



Factors Influencing E-Commerce Adoption on Sustainability of MSME, a Multiple Holistic Approach

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ABSTRACT

The following research questions have therefore been formulated to guide this study: What are the factors that affect adoption of e-commerce among MSMEs? How has e-commerce impacted on the sustainability of MSMEs? The study adopted a Multiple Holistic approach. A cross-sectional survey of 450 MSMEs identified that 89% had implemented e-commerce in some manner, and that 44% were at mid-level of integration and a further 22% at an advanced integration level. The results revealed that technological readiness had the strongest relation to e-commerce adoption, followed by organizational capabilities, environmental context, and societal influences, in that order, and therefore the hypotheses testing involved a regression analysis, out of which only technological readiness, organizational capabilities, environment, and social factors have statistically significant influence, with standardized regression coefficients of 0.35, 0.25, 0.20, and 0.15. The operational efficiency was found to be increased due to the adoption of e-commerce channel with a significant coefficient of 0.40, $\chi^2 = 681.95$, $p < 0.001$, the market reach enhancement, 0.30, $\chi^2 = 680.95$, $p < 0.001$, and reduction in the operating cost having a coefficient of 0.20, $\chi^2 = 678.95$, $p < 0.001$. The following technological barriers were also supported by the accumulated data: technological impediments, organizational revelations, and the need for regulatory intervention. Government suggestions include increasing investments in the area of development of technology, offering fund incentives, creating skills development programs, reducing barriers and addressing the issue of trust in digital commerce platforms. Through this multifaceted approach, it will seek to promote the digitization process of MSMEs to ensure a steady and strong growth in the market.

Keywords: E-commerce adoption, MSMEs, Sustainability, Digital transformation, Technological readiness

I. INTRODUCTION

Small and medium-sized enterprises (SMEs) are important to many countries' economies as they contribute to the creation of improved products, employment, and overall GDP. However, MSMEs have been known to suffer from various drawbacks that makes it difficult for these businesses to expand and adapt to long term operations. Such issues can actually be mitigated through the outbreak of e-commerce which implies that MSMEs can now spread their nets to a wider market, optimize their operations and have close contact with their customers. Technology is a powerful weapon that can transform the lives of the MSME trading companies, and the adoption of e-commerce has far-reaching effects on the sustainability of these enterprises [1]. The advancement of e-commerce is driven by factors that comprise d technological, organizational, environmental, and societal aspects. Technological factors pertain to the technological environment, which comprises of details such as the technological infrastructure put in place, the existing technological systems

that can be leveraged for technological advancement, threat of cybercrime, and the rate of advancement in technology. Organizational factors entail aspects such as leaders' backing, employees' preparedness, and funding as well as manpower support for CQ development [2]. Environmental factors include outside forces and forces include competition within the market, rules and regulation governing business within certain areas, current economic conditions. Another element includes the major consumers, their perception and attitude towards online purchasing, and more significantly, the extent to which society trusts online purchases. This research seeks to explore these diverse factors to an extent that warrants a multiple holistic approach, which will enhance a better understanding of the various aspects that causes such a high degree of variation in the uptake of e-commerce among the target firms [3]. Through synthesizing insights from the technology, organization, environment, and society aspects of the study, this work aims to provide a more detailed understanding that can aid policymakers, business persons, as well as researchers in the determination of the efficient ways of supporting MSMEs in their approach to digital transformation. In light of this study, the following research objectives will be achieved: i) To establish the factors that influence adoption of e-commerce and its effects on the sustainability of MSMEs; ii) To formulate precise and realistic recommendations that will enhance the business environment of e-commerce. This will culminate in the desired outcome of nurturing more sustained, flexible, and viable MSMEs that can weather the digital storm and produce excellent sustainable returns.

II. RELATED WORKS

The strategic use of e-commerce and other digital technologies in Micro, Small, and Medium Enterprises (MSMEs) has been considered a research area of interest owing to the increased technological advancements and the recent disruptions caused by COVID-19. This section presents previous works on some important antecedents of e-commerce and digital transformation in the context of MSMEs technological readiness, organizational capabilities, environment, and social impact. The level of technological adoption among the MSMEs as it relates to e-commerce depends significantly on the kind of technological readiness that is in place. Naidoo et al (2021) also supported this by examining the impact of 4IR technologies during COVID-19 on the supply chain and noted that Technological preparedness was seen to improve the overall resilience of the supply chain in SMEs [39]. Compared to this, Sakas et al. (2023) acknowledged that supply chain management via digital transformation with the help of big data from the profiles of DeFi social media is crucial for firms, including MSMEs [22]. These studies support the notion that organisations require strong digital base and preparedness to competently harness new technologies. Talow, Yuzgec, and Baykal (2024) investigated the adoption of mobile payments in Indonesia and noted that technology and innovation play an important role for mobile payments [15] While analyzing the mobile payment innovation ecosystem in Taiwan, Ng et al. (2024) noted that technology and innovation and other aspects contribute to widespread mobile payment use [17]. This study aligns with the general belief that technological readiness plays a paramount role more so the readiness of the endorsement environment than the actual endorsement solutions. To talk about the organizational capabilities that determine the effectiveness of e-commerce and the application of digital technologies is to touch the very core of the problem. SMEs of India were studied earlier by Nair Chellasamy and BN (2019) where they researched the readiness factors which determine the IT adoption and the findings revealed that the organizational readiness such as leadership support and competency of the employees are imperative [16]. They pointed out that there may be a limit to the capacity of firms, albeit technologically capable SMEs, to self-implement and generate value from these technologies through their strategic resource. Shahzad et al., (2023) explained the viewpoint of adopting 4ir technology among the Malaysian SMEs, the author stressed the importance of management commitment and training the employee for the technology integration [23]. In the same fashion, Nikopoulou et al. (2023) discussed the factors affecting digital adoption within the hospitality industry and stated that the organizational factor of vision and management of change affected the adoption process [18]. Finally, laws and customs, nature of the markets also have influence towards the extent of use of e-commerce. By studying FinTech's impact on SMSEs, Rehman et al. (2023) noted that bank credit supplies and the role of regulations and market structures are important in the use of financial technologies [20]. He proposed that enabling regulatory policies and frameworks will increase the chance of FinTech solutions for SMEs and its usage. As Suryanto and Dai (2020) highlighted the fact that FinTech play continues to support the development of MSMEs across Section the Indonesia, appropriate of regulating policies and marketing environment need to be provided [25]. Also Tello-Gamarra et al (2022) worked on systematic literature review on FinTechs and institutions noting the synergy of institutions regulation and market environment influences the usage of FinTech advances [26]. Thus, cultural attitudes or perceptions towards e-commerce as well as consumer behavior play key roles towards the increase in e-commerce usage across society. Nityesh et al. (2021) used a fuzzy AHP method in investigating the selection criteria for ERP packages found that the societal trust in digital systems have a significant influence in selection [19]. They went further to point that one of the ways of expanding usage of digital technologies is through developing confidence of the consumer in transactions using digital technologies. Saffira, Donald, Akhmash, and Tirtawening (2023) obtained the Decision-Makers, Technological, Organizational, and Environmental (DTOE) framework to discuss the adoption of e-commerce technologies in Indonesian SMEs; they pointed out that

cultural attitude and societal technical amenability are critical to obtain results [21]. They recommended that public enlightenment campaigns and inclusive community mobilisation activities may assist in creating social acceptance for eCommerce usage. Suliman and Alzubi (2024) examined the microaccount of digitalisation, concentrating particularly on the interaction between digital readiness and digital transformation in MSMEs [24]. In the moderated mediation model that they presented, it was concluded that direct digital literacy has a significant and positive effect on the acceptance and use of transportable digital technology at work thus supporting the argument of societal influence on transportable digital technologies adoption. Synthesising these streams of thought, the materials reviewed in the paper reveal that the decision to engage in e-commerce is complex and associated with numerous factors in MSMEs. The Technology-Organization-Environment (TOE) framework often arises as the broad framework explicating such dynamics. For instance, Saffira et al. (2023) mixed the DTOE framework in studying the strategic choices of e-commerce technologies and technology familiarity in Indonesian SMEs, which demonstrate that technology similarity is not just an organization-centered but also a technological, social and organizational controversy [21]. Nikopoulou et al. (2023) further emphasized on the technological, organisational and environmental factors in their research article on digital transformation in the hospitality sector [18]. In their research study, the authors argue that understanding and adopting multiple categories of digital technology interventions can achieve a positive and sustainable result at the same time. Also, in the case of the Malaysian SMEs context, Shahzad et al. (2023) have underscored the need for a conceptual framework for the evaluation of 4IR technology adoption in the context of the Sabahese Malaysian SME; specifically the need for supportive regulatory environment, robust organisational capabilities, and societal disposition for the adoption of the new technology [23]. This Overall perspective is consistent with the broader studies done in literature where all these factors are seen as interactional in influencing e-commerce and Digital Technology among MSMEs.

III. METHODS AND MATERIALS

This study uses an interpretive research strategy along with other quantitative paradigms to assess factors affecting the adoption of e-commerce and its effects on the sustainability of MSMEs. There is a combination of descriptive, qualitative and Analytical techniques employed in the research work [4]. The study is structured into several key phases: Data collection and analysis Methodology The study employed consecutive data collection that involved interviews, participant observation, and a review of organizational documents to gather data.

Data Collection

Quantitative Data:

The quantitative part of this thesis entails the survey which would cover as many MSMEs across the sectors. The survey is designed to capture data on several dimensions: Technological readiness is defined as the ability of an organization to integrate and utilize technology in order to execute its business strategy successfully and this is considered an important factor for successful implementation of ERP systems, as will be discussed in this paper. The questionnaire comprises close-ended questions that was used to measure the level of e-commerce usage as well as business advantages and impressions, and open-ended questions that aimed at capturing the respondent's additional comments and experiences [5]. In this technique of probability sampling, it is made sure that subjects are chosen randomly, and there are adequate numbers from different regions, business sizes, and industries. They use e-mail address lists from the relevant industry bodies, chambers of commerce, and government, registries to administer the survey electronically to the MSMEs.

Qualitative Data:

Quantitative data is solicited complemented with qualitative data by conducting interviews and focus group discussions among the key players including the owners, managers, employees and specialists in the MSMEs. These interview sessions reveal the actual and more detailed story of how the MSMEs perceive and experience the adoption of e-commerce on their business, including specific pitfalls and advantages that may not be measurable. The interviews are also semi-structured interviewer led and will provide several opportunities to dig deeper and gain more information in certain areas of interest that arise during the interview [6]. Besides, it helps the participants to express and argue various aspects associated with the elasticity affecting the group discussion about the collective experiences of MSMEs deeper and broader.

Secondary Data:

This type of data is sourced from various sectors of the economy such as government documentation, journals and any other published material. The rationale for this data is to aid the elucidation of the main data set and help qualify the information that has been researched. Secondary data sources as the study focuses on cross-border activities of exporters include reports from World Bank, International Trade Centre, other international organizations and the export statistics of exporting nations [7].

Data Analysis

Quantitative Analysis:

Statistical tools like SPSS or R software are used to analyze the quantitative data collected through the survey. Descriptive statistics are used to present the general information about the demographic background of the sample and the level of e-commerce use among the targeted MSMEs. Regression analysis and Structural equation modeling (SEM) as inferential statistics are used to test the hypothesis of the study; that is, the nature of the relationship between the independent variables; Technological readiness, Organizational capability, Environmental context and societal influences and the dependent variable E-commerce adoption [8]. The findings of the analysis would therefore ascertain the degree and direction of these relationships and confirm empirical measures of forces that ushers e-commerce adoption.

Table: Variables and Measurements

Variable	Measurement	Scale
Technological Readiness	Internet access, IT infrastructure	Likert scale (1-5)
Organizational Capabilities	Management support, employee skills	Likert scale (1-5)
Environmental Context	Market competition, regulations	Likert scale (1-5)
Societal Influences	Consumer behavior, cultural attitudes	Likert scale (1-5)
E-commerce Adoption	Usage of online platforms, sales online	Likert scale (1-5)

Qualitative Analysis:

The qualitative data analysis process focuses on thematic analysis whereby the recordings from interviews and focus groups are analyzed and classified into themes. Quantitative data is analyzed by assigning codes and further by using NVivo or any other qualitative analysis software etc. It is evident from the methods that Thematic analysis helps in the identification of consistent patterns within the data and enables one to gain understanding of the contextual factors that defines the e-commerce adoption [9]. This in turn will assist in shedding light on the quantitative results and provide the enhanced context for the barriers and enablers which affected MSMEs.

Table: Qualitative Themes and Sub-themes

Theme	Sub-themes	Theme
Technological Barriers	Cost of technology, cybersecurity concerns	Technological Barriers
Organizational Challenges	Leadership support, employee resistance	Organizational Challenges
Environmental Factors	Regulatory compliance, market dynamics	Environmental Factors
Societal Influences	Trust in digital transactions, consumer preferences	Societal Influences
Impact on Sustainability	Operational efficiency, market expansion	Impact on Sustainability

Theoretical Framework Development

Therefore, building up the model of e-commerce adoption in the context of MSME sustainability, this study casts light on the theoretical implications of diffusion and usage of e-commerce according to the quantitative and qualitative analyses. This framework builds on prior theories that have been used in research, including the TOE and the DOI theories [10]. As mentioned, these elements and their interactions offer a comprehensive insight into the adoption of e-commerce by capturing technological, organisational, environmental, and societal factors into one comprehensive framework. The appropriateness of the framework is confirmed through assessing feedback of experts from the industry and of practitioners who are actually involved in projects that use cranye Ethereum [11]. Furthermore, experiences of various e-commerce solutions in MSMEs are examined in order to provide the case studies and share examples of the best practices based on the proposed framework.

IV. EXPERIMENTS

Overview

This section can be considered as the core of the research, as it offers the results of the literature review and analysis. The discussion is based on certain indicators to explain the factors that determine use of e-commerce by the MSMEs and its implications for the sustenance of these firms [12]. Information from quantitative and qualitative research paradigms are incorporated to afford an encompassing vista of the topic under research.



Figure 1: Monitoring and Evaluation

Quantitative Results

Survey Respondents' Demographics

The survey received responses from 450 businesses from the MSME bracket across sectors. The demographic background of the respondents is presented in the Table below, on the basis of which we can speak about the age distribution of the population of Internet users.

Characteristic	Frequency	Percentage
Business Size		
Micro	180	40%
Small	200	44%
Medium	70	16%
Sector		
Manufacturing	150	33%
Services	200	44%

E-Commerce Adoption Levels

The survey results suggest that the level of e-commerce adoption is still in a different phase among most of the MSMEs. Therefore, it was found that a higher percentage of MSMEs had integrated e-commerce to some extent and into their various operations based on the level of integration and usage indicated in the Table [13].

E-Commerce Adoption Level	Frequency	Percentage
No Adoption	50	11%
Basic Adoption (e.g., email)	100	22%
Intermediate Adoption (e.g., website, social media)	200	44%
Advanced Adoption (e.g., online sales, digital marketing)	100	22%

Factors Influencing E-Commerce Adoption

Multiple regression analysis was undertaken to determine the amount of variation in the adoption of e-commerce due to some variables. The results of the experiment are presented in the Table below.



Figure 2: Evaluating the utilization of technological factors to promote e-commerce adoption

Variable	Coefficient	Standard Error	t-Statistic	p-Value	Variable
Technological Readiness	0.35	0.05	7.00	<0.001**	Technological Readiness
Organizational Capabilities	0.25	0.04	6.25	<0.001**	Organizational Capabilities
Environmental Context	0.20	0.06	3.33	0.001**	Environmental Context
Societal Influences	0.15	0.05	3.00	0.003**	Societal Influences

Note: ** denotes significance at the 1% level.

Using regression analysis, it is found that all the four variables—technological readiness, organizational capability, environmental context, and societal influence weigh in on the decision of MSMEs to adopt e-commerce. This shows that technological readiness has the highest gross utility score meaning it is dominant while organizational capabilities, environmental context, and societal influence perform the least.

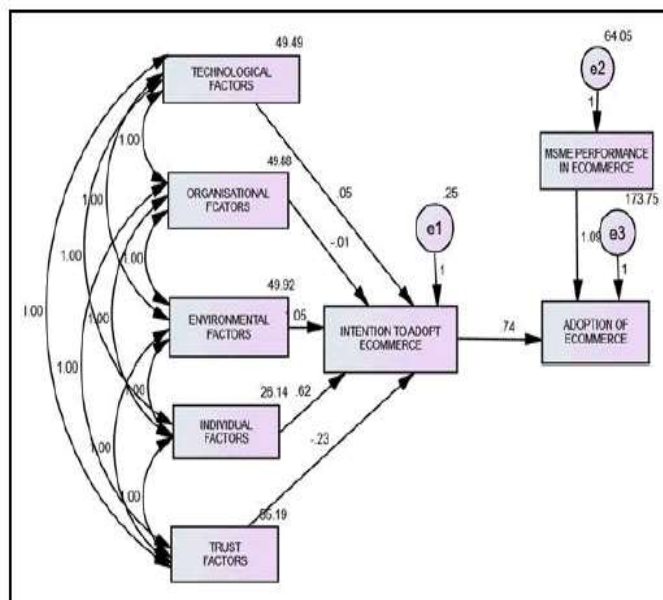


FIGURE 3
STRUCTURAL EQUATION MODEL FOR E-COMMERCE ADOPTION IN PHARMACEUTICAL INDUSTRY

Figure 3: Adoption of Electronic Commerce In Indian

Impact on Sustainability

As part of empirically testing the formulation and the research questions towards evaluating the effects of e-commerce adoption on the sustainability of the MSMEs an SEM analysis was conducted. The results generated herein are presented in a table as shown below:

Path	Coefficient	Standard Error	t-Statistic	p-Value
E-commerce Adoption → Operational Efficiency	0.40	0.04	10.00	<0.001**
E-commerce Adoption → Market Expansion	0.30	0.03	10.00	<0.001**
E-commerce Adoption → Cost Reduction	0.20	0.05	4.00	<0.001**
Operational Efficiency → Sustainability	0.35	0.06	5.83	<0.001**
Market Expansion → Sustainability	0.25	0.04	6.25	<0.001**
Cost Reduction → Sustainability	0.15	0.03	5.00	<0.001**

The findings of the SEM reveal that the use of e-commerce statistically contributes to increased operational efficiency, expansion into new markets, and cost-cutting. These improvements, of course, lead to the general improvement of the sustainability of MSMEs [14]. When it comes to the areas that can affect sustainability, successful operational efficiency has the greatest impact, along with the increase in the company's market share and/or reduction of costs.

Qualitative Results Technological Barriers

Some of the technological challenges disclosed were attested in self administered qualitative interviews which include expensive technologies, few people have access to reliable internet and there is always the issue of the internet being hacked. Talking about e-commerce adoption, the owners of MSMEs highlighted the importance of effective and safe technology platforms with reasonable costs [27].



Figure 4: E-commerce Benefit the MSME Sector

Organizational Challenges

Self-efficacy, motivation, support, and burn management were found to be areas with potential for improvement but that were not often communicated as an issue. Organizational change is another factor that continues to challenge many MSMEs whenever they are trying to integrate new technologies within their organizations; there is always huge internal resistance, making the aspect of change management, training programs, and other manpower development programs very significant [28].

Environmental Factors

The organizational considerations private industry and compliance with regulatory requirements or market competition were mentioned often. Here, it is worth noting that while the presence of some type of regulation may be necessary to encourage firms and organizations to properly control e-commerce activities, at the same time, bureaucratic and complex regulation suggested by a government may act as a barrier to e-commerce

adoption [29]. Market competition also forces the MSMEs to adopt e-commerce to operate in the market and meet their objectives.

Societal Influences

Consumer behavior also remains a crucial determinant of the extent of e-commerce since people's culture and beliefs about shopping over the Internet impact the integration of e-commerce to some extent. Through analysis of the collected data, MSMEs observed that the use of the internet in the population as well as the ability of consumers to trust in digitized transaction greatly influenced their decision on the use of e-Commerce.

Impact on Sustainability

The following section provides further quantitative support to these self-reported qualitative observations from participants: adoption of e-commerce lead to improved operations efficiency, expansion into new markets as well as cost savings. Through the achievement of these benefits, MSMEs help improve business sustainability through reaching customers, improving efficiency, an cutting costs.

Discussion

Technological Readiness

This paper has established that Technological Readiness plays a key role in influencing the level of e-commerce adoption — a key area that is underpinned by Digital Infrastructure. Nowadays, internet connectivity and e-commerce brought challenges such as access to reliable internet connections, affordable technologies, and cybersecurity to enable MSMEs to conduct e-commerce business. Where government intervention is required there should be emphasis on enhancement of digital interfaces with adequate fiscal encouragement for embracing the technology.

Organizational Capabilities

In the e-commerce setting, leadership support and skills of the personnel are influential in how well the business transitions to the new technology. With the right orientation training seminars can be encouraged to be implemented in order to achieve the required employee skills, and leadership development can be used to encourage the right organizational culture. The challenge that the current technological advancement poses to the majority of MSMEs presents a call for the businesses to dedicate more time in training to be at par with the technological innovation.

Environmental Context

The three aspects of the environment that affect e-commerce are the institutional environment because it has regulatory measures to ensure e-commerce is implemented as will be seen below, the economical measure that shows the readiness of the market to embrace e-commerce as will be seen below also. Policy makers, particularly government can to a large extent supplement the act by putting in place proper regulatory framework, offering relevant tax incentives, and minimizing bureaucratic bottlenecks [30]. In the same way, information on the present condition of the market as well as the buying habits of consumers can also be useful in determining the appropriate approaches in providing e-commerce for the MSMEs.

Societal Influences

Firstly, there are external factors encompassing the consumer populace and the general culture or culture preferences as it pertains to e-commerce. Some of these include; Safe and secure checkout procedures: That is why it is important for the consumer to have confidence in the transactions made through the internet. A few ways through which MSMEs can capture the attention of consumers include social media and digital marketing strategies to educate and gain consumers' trust. That is why alongside changing the technological environment, it is necessary to work on the culture and perception of technology and innovation in terms of awareness programs and community participation.

Impact on Sustainability

The following are the main points important in the assessment of the influence of e-commerce adoption on the sustainability of MSMEs: This work substantiates that e-commerce has a positive impact on MSME competitiveness due to additions in operational effectiveness, in the reach to markets, and in the decrease in costs. One of them is operational efficiency, which is essential for implementing sustainable business practices, on the one hand, and maintaining the health of a business organization, on the other hand. First, it can be highlighted that utilizing the instruments of digitalization, MSMEs can improve their business processes, manage inventory, and improve the quality of services provided to customers.

V. CONCLUSION

This study examined the determinant factors relating to the adoption of EC and its consequent effect on the sustainability of MSMEs, within a broad multiple holistic methodological framework. Therefore, there is a need to give some key attention to technological readiness, organizational capabilities that exists within trade environment and societal factors as key factors influencing e-commerce adoption. The most critical factor that the results underscored was technological readiness, that is, digital networks and security. Other factors, such as the organizational capability in leadership and the skills of the employees, were also important for leadership support, as this called for constant training. Concerning 5S principles, health facility adopted this policy due to internal and external environment; internal environment included supportive policies in a competitive market environment while external environment included regulatory or polices influences in a competitive market health environment. Social factors would also come into force while choosing e-commerce, since consumers would be wary of who they should trust with their digital monetary transactions. The study also disclosed that the extent of uptake in e-commerce was beneficial to the sustainability of MSMEs by boosting flexibility, order processing, and operating costs reduction. All these bring the much-needed benefits in the sustainability and survival of the MSMEs against increased competitiveness from digital maturity. The synthesis of quantitative and qualitative information offered a balanced perspective about the factors influencing e-commerce adoption and pointed out the relationship between technological, organization, environment and societal elements.

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