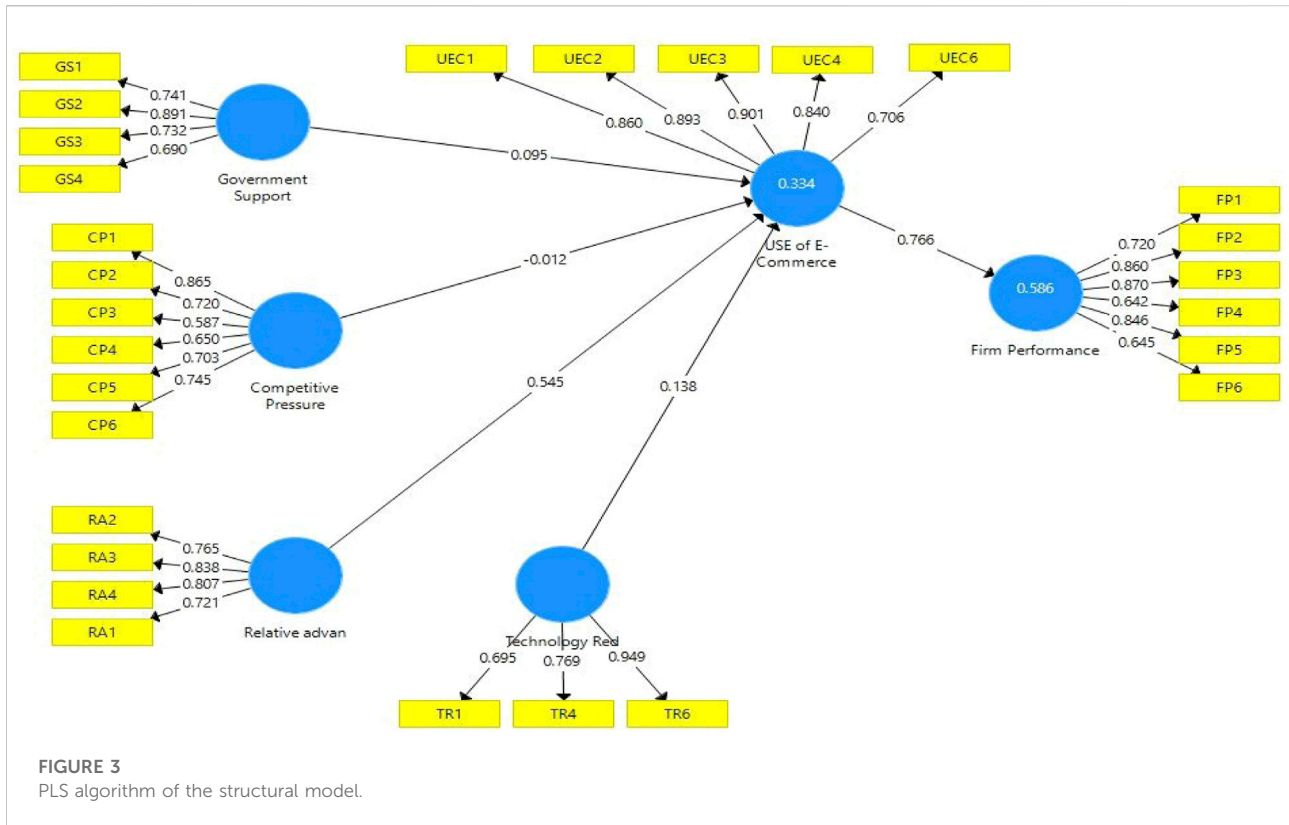


TABLE 6 Heterotrait–Monotrait ratio of correlation (HTMT).

	Competitive pressure	Firm performance	Government support	Relative advantage	Technology readiness	Use of e-commerce
Competitive pressure						
Firm performance	0.155					
Government support	0.253	0.167				
Relative advantage	0.142	0.574	0.084			
Technology readiness	0.641	0.147	0.193	0.079		
Use of e-commerce	0.129	0.828	0.124	0.644	0.155	

performance of manufacturing SMEs. Perhaps the most significant issue in manufacturing SMEs is related to the alignment of government incentives and strategic goal formulation rather than competition pressure from the industry. SMEs seek to engage in strategic relations with other trading partners to enhance performance by considering environmental factors and regulations. In conclusion, there should be upstream and downstream participation that can serve to reduce industry prices rather than competition.

4.1 A holistic comparison of our findings with other studies

Based on convincing literature, previous academics have focused on two distinct streams of study. First and foremost, they gain insights into and identify elements that influence the adoption of information and communication technology (ICT) systems (Tutusaus and Smit, 2018). In the first place, the use of innovative technology within the current adoption

TABLE 7 Mediation analysis.

No.	Relationship	Std. beta	Std. error	T-value	p-value	2.50%	97.50%	Decision
1	Competitive Pressure → USE of E-Commerce → Firm Performance	-0.009	0.038	0.243	0.404	-0.089	0.039	Not-supported
2	Government Support → USE of E-Commerce → Firm Performance	0.073	0.042	1.718	0.043	-0.070	0.121	Supported
3	Relative advantage → USE of E-Commerce → Firm Performance	0.417	0.033	12.784	0.000	0.369	0.475	Supported
4	Technology Readiness → USE of E-Commerce → Firm Performance	0.106	0.040	2.671	0.004	0.045	0.170	Supported

TABLE 8 Final results.

No.	Relationship	Std. beta	Std. error	T-value	p-value	2.50%	97.50%	Decision	R ²	f ²	Q ²
H1	Competitive Pressure → USE of E-Commerce	-0.012	0.051	0.232	0.408	-0.157	0.041	Not supported	0.586	0.000	0.336
H2	Government Support → USE of E-Commerce	0.095	0.052	1.848	0.033	0.015	0.154	Supported	0.334	0.013	0.229
H3	Relative advantage → USE of E-Commerce	0.545	0.036	15.005	0.000	0.487	0.604	Supported		0.441	
H4	Technology Red_ → USE of E-Commerce	0.138	0.054	2.570	0.005	0.063	0.220	Supported		0.020	
H5	USE of E-Commerce → Firm Performance	0.766	0.021	36.541	0.000	0.730	0.798	Supported		0.416	

context (Aremu et al., 2020). As a consequence of our research, we discovered a lack of debate about the particular use of technology, such as e-commerce, that eventually leads to increased firm performance. Consider the study (Aboelmaged, 2018), which fails to draw the relationship between sustainability and competitive capacity regarding environmental regulations and technology drivers. Based on past publications, most researchers focus on simple stratified random sampling (Zaman & Bulut, 2020). Past scholars used technology readiness as the technology readiness index (TRI) and analyzed the term as ready to adopt the technology (Ramírez et al, 2020). But, our study focused on two specific ingredients of technology readiness: IT infrastructure and IT human skills, to explore the adoption effect. The combined effect of IT infrastructure and IT skills is rarely investigated. Also, these two resources are specifically needed in emerging countries' SMEs.

4.2 Theoretical implications of the study

When it comes to the theoretical contribution of e-commerce use, its addition as a mediator substantially contributes to the whole picture of the situation. The RBV and the DOI, two components of the TOE model that have been linked to business performance as a result of the use of e-commerce, have made significant contributions to the literature and served as a source for extending the pool of knowledge and understanding. As a result, this research

provides a developing knowledge of the issues connected with the TOE model, which generally influences the usage of electronic commerce in general.

4.3 Practical implications of the study

Because of the world's digitization, electronic commerce is becoming increasingly important and will continue to gain in importance over time. This study, which is based on TOE variables specific to Pakistani manufacturing firms and employs the TOE framework to make it feasible for the use of e-commerce, has produced a valuable and practical set of results that can be used in the real world. According to the authors, these insights may be applied in academic and practical settings. Over the long term, it is anticipated that the performance of Pakistani manufacturing SMEs will increase due to this initiative. For these reasons, this research contributes to developing relevant guidelines for policymakers, allowing these groups of individuals to more efficiently and effectively target the adoption of e-commerce usage in Pakistani manufacturing SMEs and, by extension, manufacturing SMEs around the world.

5 Concluding remarks

This research reveals the mediating effects of e-commerce usage, beginning with the point that a firm's external

environment and technological capabilities are indispensable factors towards e-commerce adoption and subsequent firm performance in SMEs. Environmental uncertainty is regarded as a major problem for SMEs and creates hurdles in improving performance through innovation. Using relative advantage, government support, and technology readiness to increase technology adoption directly and indirectly affects firm performance. In the present study, both the technological factors' relative advantage and technology readiness have a significant positive relationship with the use of e-commerce.

These findings assert that firms that are proactive in technology adoption and have the requisite human resources for technology adoption outperform their counterparts. However, peer firms' competitive pressure as an environmental variable does not significantly promote corporate innovation and e-commerce adoption in Pakistani SMEs. However, governmental support has a significant impact on the adoption of e-commerce in manufacturing SMEs. These results show that both environmental and technological factors have an influence on corporate innovation and overall firm performance. Therefore, the study concludes that, with the support of the government, there is a need for senior management's competence related to technology usage for the smooth implementation of the innovation process in SMEs. Future studies can examine e-commerce usage in B2B, B2C, and C2C firms and their subsequent performance optimization.

Though the study context is limited to manufacturing firms. Future studies can extend this line of research by including the service and retail sectors or by examining data from developing countries. Moreover, to enhance the generalizability of the findings, further studies can consider an industry-wise comparison or cross-country comparative analysis.

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Data availability statement

The original contributions presented in the study are included in the article/supplementary material; further inquiries can be directed to the corresponding author.

Author contributions

AA and AH wrote the manuscript and carried out review and editing. AS and RH contributed to data collection and analysis, and HM contributed to funding acquisition for this research.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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