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Systematic Review of Factors and Barriers Influencing E-Commerce Adoption among SMEs over the Last Decade: A TOE Framework Perspective

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Abstract

This systematic review critically examines the technological, organizational, and environmental (TOE) factors influencing e-commerce adoption among small and medium-sized enterprises (SMEs) over the past decade. By dissecting the distinct roles of these TOE factors, the review identifies both the facilitators and inhibitors affecting SMEs as they navigate the complexities of e-commerce integration. The analysis reveals that while technological innovations and digital readiness significantly drive adoption, SMEs face persistent challenges related to resource limitations, cybersecurity concerns, and rapid technological change. Organizational readiness, highlighted by change management and strategic alignment, emerges as a critical determinant, whereas the environmental context, including market trends and regulatory policies, shapes the e-commerce landscape within which SMEs operate. This review emphasizes the need for a nuanced understanding of these multidimensional factors and recommends targeted interventions to alleviate barriers. Suggestions for future research include longitudinal studies to track the evolution of e-commerce adoption strategies, the impact of emerging technologies on SMEs' competitive advantage, and the role of government policy in fostering a supportive ecosystem for digital transformation.

Keywords TOE framework · Systematic review · E-commerce · SMEs · Factors and barriers

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Introduction

As articulated by Al-aaridhi (2018), the Internet's role in day-to-day activities has greatly expanded. The COVID-19 pandemic further amplified this trend, leading to a surge in online interactions as traditional retail outlets swiftly transitioned to online sales, a shift noted by Xie et al. (2022). Consequently, there has been a pronounced shift toward integrating Internet use into routine life, a change highlighted in the works of Khan et al. (2020).

E-commerce, as designated by the World Trade Organization in 1998, refers to the digital processes involved in producing, distributing, marketing, selling, and delivering products and services. Tolstoy et al. (2021) have characterized it as conducting commerce of goods or services through electronic networks like the Internet. Research conducted by Schu et al. (2016) and reiterated by Tolstoy et al. (2021) suggests that the adoption of e-commerce can catalyze small and medium-sized enterprise (SME) growth through the exploration of new markets and reaching new customer segments previously unengaged. In summary, the dynamics of international expansion for smaller businesses have evolved, driven by the rapid shift toward digital, automation in business transactions, the emergence of niche markets, and the rise of the service economy, as observed by the OECD in 2017.

The significance of SMEs to a nation's economic expansion is indisputable, as posited by Rahayu and Day (2017). Kurnia et al. (2015) highlighted the substantial contributions of SMEs to the economic tapestry, especially within developing countries. Al-Alawi and Al-Ali (2015) provided evidence that portrays SMEs not only as crucial players in socio-economic progress and employment generation but as resilient pillars even during fiscal downturns, a sentiment echoed in earlier works (Burrone, 2005; Levy & Powell, 2005; OECD, 2010). Recent data from MIDA (2023) underscores the foundational role of SMEs worldwide. In Malaysia, astonishingly, 1.15 million SMEs make up more than 97% of all businesses and account for 38.2% of the gross domestic product (GDP), underscoring their pivotal role in the Malaysian economy. Consequently, it is evident that SMEs can greatly benefit from engaging in e-commerce to secure their future sustainability, a view supported by Tolstoy et al. (2021).

Despite the wealth of research on the uptake of e-commerce (Herzallah & Mukhtar, 2015; Kabanda & Brown, 2017; Lip-Sam & Hock-Eam, 2011; Mahroeian, 2012), there remain underexplored areas that warrant attention.

Additionally, while e-commerce models and theoretical frameworks have been widely applied across numerous sectors to understand and predict consumer behaviors, their use within the SME context seems somewhat restrained. Consequently, the forthcoming research will define its objectives within this framework.

(a) To explore the TOE factors influencing e-commerce adoption among SMEs
(b) To explore the barriers to e-commerce adoption among SMEs
(c) To provide strategic recommendations for boosting e-commerce adoption among SMEs and suggest directions for future research.

Literature Review

Definition of E-Commerce

E-commerce is the practice of conducting business transactions—buying and selling—via digital platforms or over the Internet. The concept was first coined by Robert Jacobson, who served as the Principal Consultant to the Utilities & Commerce Committee of the California State Assembly. The term made its debut in the legislative arena within the title and text of the Electronic Commerce Act of California, a piece of legislation advocated by the then Committee Chairwoman, Gwen Moore (D-L.A.), and implemented into law in the year 1984.

E-commerce commonly utilizes the Internet as a fundamental component throughout various stages of a transaction's life cycle, though other technologies such as email may also be employed. According to Statista (2021), typical e-commerce activities encompass the acquisition of products (for instance, purchasing books from platforms like Amazon) or services (like digital music downloads available on distribution channels such as the iTunes Store). E-commerce manifests in three principal areas: electronic markets, online auctions, and online retailing (Wienclaw, 2013). It is underpinned by electronic business.

The intrinsic value of e-commerce lies in facilitating online shopping and payment through the Internet, thus economizing time and space for both consumers and enterprises. This notably enhances transaction efficiency, particularly for busy office workers, and contributes to substantial time savings (Subramani and Walden 2001).

Business Type of E-Commerce

There exist six fundamental categories of e-commerce as shown in Fig. 1.

1. *Commerce between companies (B2B)*: This type of e-commerce is characterized by dealings between business entities. It involves trading goods, services, or data among firms.
2. *Commerce from business to individual (B2C)*: This refers to exchanges where companies sell directly to consumers. It is the most prevalent form, often seen in online retail environments.
3. *Individual-to-individual commerce (C2C)*: In this scenario, transactions occur between private individuals, with digital platforms serving as facilitators for the trade of products or services.
4. *Individual-to-business exchanges (C2B)*: Here, individuals offer their products or services to companies. This commerce model is commonly linked with independent work and crowdsourced content.
5. *Deals from government to business (G2B)*: This e-commerce model involves interactions and transactions from public authorities to commercial entities, encompassing governmental services or procurement activities.

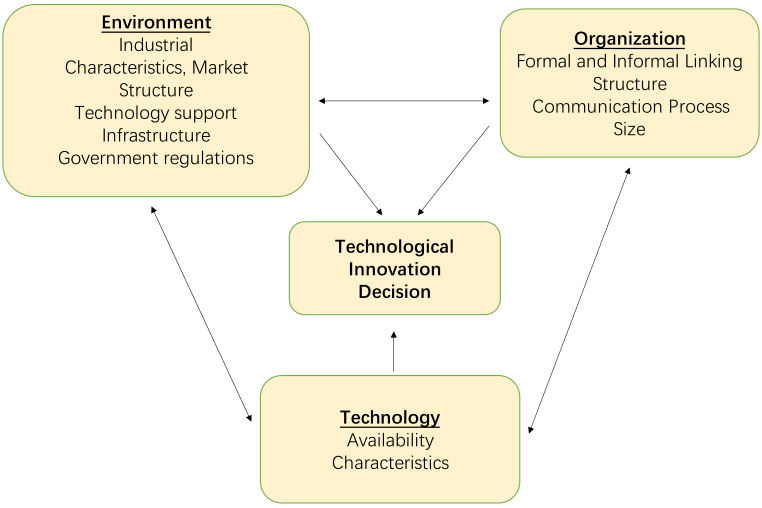

Fig. 1 Business type of e-commerce. Source: Doğaner (2007)

6. *Government-to-individual consumer transactions (G2C)*: This involves direct transactions from government bodies to private citizens, often entailing the provision of governmental services to the populace.

E-Commerce Timeline

The timeline of e-commerce development spans several decades and is marked by key milestones. The following is a brief overview of the e-commerce timeline:

(a) 1970s: Early Concepts and Innovations
The foundations of e-commerce were laid with the development of early electronic data interchange (EDI) systems, enabling electronic transactions between businesses.

(b) 1980s: Emergence of Online Shopping
The concept of online shopping began to take shape with the introduction of platforms like CompuServe and Electronic Mall. The first recorded online transaction occurred in 1984.

(c) 1990s: Commercialization and Dot-Com Boom
The 1990s witnessed the commercialization of the Internet, leading to the rise of e-commerce giants like Amazon and eBay. The dot-com boom brought a surge in e-commerce startups.

(d) 1995: Amazon and eBay Launch
Amazon was founded by Jeff Bezos in July 1994 but officially launched in 1995, initially as an online bookstore. eBay, a pioneering online auction platform, was also launched in 1995.

(e) 1999: Introduction of PayPal

PayPal was founded in December 1998 and became a widely used online payment system, contributing to the growth of e-commerce.

(f) Early 2000s: Expansion and Diversification
E-commerce continued to grow, and companies diversified their offerings. Online payment systems, improved security, and faster Internet connections facilitated further expansion.

(g) Mid-2000s: Mobile Commerce (M-Commerce) Emergence
The mid-2000s saw the advent of mobile commerce, allowing consumers to make purchases using smartphones. Companies began optimizing their websites for mobile devices.

(h) Late 2000s: Social Commerce and Group Buying
Social commerce gained traction as companies integrated e-commerce with social media platforms. Group buying sites like Groupon became popular.

(i) 2010s: Mobile Dominance and Omnichannel Retail
Mobile e-commerce continued to rise, with smartphones becoming the primary device for online shopping. Omnichannel strategies, integrating online and offline retail experiences, gained importance.

(j) 2014: Rise of Alibaba
Alibaba Group, a Chinese e-commerce giant, went public in the USA with the largest initial public offering (IPO) in history, further highlighting the global impact of e-commerce.

(k) 2020s: Acceleration and Global Pandemic Impact The COVID-19 pandemic accelerated the shift to online shopping, with e-commerce experiencing unprecedented growth. The importance of contactless transactions and digital platforms became more apparent.

The e-commerce timeline reflects a dynamic evolution, from the early concepts of electronic transactions to the widespread adoption of online shopping and the integration of technology into the retail landscape.

Global Trends of E-Commerce

E-commerce has significantly impacted businesses globally by fostering active customer engagement and transcending traditional sales transactions (Burgess et al., 2009; Eisingerich et al., 2008). As a key player in the globalization movement, cross-border e-commerce has facilitated market entry, new venture creation, and overcoming of trade barriers by numerous companies, marking a shift toward discreet business information exchanges and collaborations. This shift has particularly benefited SMEs by introducing a novel paradigm for transactions, aiding in financial stability, resource utilization, and increased revenues (Chen et al., 2022). E-commerce reached a pivotal milestone in 2012, with sales exceeding $1 trillion (eMarketer, 2012), and the advent of mobile commerce was projected to claim a significant market share by 2017 (Enright 2013). This integration, along with IT advancements in e-commerce, presents vast opportunities for rapid business growth, underscored by the importance of system quality, service quality, and user satisfaction (DeLone et al., 2014). The elimination

of geographical and temporal constraints offers a platform for global customer connectivity and cost reduction, emphasizing personalized marketing strategies to enhance product competitiveness (Bakos 2001). Furthermore, the adoption of 3D graphics and augmented reality by brands like Sony and Wayfair reflects evolving marketing techniques for a more engaging consumer experience (Constine 2018).

Technology-Organization-Environment (TOE) Framework

"The Processes of Technological Innovation" by Tornatzky and Fleischer (1990) thoroughly examined the lifecycle of technological innovation, from its inception by engineers and entrepreneurs through to the adoption and utilization within a corporate setting. Within this broad exploration, the TOE framework is introduced, clarifying the role that a firm's unique setting plays in the integration and embracement of new technologies.

In this framework designed for analysis at the organizational level, the TOE posits that a triad of aspects within a company's milieu—namely, technological, organizational, and environmental factors—plays a critical role in guiding the decision-making process regarding technology adoption as Fig. 2. These components collectively impact the way in which technological advancements are assimilated within a business.

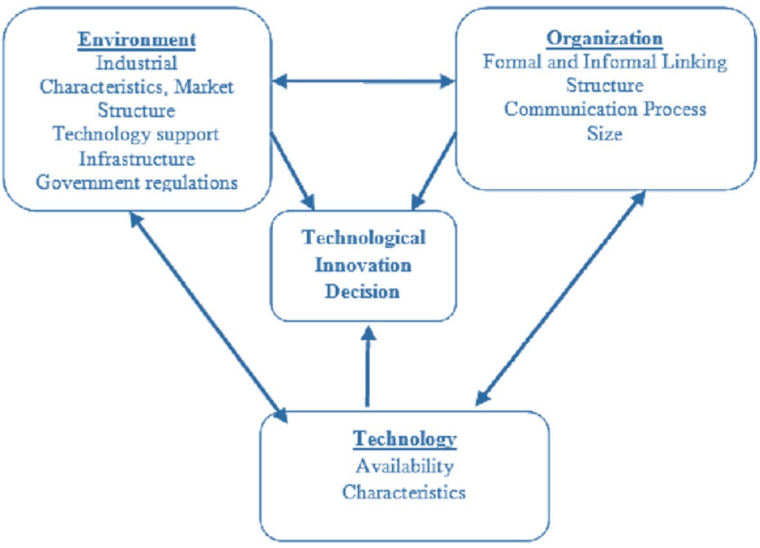

Fig. 2 TOE framework. Source: Tornatzky and Fleischer (1990)

Research Methodology

Literature reviews can be systematically classified into various forms, including those that are focused on specific domains, theories, and methodologies, and employ meta-analysis. Reviews centered on domains cover a wide array of topics that extend to disciplines within the business sphere, such as management and marketing, as well as areas outside of business. The use of meta-analysis in literature reviews is increasing across a multitude of fields, a trend that is well documented across different academic disciplines (Paul & Feliciano-Cestero, 2020).

This research is centered on a domain-based exploration to assess how e-commerce influences SME performance. Utilizing a longitudinal methodology, this study methodically sifts through numerous articles on the topic from the years 2013 to 2024. The procedure includes an organized structure for the review, employing tabulation for clarity. Key sources such as Scopus, Google Scholar, and ScientDirect were mined for relevant articles spanning the last 10 years. The objective of this comprehensive analysis is to pinpoint the factors influencing the adoption of e-commerce within the technology-organization-environment (TOE) framework for SMEs. This facet is extensively examined in Table 1, focusing on how these elements affect the integration and effectiveness of e-commerce strategies in small businesses. Table 2 shows the challenges of adopting e-commerce among SMEs, and Table 3 lists the top five journals related to e-commerce and the TOE framework, ranked by their quartile and *H* index according to the Scimago Journal & Country Rank.

For the purposes of this study, the literature review was confined to articles published in academic journals, specifically excluding conference papers and review papers to concentrate on the most rigorously vetted empirical findings within the chosen time frame. Furthermore, this study incorporates methodological flowcharts to provide a clearer understanding of the research processes undertaken as Fig. 3.

Results and Discussion

This systematic review sought to analyze literature from the last decade pertaining to factors that affect e-commerce adoption among SMEs from the TOE framework perspective. The findings unearth nuanced factors that influence e-commerce adoption and unearth barriers that SMEs encounter.

Technology Challenges

The adoption of e-commerce among SMEs is significantly hampered by technological challenges. One primary deterrent is the substantial expenses associated with implementing e-commerce infrastructure and maintaining it. Many SMEs operate

Table 1 Impact of elements on e-commerce adoption in SMEs

No	Technology factors	Authors	Description
1	Relative advantage	Nather Khsroo et al. (2024); Zhang and Idris (2024); Quyet (2024); Ahmad and Siraj (2023); Emon and Nahid (2023); Ludin et al. (2022); Akpan et al. (2022); Saáry et al. (2022); Mujahed et al. (2022); Kraft et al. (2021); Hussain et al. (2021); Apostolov and Coco (2021); Mohapatra and Thakurta (2019); Hussein et al. (2019); Groot et al. (2019); Moeuf et al. (2018); Gayen et al. (2016)	The anticipated benefits an organization gains from utilizing technology versus abstaining from its use
2	Perceived usefulness	Zhang and Idris (2024); Bracci et al. (2022); Nichifor et al. (2022); Hussain et al. (2021); Cinjarevic et al. (2021); Hussein et al. (2019); Mohapatra and Thakurta (2019); Sharifonnasabi et al. (2018); Chen et al. (2018); Lim and Baharudin (2013)	The conviction held by owners or managers that the implementation of technology will bolster organizational efficacy
3	Perceived ease of use	Nichifor et al. (2022); Bracci et al. (2022); Cranmer et al. (2021); Mohapatra and Thakurta (2019); Chen et al. (2018); Gayen et al. (2016); Lim and Baharudin (2013)	An individual's perception that the application of technology will not require extensive effort
4	Compatibility	Nguyen et al. (2024); Nather Khsroo et al. (2024); Alanudin et al. (2024); Ahmad and Siraj (2023); Emon and Nahid (2023); Cinjarevic et al. (2021); Chen et al. (2018); Gayen et al. (2016); Ainin et al. (2015)	The alignment of technology with an organization's existing technical setup, cultural ethos, values, and operational methods
5	Technology readiness	Quyet (2024); Sudari (2023); Ahmad and Siraj (2023); Hussain et al. (2021); Chonsawat and Sopadang (2020); Gayen et al. (2016)	Technology readiness encompasses the compatibility of an organization's technical framework, congruent systems, and the technical capabilities of its workforce
6	Security and reliability	Svatosova (2020); Ghandour (2015); Wang et al. (2015); Li et al. (2015); Wu et al. (2014)	Safety details are prominently presented to viewers on the website
7	Interactivity and usability	Svatosova (2020); Qalati et al. (2020); Ghobakhloo et al. (2015); Wang et al. (2015); Ainin et al. (2015)	The website offers user-friendly functionality, streamlining the buying process or access to information, and facilitating smooth navigation with interactive elements that enhance customer involvement

Table 1 (continued)

8	Marketing support	Svatosova (2020); Di Fatta et al. (2018); Song et al. (2016); Chen and Zhang (2013)	Management of marketing efforts centered on visual product presentations, promotional discounts, complimentary return policies, and flexible pricing strategies
9	Quality of Information	Alawi et al. (2018); Ghobakhloo et al. (2015)	Providing reliable and accurate information to business associates and customers
10	Quality of system	Alawi et al. (2018); Ghobakhloo et al. (2015)	User-friendliness, accuracy, and dependability
11	Privacy	Li et al. (2015)	Components and communications that assure the confidentiality of the consumer's information
No	Organizational factors	Authors	Description
12	Awareness of potential market prospects or shifts	Zhang and Idris (2024); Fadilla et al. (2023); Ludin et al. (2022); Loon and Chik (2019); Müller et al. (2018)	SMEs actively engage in technological innovation to capitalize on identified market opportunities or adjust to changes
13	Top management support	Alanudin et al. (2024); Zhang and Idris (2024); Quyet (2024); Koe and Wulandari (2023); Fadilla et al. (2023); Religia et al. (2023); Emon and Nahid (2023); Mujahed et al. (2022); Hussain et al. (2021); Müller et al. (2021); Garzella et al. (2020); Hussein et al. (2019)	Endorsement from the owner or manager in adopting new technology and/or altering business strategies
14	Innovation activity	Lestari et al. (2020); Alam et al. (2019); Loon and Chik (2019); Gatautis et al. (2019); Pucihar et al. (2019); Bouwman et al. (2018); Popa et al. (2018); Chong et al. (2018); Scuotto et al. (2017a); Yang et al. (2015); Ma et al. (2015); Thompson et al. (2013); Hardie et al. (2013); Hulbert et al. (2013)	A business engages in actions to enhance the value of its products and services
15	Strategy orientation	Fadilla et al. (2023); Yousaf et al. (2021); Gatautis et al. (2019); Bouwman et al. (2018); Gayen et al. (2016)	A strategic decision-making approach facilitates the adoption of technological advancements
16	Management of customer relationships	Lestari et al. (2020); Jiang et al. (2019); Loon and Chik (2019); Ghandour (2018); Chong et al. (2018); Herzallah and Mukhtar (2016); Chong et al. (2016); Li et al. (2015); Al-Ansaari et al. (2015); Ma et al. (2015); Wang et al. (2015); Eid and El-Gohary (2013); Chen and Zhang (2013)	Pre and post-sale using diverse mechanisms, like CRM systems

Table 1 (continued)

17	Resources for financial	Nguyen et al. (2024); Alanudin et al. (2024); Quyet (2024); Bening et al. (2023); Emon and Nahid (2023); Patma et al. (2020); Sharifonnasabi et al. (2018); Yang et al. (2015); Wu et al. (2014); Hardie et al. (2013); Eid and El-Gohary (2013)	Budgetary allocation for the establishment, upgrade, and enhancement of the e-commerce platform
18	Knowledge management	Sudari (2023); Lestari et al. (2020); Scuotto et al. (2017a, 2017b); Scuotto et al. (2017a); Ma et al. (2015)	The ability to distribute customer data and insights on market trends
19	Firm size	Zhang and Idris (2024); Bening et al. (2023); Sharifonnasabi et al. (2018); Chen and Zhang (2015)	The scale of an organization indicates its operational capabilities and is a crucial determinant of its performance
20	Structure of firm	Loon and Chik (2019); Scuotto et al. (2017a, 2017b); Xu et al. (2017); Khan et al. (2016); Al-Ansaari et al. (2015); Yang et al. (2015)	Addresses e-commerce challenges through collaborations and strategic alliances, considering trust, competitive pressure, geographical proximity, and management of external relationships
21	IT knowledge	Bening et al. (2023); Chen and Zhang (2013)	Proficiency and expertise in information technology within the company
22	Quality of service	Jun et al. (2021); Haibo et al. (2016); Al-Ansaari et al. (2015); Ghobakhloo et al. (2015)	An ample supply of information can lead to increased opportunities for negotiation, a factor deemed more pivotal in business-to-business transactions
No	Environmental factors	Authors	Description
23	Backing from a reliable entity	Mujahed et al. (2022); Hussain et al. (2021); Norris (2020); Groot et al. (2019); Yang et al. (2019)	Support from a credible source encourages SMEs to undertake technology-driven changes
24	Market competition	Alanudin et al. (2024); Zhang and Idris (2024); Quyet (2024); Ahmad and Siraj (2023); Emon and Nahid (2023); Sudari (2023); Bening et al. (2023); Religia et al. (2023); Fadilla et al. (2023); Yang et al. (2022); Ludin et al. (2022); Cinjarevic et al. (2021); Hussain et al. (2021); Pucihar et al. (2019); Zhang et al. (2015)	Innovative actions are often prompted by the strategic moves of rival businesses
25	Demands from customers and/or suppliers	Bening et al. (2023); Sudari (2023); Fadilla et al. (2023); Yang et al. (2022); Apostolov and Coco (2021); Cinjarevic et al. (2021); Norris (2020); Müller et al. (2018); Gayen et al. (2016)	Demands from customers and/or suppliers for technological compliance, such as standardized data exchanges, necessitate adjustments by SMEs

Table 1 (continued)

26	Government support	Zhang and Idris (2024); Quyet (2024); Fadilla et al. (2023); Emon and Nahid (2023); Ahmad and Siraj (2023); Bening et al. (2023); Religia et al. (2023); Bracci et al. (2022); Ludin et al. (2022); Subriadi and Wardhani (2022); Cinjarevic et al. (2021); Hussain et al. (2021); Hånell et al. (2019); Loon and Chik (2019); Groot et al. (2019); Albano et al. (2015); Zhang et al. (2015); Hulbert et al. (2013); Hardie et al. (2013)	Legislative mandates prompt the uptake of novel technologies to meet newly established industry benchmarks
27	Market disturbances	Alanudin et al. (2024); Fadilla et al. (2023); Giotopoulos et al. (2022); Musa et al. (2022); Ludin et al. (2022); Ragazou et al. (2022); Akpan et al. (2022); Khurana et al. (2022); Paoloni et al. (2022); Subriadi and Wardhani (2022); Lu et al. (2022); Zamani et al. (2022); Akpan et al. (2021); Gregurec et al. (2021); Hussain et al. (2021); Priyono et al. (2020)	Supply chain disruptions, exemplified by the COVID-19 crisis, necessitate technological adaptation and business model alterations for SMEs to remain resilient
28	Pressure of industry	Alanudin et al. (2024); Zhang and Idris (2024); Sudari (2023); Religia et al. (2023); Fadilla et al. (2023); Ahmad and Siraj (2023); Hussain et al. (2021); Qalati et al. (2020); Lestari et al. (2020); Hånell et al. (2019); Di Fatta et al. (2018); Kitchens et al. (2018); Scuotto et al. (2017a, 2017b); Chong et al. (2016); Albano et al. (2015); Zhang et al. (2015); Miles (2014); Hulbert et al. (2013)	Intensity of competition, consumer demands, and organizational constraints

Source: created by the authors

Table 2 Challenges of adopting e-commerce among SMEs

No	Technology challenges	Authors	Description	Frequency
1	Substantial expenses	Gamage (2023); Loo et al. (2023); Kumar et al. (2022); Musa et al. (2022); Fanelli (2021); Cranmer et al. (2021); Indrawati et al. (2020); Ingaldi and Ulewicz (2020); Mkansi et al. (2019); Mohapatra and Thakurta (2019); Moeuf et al. (2018); Hao et al. (2018); Pomffyová et al. (2017); Lim and Baharudin (2013)	Costs associated with technology encompass setup, education, enhancement, and recruitment	14
2	Concerns regarding security	Loo et al. (2023); Pfister and Lehmann (2022); Bracci et al. (2022); Kumar et al (2022); Juszczyk and Shahzad (2022); Lu et al. (2022); Gavrila and Ancillo (2021); Akpan et al. (2021); Westerlund (2020); Rozmi et al. (2020); Karunagaran et al. (2019); Hussein et al. (2019); Mohapatra and Thakurta (2019); Birkel et al. (2019); Jhang-Li and Chang (2017); Venkatachalam et al. (2014); Lim and Baharudin (2013)	The necessity for technology to address safeguarding measures, including protection of sensitive information and privacy of data	17
3	Compatibility and Incorporation	Juszczyk and Shahzad (2022); Teoh et al. (2022); Westerlund (2020); Birkel et al. (2019); Jhang-Li and Chang (2017); Venkatachalam et al. (2014)	The imperative for technology to be compatible and integrated with pre-existing systems, standards, and interfaces both internally and among various businesses	6
4	Complication	Gamage (2023); Lu et al. (2022); Rozmi et al. (2020); Birkel et al. (2019); Moeuf et al. (2018)	SMEs encounter challenges in navigating the intricacies inherent to certain technological solutions	5
No	Organizational challenges	Authors	Description	Frequency
5	Insufficient knowledge about technology	Nichifor et al. (2022); Kumar et al (2022); Azevedo and Almeida (2021); Westerlund (2020); Mohapatra and Thakurta (2019)	SMEs may not be fully aware of the emergence of new technological advancements	5
6	Resource constraints	Matenga and Mpofu (2022); Pfister and Lehmann (2022); Kumar et al (2022); Alshareef and Tunio (2022); Lu et al. (2022); Sell et al. (2019); Brink (2017); Bourdon and Jaouen (2016)	There are often notable limitations in terms of staffing, time availability, and financial capacity	8
7	Opposition to technological adaptation	Loo et al. (2023); Lu et al. (2022); Teoh et al. (2022); Pfister and Lehmann (2022); Kumar et al (2022); Indrawati et al. (2020); Westerlund (2020); Birkel et al. (2019); Bourdon and Jaouen (2016)	There is a tendency among employees to resist adopting new technologies and altering their customary work processes	9

Table 2 (continued)

8	Strategic deficiencies	Trstenjak et al. (2022); Apostolov and Coco (2021); Sell et al. (2019); Chen and Zhang (2015)	An absence of proper strategic planning and foresight can complicate the realization of the full advantages of technological adoption	4
9	Skill shortages	Gamage (2023); Trstenjak et al. (2022); Teoh et al. (2022); Musa et al. (2022); Reim et al. (2022); Apostolov and Coco (2021); Fanelli (2021); Ibarra et al. (2020); Indrawati et al. (2020); Westerlund (2020); Bourdon and Jaouen (2016)	There is often a scarcity of competencies necessary for the successful integration and management of new technologies	11
10	Market entry barriers	Indrawati et al. (2020); Mkansi et al. (2019); Yang et al. (2019)	The dominance of larger corporations in the marketplace poses challenges for smaller entities trying to establish a foothold	3
11	Management reluctances	Loo et al. (2023); Yang et al. (2019); Brink (2017)	Leaders and managers may exhibit hesitance in assuming accountability for the integration and effective utilization of new technology	3
No	Environmental challenges	Authors	Description	Frequency
12	Partnership difficulties	Bootz et al. (2022); Lu et al. (2022); Alshareef and Tunio (2022); Reim et al. (2022); Fanelli (2021); Apostolov and Coco (2021); Indrawati et al. (2020)	The absence of suitable business allies or issues arising from partners' conduct. Complications involved in partnership administration	7
13	Challenging socio-economic conditions	Gamage (2023); Akpan et al. (2022); Mujahed et al. (2022); Hussain et al. (2021); Indrawati et al. (2020); Mkansi et al. (2019); Groot et al. (2019)	An environment marked by inadequate education, underdeveloped infrastructure, and scant governmental backing	7
14	Consumer adoption resistance	Reim et al. (2022); Huynh (2022); Fanelli (2021); Westerlund (2020); Birkel et al. (2019); Coreynen et al. (2017); Bourdon and Jaouen (2016)	A deficiency in either consumer willingness to embrace technology or demand for technologically driven products or services	7
15	Financial access barriers	Alshareef and Tunio (2022); Kumar et al (2022); Akpan et al. (2021); Fanelli (2021); Indrawati et al. (2020); Ingaldi and Ulewicz (2020); Groot et al. (2019)	Hurdles faced in securing necessary funding or financial aid that is misaligned with the requirements of SMEs	7
16	Restrictive policy environment	Bracci et al. (2022); Kumar et al (2022); Alshareef and Tunio (2022); Juszczyk and Shahzad (2022); Fanelli (2021); Akpan et al. (2021); Rozmi et al. (2020); Indrawati et al. (2020); Groot et al. (2019)	Regulatory frameworks that fail to prioritize or expedite innovation or are beset with red tape	9

Source: created by the authors

with limited finances, and the initial investment and ongoing costs of e-commerce can be prohibitive. Additionally, concerns regarding the security of online transactions continue to be a substantial impediment. As reported in the literature, SMEs grapple with the risk of cyber threats that could potentially harm their reputation and lead to financial losses.

Another significant barrier is the challenge of compatibility and integration with existing systems. SMEs often find it problematic to integrate new e-commerce solutions with their pre-existing processes and systems. This problem is compounded by the complex nature of e-commerce technologies which small businesses, with their limited technical expertise, often find difficult to navigate.

Organizational Challenges

Organizational challenges are also significant barriers to e-commerce adoption within SMEs. Foremost among these barriers is a widespread lack of knowledge about technology within these enterprises. A related issue is resource constraints; SMEs often do not have the financial or human resources necessary to implement and support e-commerce. There is also a general opposition to technological adaptation due to a hesitation within these organizations' cultures to change longstanding business practices.

Strategic deficiencies are apparent within SMEs, as a clear strategy for e-commerce adoption is often lacking. This issue is exacerbated by skill shortages, limiting the organization's ability to conduct e-commerce effectively. Market entry barriers, such as fierce online competition and a lack of online market understanding, further constrain SMEs. Finally, management reluctances, rooted in skepticism about the benefits of e-commerce or fear of potential failure, also restrict adoption.

Environmental Challenges

Externally, SMEs face a variety of environmental challenges including partnership difficulties. Establishing trust and collaboration with online partners can be challenging, particularly when it comes to logistics and supply chain management. Moreover, challenging socio-economic conditions, such as market instability or lack of Internet access in certain regions, can hinder e-commerce initiatives.

Consumer adoption resistance plays a role; not all target demographics may be ready or willing to shift from traditional brick-and-mortar transactions to online ones. Financial obstacles, particularly in gaining access to credit and other financial services needed to support an e-commerce platform, are also prevalent. Lastly, a restrictive policy environment can impose additional burdens on SMEs, with regulations that fail to keep pace with technological changes potentially stifling e-commerce development.

Conclusion

In conclusion, the systematic review of the TOE framework concerning e-commerce adoption by SMEs over the last decade has illuminated a complex interplay of technological, organizational, and environmental challenges. Technological barriers such as high costs, security concerns, compatibility issues, and system complexities present pronounced hurdles. Organizational challenges, including limited technology awareness, resource constraints, resistance to change, strategic gaps, skill deficiencies, market entry challenges, and management reluctance, significantly deter e-commerce adoption. Moreover, SMEs are also navigating a thorny environmental landscape marked by difficulties in partnerships, challenging socio-economic conditions, consumer resistance to online shopping, financial accessibility, and restrictive policies.

Addressing these challenges calls for a multifaceted approach, where support systems from government, industry associations, and technological partnerships play a pivotal role. Future research should emphasize creating practical strategies and frameworks to support SMEs as they navigate the complexities of e-commerce adoption. It should also focus on the development of adaptive policies that recognize the rapid evolution of digital technologies. With an expected increase in global e-commerce, identifying and overcoming these barriers represent not only an entrepreneurial imperative for SMEs but a broader economic necessity. Therefore, a concerted effort by all stakeholders is crucial for fostering an inclusive digital economy where SMEs can thrive.

Recommendations and Future Research

This review provides multiple avenues for future research. It is recommended that future studies delve deeper into SMEs' strategic planning processes for e-commerce adoption and seek to understand how SMEs can overcome the reluctance to change manifested at the management level. Moreover, there is a need for research that formulates frameworks to lower financial barriers for SME entry into e-commerce. Additionally, examining the role of governmental policies and regulations in facilitating or hindering e-commerce adoption by SMEs could yield insights into ways forward. The trend toward mobile commerce as a gateway for SMEs entering e-commerce with comparatively lower initial costs also deserves further investigation. Lastly, the development of partnerships and networks to assist SMEs in e-commerce adoption could be a focus area that may unveil synergies reducing the environmental challenges currently faced by SMEs.

Implications for SMEs

The implications for SMEs emerging from this review are significant in shaping their strategies toward effective e-commerce adoption. In grappling with technological, organizational, and environmental challenges, SMEs must prioritize the following key areas to leverage e-commerce effectively:

Table 3 The top five journals related to e-commerce and the TOE framework

Title	*H* index	Citations	Quartile
Electronic Commerce Research and Applications	101	4943	Q1
International Journal of Electronic Commerce	97	3370	Q1
Journal of Theoretical and Applied Electronic Commerce Research	47	1022	Q2
Electronic Commerce Research	53	1551	Q3
Journal of Organizational Computing and Electronic Commerce	48	654	Q3

Source: created by the authors

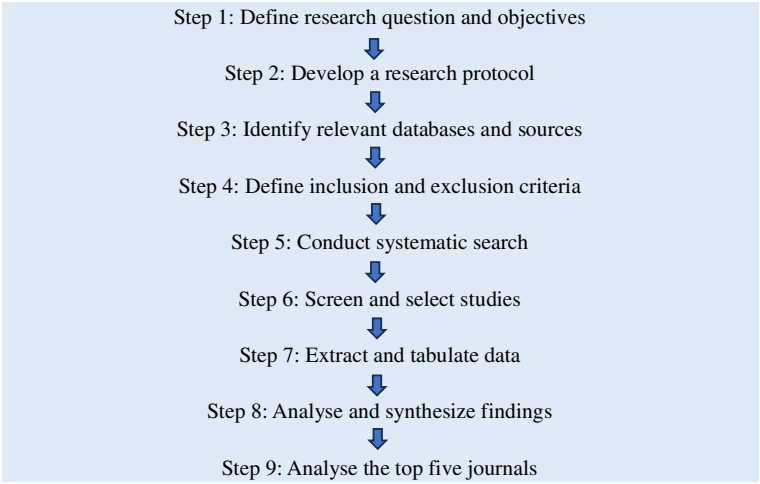

Fig. 3 Methodological flowcharts. Source: Created by the authors

(a) **Investment in knowledge and skills:** SMEs must allocate resources to train their workforce, enhancing their technology literacy and skills related to e-commerce platforms. This investment will mitigate the knowledge gaps and skill shortages that often impede successful digital transitions.
(b) **Strategic planning and resource allocation:** Strategic planning is critical for SMEs, and resources should be thoughtfully allocated to ensure that e-commerce adoption aligns with overall business goals. This includes budgeting for e-commerce setups and operations and optimizing existing resources for seamless integration.
(c) **Security measures:** With the looming threat of cyber security risks, SMEs must adopt robust security measures to protect customer data and build trust in their e-commerce platforms. Investing in cybersecurity defenses is non-negotiable in the digital marketplace.
(d) **Adaptation to technological change:** SMEs should foster an organizational culture that is adaptable and receptive to technological changes. This could enhance their competitiveness and enable quicker responses to technological advancements.

(e) **Partnerships and alliances:** Forming strategic partnerships and alliances can help SMEs overcome environmental challenges such as financial barriers and partnership difficulties. These collaborations can also provide valuable support networks for logistics and distribution.
(f) **Engagement with policymakers:** SMEs should engage proactively with policymakers to advocate for regulations and policies that support e-commerce growth and provide avenues for financial aid and incentives for adopting digital platforms.
(g) **Customer-centric approach:** Understanding consumers' resistance to adopting online shopping and addressing it through targeted marketing strategies and educational initiatives can help SMEs attract and retain customers in their e-commerce ventures.
(h) **Leveraging mobile commerce:** As mobile devices continue to proliferate, SMEs should consider mobile commerce as a viable and perhaps more accessible e-commerce entry point, which can be less expensive and more adaptable to various market conditions.

These implications drive home the need for SMEs to holistically approach e-commerce adoption. This includes not only overcoming internal barriers but also proactively engaging with external factors that affect online business practices. By doing so, SMEs can better position themselves to harness the benefits of e-commerce and ensure sustainability and growth in the digital age.

Data Availability This study is a systematic review and does not involve the generation of new data. All data analysed during this review are derived from published articles and sources cited in the manuscript. These sources are publicly available and can be accessed through the respective publishers' websites or academic databases. No additional data were generated or analysed specifically for this review.

Declarations

Conflict of Interest The authors declare no competing interests.

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