Advances in Consumer Research
https://acr-journal.com/
Volume-3 | Issue-1 | Jan 2026
Original Researcher Article

Understanding MSME Business Performance through E-commerce Adoption: An Integrated TOE–DOI–RBV–Institutional Theory Analysis in Delhi

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ABSTRACT
The fast rate of digitalisation of business processes has made e-commerce adoption to be an indispensable element in the competitiveness of Micro, Small and Medium Enterprises (MSME) sector. While prior studies have extensively examined Technology-Organisation-Environment (TOE) framework, limited research has integrated innovation attributes, firm-specific capabilities, and institutional forces to explain performance outcomes. Addressing this gap, the present study examines the impact of e-commerce adoption on MSME business performance by integrating the TOE framework with Diffusion of Innovation (DOI), Resource-Based View (RBV), and Institutional Theory. The primary data was collected from 387 MSMEs operating in Delhi through a structured questionnaire. The use of exploratory factor analysis confirmed a thirteen-factor measure structure, and convergent and discriminant validity were determined using confirmatory factor analysis (CFA). The analysis based on principal component regression showed that technological and environmental factors (especially IT knowledge, governmental support, competition pressure, and market readiness) positively contributed to business performance due to the adoption of e-commerce. The effects of organisational constructs like culture, structure, and managerial support were relatively weak. The integrated theoretical approach demonstrates strong explanatory power as the model explained 72.9% of the business performance variation ($R^2 = 0.729$). The implications of these findings include the extension of the TOE framework to the context of an emerging-market environment and provide substantive implications to MSME managers and policymakers who strive to strengthen the initiatives aimed at digital transformation..
Keywords: E-commerce, MSMEs, Technology–Organization–Environment (TOE), Diffusion of Innovation (DOI), Resource-Based View (RBV), Institutional Theory...

1. INTRODUCTION:

The Digital transformation has become a defining factor of expansion, competitiveness and sustainability among Micro, Small and Medium Enterprises (MSMEs) especially in emerging economies where businesses are operating within the limitation of limited resources, infrastructural shortages and increased market pressures. The MSME sector in India is a key contributor to national GDP and employment, with unequal digital adoption owing to technological, organizational, and environmental factors (Narayan et al., 2021; Ministry of MSME, 2023). Particularly, e-commerce has emerged as a transformative process that helps MSMEs increase the market reach, lower the operation expenses, improve efficiency, and interact with digitally empowered consumers more efficiently (Agwu and Murray, 2018; Chen et al., 2021). With the customer behaviour being under rapid change to online channels, capacity to embrace e-commerce has become fundamental to MSMEs staying competitive in the dynamic business environment (Li et al., 2023).

Despite the fact that Technology-Organization-Environment (TOE) framework (Tornatzky and Fleischer, 1990) has been extensively used to examine the digital adoption among SMEs and MSMEs (Oliveira and Martins, 2011; Awa et al., 2015), recent literature emphasizes that the use of TOE is not the most effective approach to understand the adoption behaviour (Borgman et al., 2020; Dwivedi et al., 2022). On its part, technological readiness alone cannot be used completely to explain adoption decisions unless these are added together with innovation-related attributes, internal capabilities, and institutional forces. Perceived attributes exhibited by the Diffusion of Innovation (DOI) theory (Rogers, 2003) include relative advantage, compatibility, complexities and observability. The Resource-Based View (RBV) (Barney, 1991) underlines the contribution of the firm-specific resources, management support, abilities, and firm culture to digital transformation (Chen

et al., 2015). At the same time, Coercive, Competitive, and Socio-cultural pressures It can be seen that the technology adoption behaviour of organizations is determined by coercive, competitive, and socio-cultural pressures (DiMaggio and Powell, 1983), especially in emerging economies (Peng et al., 2021; Nguyen et al., 2023).

Although these theories are relevant, the majority of Indian MSME studies depend on the TOE framework (Ahmad and Sinha, 2024; Sujatha and Karthikeyan, 2021), which leads to the fragmentation of the theory. There is very little research which combines TOE with DOI, RBV, and Institutional Theory resulting in a partial explanation of e-commerce adoption. Additionally, little empirical research has been conducted on how such multidimensional determinants in combination affect the business performance with most studies emphasizing on readiness or intention. Specific data to the country is also not abundant, especially in metropolitan competitive hubs like Delhi, where the digital maturity as well as customer demands, and market competition are more varied than in other regions (Agarwal & Wu, 2015). Moreover, not many studies use extensive sample sizes and sophisticated methods of analysis like the Confirmatory Factor Analysis (CFA) and Principal Component Regression (PCR) to verify the constructs and prove the causal relationships.

To fill these gaps, this research paper constructs and empirically validates a coherent, holistic model comprising TOE, DOI, RBV and Institutional Theory in order to transcend the theoretical disjointedness of Indian MSME literature. In particular, the research explores the combined impacts of technological preparedness, organizational strengths, innovation qualities and environmental forces on the adoption of e-commerce and still goes ahead to explore how adoption leads to the enhancement of firm performance a field that has not been researched substantially.

2. Literature Review

Applying e-commerce to Micro, Small, and Medium Enterprises (MSMEs) has turned into a topic of recent interest among scholars due to the transformational properties of digital technologies to enhance competitive advantage and efficiency of the business operations, as well as its expansion. Nevertheless, the level of adoption is very divergent across the developing countries, which is attributable to the structural obstacles and situational elements (Narayan et al., 2021; Chen et al., 2021). Theoretical and empirical research indicates that there exists an interplay of technological, organizational and environmental factors that determine the technology adoption of MSMEs that are explained in the Technology-Organization-Environment (TOE) model. However, more recent studies claim that the TOE framework may not be multidimensional enough to explain digital adoption, particularly in resource-constraining environments (Borgman et al., 2020; Dwivedi et al., 2022). In response, scholars are increasingly supportive of further consideration of other theoretical contributions, including the Diffusion of Innovation (DOI), the Resource-Based View (RBV), and the Institutional Theory, in order to increase the richness of the explanations (Nguyen et al., 2023; Peng et al., 2021). The second part is a summary of the literature in these theoretical views.

2.1 Technological Factors (TOE + DOI Theory)

Technological reasons make up the perceived nature of e-commerce that obscures the adoption decision of MSMEs. The DOI theory (Rogers, 2003) is particularly applicable because it describes the way the aspects of innovation affect adoption behaviour.

1.1.1 IT Knowledge

The digital adoption depends mainly on the IT knowledge of the owners, managers and employees. IT knowledge facilitates less uncertainty of technology, enhances problem-solving abilities and simplifies the process of integrating digital systems into the operations of firms (Kauffman and Walden, 2021). Empirical studies in third world countries reveal that IT literacy deficit is among the most important barriers, particularly when it comes to micro-enterprises (Narayan et al., 2021). Donbesuur et al. (2020) suggest that IT competence is a competitive internal strength facilitating the competence of the firm to utilize digital opportunities in an efficient way. MSMEs with inadequate digital competences are more prone to perceive more risk and complexity concerning the e-commerce systems.

2.1.2 Compatibility

The term compatibility refers to the level of compatibility between e-commerce and the current technological infrastructure, processes, and values of the firm (Rogers, 2003). According to previous research, MSMEs find penetration of digital platforms more viable when these platforms supplement the existing workflows (Choshin and Ghaffari, 2017). Chen et al. (2021) note that compatibility influences the decisions to adopt and the satisfaction after adoption. However, Indian MSMEs tend to work with the old processes and old business models which makes it difficult to align with e-commerce systems (Agarwal and Wu, 2015).

2.1.3 Relative Advantage

Relative advantage, or the perceived excellence of e-commerce over regular business operations, has always been pointed out to be one of the best predictors of adoption (Shah Alam et al., 2020). According to Oliveira and Martins (2011), the main benefits gained by using e-commerce by the SMEs include increased efficiency, low cost, increased market reach, and an enhanced customer experience. Li et al. (2023) show that the perceived relative advantage has a strong effect not just on the adoption but also on the continued digital use.

2.1.4 Complexity

Complexity is the degree to which e-commerce is viewed to be hard to understand or use. Complexity increases the cognitive load, training expenses and operational resistance (Kapurubandara and Lawson, 2007). According to Nguyen et al. (2023), perceived complexity is an important disincentive in the setting with low digital maturity. Many Indian MSMEs still find e-commerce to be a complicated technical challenge because of interface challenges, payment system problems, and low levels of digital support (Narayan et al., 2021).

2.2 Organizational Factors (TOE + RBV Theory)

Organizational factors explain internal situations that support or hinder the adoption of e-commerce. According to RBV (Barney, 1991), the ability of firms to be technologically innovative is determined by their internal resources, both tangible and intangible.

2.2.1 Organizational Culture

The culture of the organization is innovative, learning-based and this helps in exploration of new technologies and further digital experimentation (Zhu and Kraemer, 2005). Chen et al. (2015) suppose that an organization having a favorable culture provides greater flexibility and adaptability of adoption of e-commerce. Conversely, conservative, risk-averse cultures are the regular characteristics of Indian MSMEs, and they are driven by the systems of decisions that are dominated by owners (Awiagah et al., 2016). This cultural predisposition would probably disrupt the willingness to digital transformation.

2.2.2 Organizational Structure

The decentralized and flexible organization allows making decisions fast and reducing the bureaucratic delays involved in the introduction of new technologies (Awiagah et al., 2016). According to Ifinedo (2011), flat organizational structure improves communication and fast adoption. On the contrary, inflexible organizations hamper agility and technology exploration

.

2.2.3 Organizational Size

The size of organization determines the availability of resources, digital infrastructure and skilled personnel. Several studies have found a positive dependence between size and technology adoption (Awa et al., 2015). However, the results are not consistent. Oliveira and Martins (2011) do not find positive effects of size on the adoption of e-commerce, suggesting the contextual differences. Smaller companies might have the advantage of being agile but limited in resources; bigger companies have more resources but might be less responsive.

2.2.4 Management Support

Digital adoption is a pillar that is based on management support. Leaders influence the strategic direction, make allocation and prepare organisations to change (Ifinedo, 2011). According to Dwivedi et al. (2022), managerial commitment is a significant predictor of success of digital transformation initiatives in SMEs. The leadership attitudes play a more important role in MSMEs where ownership and management are more intertwined.

2.3 Environmental Factors (TOE + Institutional Theory)

Environmental factors refer to the external factors that have an impact on MSME adoption of digital. The elements that influence organizational behaviour, according to the Institutional Theory (DiMaggio and Powell, 1983) are coercive, normative, and mimetic pressures.

2.3.1 Government Support

The adoption of MSMEs can be greatly boosted by government interventions, including subsidies, digital training, regulatory frameworks, and development of infrastructure (Peng et al., 2021). In India, there are measures like Digital India or Udyam Registration to encourage digital inclusion, however, there are still gaps in their implementation (Soni et al., 2022).

2.3.2 Competitive Pressure

Rivalry also makes companies turn to e-commerce to retain their customers, react to competition, and remain relevant in the market (Nguyen et al., 2023). Awa et al. (2015) note that SMEs in competitive markets will be more prone to innovations. This is further enhanced by the metropolitan ecosystem of Delhi because of increasing customer demands and penetration of the digital market.

2.3.3 Market Readiness

Market preparedness indicates consumer digital literacy, online buying behaviour, payment infrastructure and logistical strengths. The e-commerce adoption is boosted by high market preparedness (Dwivedi et al., 2022). Nevertheless, Indian markets are characterized by significant inequalities in digital maturity in urban and semi-urban areas, that vary in their impact on MSMEs (Agarwal and Wu, 2015).

2.3.4 Socio-economic Aspects

The socio-economic factors which include digital inclusion, income and education, and the local infrastructure have a strong impact on the ability of MSMEs to embrace e-commerce (Chen et al., 2021). Many Indian MSMEs are based in places that have digital inequalities thus, reducing the willingness to adopt online.

2.4 E-commerce Adoption and Business Performance

The implementation of e-commerce has become a strategic force of competitive advantage and long-term performance in MSMEs, especially in the emerging economies where digital technologies can balance the resource limitation. A large body of literature proves that the adoption of e-commerce positively affects operational performance, customer interaction, and the growth of the market (Chen et al., 2021; Li et al., 2023). In resource-heavy firms, digital platforms reduce the asymmetry of costs and enhance efficiency because they automate business operations, reduce information asymmetry, and enhance its supply-chain coordination (Agwu & Murray, 2018). Such advantages are converted into better financial performance, productivity increase, and better strategic positioning compared to non-adopting firms.

Strategically, e-commerce offers MSMEs a wider domestic and international market hence accessing more customers who are geographically constrained (Awa et al., 2015). The increased sales volume, as well as brand awareness and customer loyalty, is achieved by this increased market access. Empirical data proves that digital tools enable SMEs to grow their sales faster and gain a larger market share because of improved marketing and management of customer relationships (Shah Alam et al., 2020). E-commerce platforms make the process of data collection in real-time and customer analytics, as well as personalization, less complicated and contribute to making better-informed decisions and individual marketing strategies (Dwivedi et al., 2022).

There is also an improvement in the performance in the operations. The implementation of e-commerce results in better workflow, reduction of manual errors, reduction of transactional and inventory costs and growth in better inventory (Zhu and Kraemer, 2005). Among the benefits that MSMEs are enjoying, there are standardized and automated processes such as online billing, inventory control, the integration of online payments, and logistics coordination. This kind of progression makes the businesses more receptive, hastens the time taken in delivery and enhances the quality of service hence boosting customer satisfaction and loyalty. This outcome can be linked to the Resource-Based View (RBV) that states that the digital capabilities could be converted into valuable, rare, and hard-to- copy resources, which could produce the long-term advantages in performance (Barney, 1991; Chen et al., 2015).

Furthermore, the use of e-commerce enhances the innovation potential of firms, as it allows introducing new products, diversification of business, and testing new business models (Nguyen et al., 2023). Research shows digitally enabled MSMEs are more agile and flexible, which puts them in a better position to overcome competitive and market uncertainties (Peng et al., 2021). Digital adoption also increases the capabilities of firms to cooperate with their suppliers, distributors and customers by providing integrated communication systems, and thus increasing the value chain connectedness and efficiency of the value chain.

In a country with a developing economy like India, the level of performance improvement is notably high because of the fast adoption of digital payments, the growth of customer digital literacy, and governmental assistance of online business ecosystems (Soni et al., 2022). However, the degree to which e-commerce enhances performance is subject to complementary issues when it comes to managerial competency, technological preparedness, workforce competence, and environmental encouragement. Without proper internal capabilities, the adoption can deliver small or uneven performance results especially in micro-enterprises that are working in low-tech settings (Narayan et al., 2021). Based on this, the connection between e-commerce adoption and business performance is not linear but contextual and organizational conditions mediate it.

Although comprehensive literature exists on the determinants of adoption, relatively limited studies have been conducted in the Indian MSME setting with respect to the empirical research on the impact of e-commerce adoption in the context of quantifiable business performance. Current studies are focused mainly on intention, readiness, or barriers (Ahmad and Sinha, 2024), thus establishing a gap in the literature on adoption -to-performance pathways. This gap is filled in the present study since the study is conducted on an empirical basis, and the research uses adoption of e-commerce in contributing to various aspects of business performance such as customer satisfaction, efficiency, profitability, market share, and overall productivity.

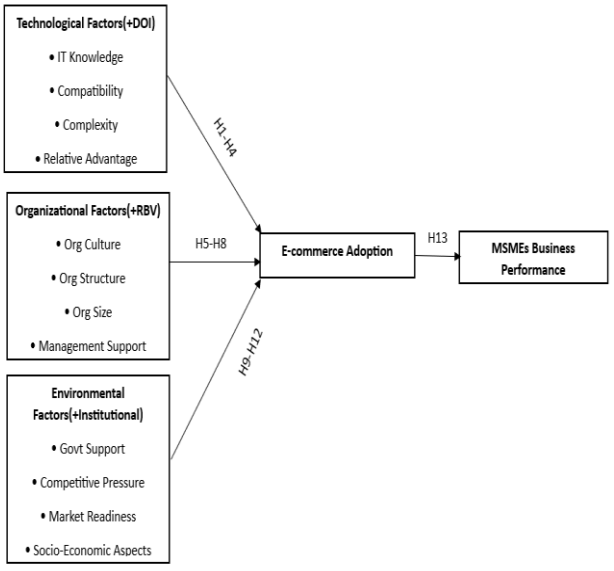
3. Conceptual Framework

This study is theoretically founded on the foundation of the integrated theoretical framework of Technology Organization Environment (TOE) framework, Diffusion of Innovation (DOI) Theory, Resource Based View (RBV) and the Institutional Theory. This combined methodology encompasses the multidimensional determinants of e-commerce adoption amongst the MSMEs and how all the determinants interact to dictate the performance of the business.

The framework clusters the antecedent variables into three central dimensions, such as technological, organizational and environmental, and each of them is backed by a significant theoretical lens. The technological aspect (DOI + TOE) encompasses the attributes of innovation, i.e., IT knowledge, compatibility, complexity, as well as relative advantage, which predetermine the MSMEs attitudes to the viability and usefulness of e-commerce. Organizational dimension (RBV + TOE) describes internal capabilities such as organizational culture, organization, scale, and management support, which determine the willingness and capability of firms to go digital. The environmental dimension (Institutional Theory + TOE) is an external pressure in the form of government support, competition intensity, market preparedness, and the socio-economic environment that influence the strategic choices of MSMEs to venture in online business.

The twelve antecedent factors combine to affect the main construct of the model: the e-commerce adoption. When embraced, e-commerce is supposed to enhance positively in the business performance of MSMEs as it will facilitate efficient operations, better interaction with customers, increase in market reach, and competitiveness. In such a way, the framework places e-commerce adoption as an intervening factor between contextual determinants and performance outcomes.

Figure 1: Proposed Conceptual Framework for E-commerce Adoption and Business Performance



Source: Author's own illustration

4. Hypothesis Development

This section will formulate hypotheses connecting the determinants of e-commerce adoption to technological,

organizational, and environmental factors based on the integrated theoretical knowledge provided in the literature and then the business performance among MSMEs.

4.1 Technological Factors

H1: IT knowledge has a significant effect on MSME business performance through e-commerce adoption.
H2: Compatibility has a significant effect on MSME business performance through e-commerce adoption.
H3: Complexity negatively affects MSME business performance through e-commerce adoption.
H4: Relative advantage has a significant effect on MSME business performance through e-commerce adoption.

4.2 Organizational Factors

H5: Organizational culture has a significant effect on MSME business performance through e-commerce adoption.
H6: Organizational structure has a significant effect on MSME business performance through e-commerce adoption.
H7: Organizational size has a significant effect on MSME business performance through e-commerce adoption.
H8: Management support has a significant effect on MSME business performance through e-commerce adoption.

4.3 Environmental Factors

H9: Government support has a significant effect on MSME business performance through e-commerce adoption.
H10: Competitive pressure has a significant effect on MSME business performance through e-commerce adoption.
H11: Market readiness has a significant effect on MSME business performance through e-commerce adoption.
H12: Socio-economic aspects have a significant effect on MSME business performance through e-commerce adoption.

4.4 Business Performance

H13: E-commerce adoption has a significant effect on the business performance of MSMEs.

5. Research Methodology

The research design was a quantitative, cross-sectional research design, as the study sought to understand the determinants of e-commerce adoption, among Micro, Small and Medium Enterprises (MSMEs) in Delhi and how it ultimately affected the business performance. Quantitative designs are ideal to a study of technology adoption since they permit testing of theory-based causal association and permit a stringent evaluation of latent constructs (Creswell and Creswell, 2018; Hair et al., 2020).

5.1 Survey Items and Data Collection Tool

The measuring tool had been established by modifying the questions in the existing and tested scales in the Technology-Organization-Environment (TOE) model, Diffusion of Innovation (DOI)-theory, Resource-Based View (RBV), and Institutional Theory. The questionnaire used in the final form had five sections namely: (1) demographic information, (2) MSME profile, (3) basic e-commerce usage, (4) technological determinants, organizational and environmental determinants, and (5) business performance indicators. The measures of all the constructs were made on a 5-point Likert scale (1-strongly disagree to 5-strongly agree).

The technological factors were IT Knowledge, Compatibility, Complexity, and Relative Advantage, assessed with the help of items modified by the authors of Rogers (2003), Moore and Benbasat (1991), and Oliveira and Martins (2011). As an illustration, the IT Knowledge items measured the opinion of the respondents on digital competence, availability of the Internet, technical readiness, and security, and Compatibility items measured the alignment of the e-commerce systems with the existing processes, culture, and infrastructure. Complexity assessed perceived difficulty, load on troubleshooting, and financial/technical issues, and Relative Advantage assessed perceived benefits including reduction of costs, market reach, efficiency and customer satisfaction. All these include 19 items/statements to capture the essence of this factor.

The organizational factors were tested based on the items adjusted to digitalization studies via RBV (Barney, 1991; Zhu and Kraemer, 2005). These were Organizational Culture, Management Support, Organizational Structure and Organizational Size ranging over 15 items. The items measured leadership commitment, innovation culture, flow of communication and availability of resources.

The measurement of the environmental factors included Government Support, Competitive Pressure, Market Readiness, and Socio-economic Aspects based on 16 items based on the measurements of Tornatzky and Fleischer (1990), Oliveira and Martins (2011) and the recent study on institutional adoption. These objects represented regulatory clarity, competitor behaviour, and customer and supplier digital readiness, the availability of infrastructure, and socio-economic digital inclusion.

The business performance indicators included nine items that included efficiency, profitability, ROI, customer satisfaction, brand value, productivity, cost reduction and market share.

Five academicians and two industry practitioners reviewed the first questionnaire to guarantee face validity. The pilot test was done on 25 MSMEs to determine the clarity of items, the order of items, and the reliability. Feedback was used to make slight changes to the wording and structure of the survey, prior to implementing the final survey. The data was collected between August 2024 and March 2025 to use the combination of an offline survey and online forms because the maximum number of MSMEs with different digital capabilities were considered.

5.2 Respondent Selection Criteria

The target of the study was registered MSMEs in the state of Delhi that covered manufacturing, services and trading industries. Delhi was specifically chosen since it has a high concentration of industry, one of the top five e-commerce hubs in India, a high digital readiness, and a competitive industry which is why it forms a good study location to capture e-commerce adoption behaviour among urban MSMEs in India.

The criteria used to select the respondent are as follows:

1. The firm were formally registered as an MSME under the Udyam Registration Portal.
2. The respondents were senior executives of the MSMEs.
3. The enterprise had adopted, initiated or shown interest in e-commerce.
4. The firms were located within Delhi's recognised industrial zones.

Data were collected primarily through offline field visits to major industrial clusters such as Mangolpuri, Bawana, Mundka, Mayapuri, Naraina, and Nangli Sakravati, Okhla etc which comprise high concentrations of micro and small manufacturing and trading units. These areas were chosen because field surveys are more effective where digital literacy varies and where many respondents prefer face-to-face interactions. The sampling technique is non probability i.e convenience and snowball were used, consistent with prior MSME studies where reliable sampling frames are limited (Kumar et al., 2022).

Out of the total MSMEs approached, 387 valid responses were obtained. This sample exceeds the recommended minimum of "10 respondents per indicator" for multivariate analysis (Hair et al., 2019) and is sufficiently diverse in terms of sector, size, and technology usage to allow generalisable insights about e-commerce adoption among MSMEs in Delhi.

5.3 Data Analysis Techniques

Data were analysed in SPSS and STATA following a multi-step procedure:

5.3.1 Reliability and Sampling Adequacy

Cronbach's alpha (threshold $\alpha \geq 0.70$) was computed to assess internal consistency (Nunnally & Bernstein, 1994). Sampling adequacy was assessed through the Kaiser–Meyer–Olkin (KMO ≥ 0.60) statistic and Bartlett's Test of Sphericity (Kaiser, 1974).

5.3.2 Exploratory Factor Analysis (EFA)

EFA using principal axis factoring and promax rotation was performed to identify the underlying factor structure. Loadings ≥ 0.50 were considered acceptable (Hair et al., 2019).

5.3.3 Confirmatory Factor Analysis (CFA)

CFA was conducted in STATA to confirm the measurement model and assess convergent and discriminant validity using Composite Reliability (CR $\geq$ 0.70) and Average Variance Extracted (AVE $\geq$ 0.50). Model fit was evaluated using CFI, TLI, RMSEA, and SRMR thresholds recommended by Hu and Bentler (1999).

5.3.4 Principal Component Regression

PCR was used because the independent variables were transformed into factor scores through CFA, which helps reduce multicollinearity and captures the shared variance among items. PCR is different from multiple regression because it uses component scores instead of original variables.

6. Data Analysis and Results

In this section, the findings of the statistical analysis performed in SPSS and STATA have been indicated. Analysis was done in a systematic order in which data were screened, reliability, EFA and CFA were performed with hypothesis being tested in the end using a PCR.

6.1 Sampling Adequacy and Reliability

The Kaiser Meyer Olkins (KMO) measure and Bartlett Test of Sphericity were used in sampling adequacy. KMO = 0.785 shows that there is meritorious sampling adequacy, which exceeds the suggested level of 0.60. The Test proposed by Bartlett proved to be very important (^{2} = 10755.71, p = 0.001), thus indicating that there were enough inter-correlations between the items in order to continue with the factor analysis. All the thirteen constructs showed a high internal consistency with Cronbach alpha of between 0.82 and 0.94.

Table 1: Reliability and Sampling Adequacy Tests

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.785
Bartlett's Test of Sphercity	Approx. Chi-Square	10755.712
	df	1891
	Sig.	.000

Source: Author's Calculation

These results indicate that the dataset is both adequate and internally consistent for further multivariate analysis. The meritorious KMO value and highly significant Bartlett's test confirm that the items share sufficient common variance to justify factor analysis. The high Cronbach's alpha values suggest that the constructs capture stable and coherent dimensions of MSMEs' e-commerce adoption context, which increases confidence in the subsequent EFA, CFA and regression results.

6.2 Exploratory Factor Analysis

Exploratory Factor Analysis (EFA) was done as Principal Axis Factoring with Promax (oblique) rotation because the constructs included in the TOE–DOI–RBV-Institutional framework are theoretically supposed to be correlated as opposed to being orthogonal. Promax is also applicable when the latent variables might conceptually overlap with one another and when one seeks to have more realistic and interpretable factor structure of social science studies (Costello and Osborne, 2005; Fabrigar et al., 1999). Promax rotation created a decisive thirteen-factor solution that was in line with the conceptual model.

Table 2: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.622	9.068	9.068	5.622	9.068	9.068
2	4.098	6.609	15.677	4.098	6.609	15.677
3	3.817	6.156	21.834	3.817	6.156	21.834

4	3.509	5.659	27.493	3.509	5.659	27.493
5	3.178	5.125	32.618	3.178	5.125	32.618
6	2.983	4.811	37.429	2.983	4.811	37.429
7	2.938	4.738	42.167	2.938	4.738	42.167
8	2.749	4.434	46.602	2.749	4.434	46.602
9	2.629	4.240	50.841	2.629	4.240	50.841
10	2.512	4.052	54.893	2.512	4.052	54.893
11	2.221	3.582	58.475	2.221	3.582	58.475
12	2.172	3.503	61.978	2.172	3.503	61.978
13	1.953	3.151	65.129	1.953	3.151	65.129
14	.801	1.292	66.421			
15	.752	1.214	67.634			
16	.725	1.169	68.803			
17	.708	1.143	69.946			

Source: Author's Calculation

The table 2 explained the Total Variance Explained provides the number of components which is extracted by Principal Component Analysis (PCA) and the total variance which is explained by each. In this analysis, 13 factors (components) were taken out since they had an eigenvalue more than 1, according to Kaiser criterion (Kaiser, 1974). These 13 elements explain 65.13 per cent of the total variance, which is satisfactory as far as behavioural and social science research are concerned, and cumulative vintage over 60 per cent is considered satisfactory (Hair et al., 2019).

The first factor accounts 9.07% of the total variance followed by the second (6.61), third (6.16), fourth (5.66), and the fifth or sixth, with each subsequent factor contributing to the total variance, but the contribution by each further point on, continues to decrease. This trend implies that the first few components account a bigger share of the difference between variables whereas the rest of the components are smaller yet significant shares of variation.

The thirteen factors broadly correspond to the conceptual structure of the TOE–DOI–RBV–Institutional framework, confirming that technological, organizational and environmental dimensions emerge clearly from the data. The satisfactory cumulative variance (65.13%) indicates that the extracted factors explain a large portion of MSMEs' perceptions related to e-commerce, which is in line with earlier adoption studies in SMEs.

Table 3: Pattern Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13
IT1	.800												
IT2	.838												
IT3	.797												
IT4	.800												
COM1		.806											
COM2		.796											
COM3		.792											
COM4		.799											
COM5		.791											
CMP1			.803										
CMP2			.808										
CMP3			.784										
CMP4			.793										
RA1				.813									

RA2				.784									
RA3				.835									
RA4				.746									
RA5				.768									
RA6				.733									
OC1					.805								
OC2					.810								
OC3					.810								
OC4					.815								
MS1						.809							
MS2						.794							
MS3						.796							
MS4						.795							
MS5						.783							
OST1							.818						
OST2							.811						
OST3							.830						
OST4							.798						
OS1								.856					
OS2								.796					
OS3								.831					
GS1									.787				
GS2									.837				
GS3									.804				
GS4									.824				
CP1										.777			
CP2										.770			
CP3										.804			
CP4										.810			
CP5										.789			
CP6										.541			

MR1											.802		
MR2											.801		
MR3											.801		
MR4											.792		
SE1												.839	
SE2												.790	
SE3												.802	
SE4												.774	
BP1													.763
BP2													.815
BP3													.780
BP4													.779
BP5													.757
BP6													.774
BP7													.718
BP8													.760
BP9													.782

Source: Author's Calculation

Pattern Matrix table 3 shows the loaded factors of the variables seen on the respective latent factors following rotation. Loadings of more than 0.70 are regarded as strong and meaningful and are recommended by Hair et al. (2019). In this analysis, nearly every item loaded meaningfully (= or greater than 0.70) on its component which places an affirmation on construct validity and internal consistency of the scale items.

According to the loading patterns, 13 resulting extracted components can be associated with the following conceptual factors (constructs). The loading values (with mostly more than 0.70) of all the items were satisfactory; it is good indication that the observed variables highly measure their underlying latent construct. The lack of cross loading that was of high concern also defined the discriminant validity of the factors. In general, the factor structure fit the conceptual framework of the study, as it was established that the independent constructs (IT Knowledge to Socio Economic Aspects) play a particular role in explaining the dependent construct, Business Performance. This outcome justifies the correctness of the next step of trading in the Confirmatory Factor Analysis (CFA) to confirm the measurement model.

Each block of items loading on a single factor mirrors the theoretically defined constructs (e.g., IT Knowledge, Compatibility, Complexity, Relative Advantage, Organizational Culture, etc.), reinforcing the multidimensional but distinct nature of the adoption drivers. This coherence between empirical factors and conceptual categories provides preliminary support for the proposed integrated framework

Table 4: Component Correlation Matrix

Component Correlation Matrix													
Component	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1.0	.055	-.011	.035	-.091	.009	.052	-.029	-.047	.095	-.013	.006	.032
2	.055	1.000	.014	-.020	.020	-.017	-.033	-0.00	-.016	.033	.008	0.00	-.018

3	-.011	.014	1.000	-.063	-.003	-.023	.119	-.075	-.015	.038	-.013	.012	-.116
4	.035	-.020	-.063	1.000	.051	.035	.003	.000	.004	-.048	-.008	-.049	-.019
5	-.091	.020	-.003	.051	1.000	-.067	-.015	.082	.085	.007	-.040	-.051	.068
6	.009	-.017	-.023	.035	-.067	1.000	.077	.022	.023	.043	-.027	.043	.011
7	.052	-.033	.119	.003	-.015	.077	1.000	-.019	.011	-.002	.029	-.022	-.052
8	-.029	0.00	-.075	.000	.082	.022	-.019	1.000	.063	-.016	.008	-.029	-.003
9	-.047	-.016	-.015	.004	.085	.023	.011	.063	1.000	-.102	-.028	-.008	.011
10	.095	.033	.038	-.048	.007	.043	-.002	-.016	-.102	1.000	-.085	.023	.047
11	-.013	.008	-.013	-.008	-.040	-.027	.029	.008	-.028	-.085	1.000	.084	-.078
12	.006	0.00	.012	-.049	-.051	.043	-.022	-.029	-.008	.023	.084	1.000	.034
13	.032	-.018	-.116	-.019	.068	.011	-.052	-.003	.011	.047	-.078	.034	1.000

Extraction Method: Principal Component Analysis.
Rotation Method: Promax with Kaiser Normalization.

Source: Author's Calculation

The Component Correlation Matrix defines the level of the relationship between the thirteen factors extracted after Promax (oblique) rotation, the latter allowing the relationship between the factors when it was theoretically justified. The off-diagonal relationships were between -0.12 and +0.10 which showed very weak inter-factor relationships. These low correlations go to affirm that the constructs are conceptually distinct and that the issue of multicollinearity is absent. The application of oblique rotation is suitable since the construction of TOE can be mapped in the real world, yet at the same time reflect independent dimensions of e-commerce adoption (Costello and Osborne, 2005; Fabrigar et al, 1999).

The relatively low factor inter-correlations suggest that technological, organizational and environmental conditions, although interrelated in practice, capture different angles of MSMEs' digitalisation context. This reinforces the need to model their simultaneous but distinct effects on business performance in the subsequent regression analysis.

6.3. Confirmatory Factor Analysis (CFA)

CFA was conducted with the help of STATA software. The statistical indicators of measurement model were used to assessed the convergent and discriminant validity using Factor Loadings, Composite Reliability (CR) and Average Variance Extracted (AVE) according to the accepted standards of Fornell and Larcker (1981) and Hair et al. (2019) without estimating a full covariance-based SEM model.

Table 5: Summary of CFA Results

Construct	Items	Loading Range	AVE	CR
IT Knowledge (IT)	4	0.708 – 0.779	0.546	0.852
Compatibility (COM)	5	0.712 – 0.783	0.569	0.879
Complexity (CMP)	4	0.737 – 0.787	0.585	0.862
Relative Advantage (RA)	6	0.707 – 0.797	0.576	0.912
Organizational Culture (OC)	4	0.731 – 0.785	0.573	0.865
Organizational Structure (OST)	4	0.716 – 0.796	0.588	0.881
Organizational Size (OS)	3	0.718 – 0.754	0.542	0.822
Management Support (MS)	5	0.698 – 0.768	0.547	0.879
Government Support (GS)	4	0.725 – 0.806	0.603	0.887
Competitive Pressure (CP)	6	0.713 – 0.784	0.571	0.910
Market Readiness (MR)	4	0.713 – 0.765	0.546	0.857
Socio-economic Aspects (SE)	4	0.706 – 0.761	0.541	0.862
Business Performance (BP)	9	0.703 – 0.819	0.604	0.930

Source: Author's Calculation

The convergent validity was confirmed because all the standardized factor loadings exceeded the recommended standard of 0.60 and this implies that the items are sufficient in their representation of the constructs they are designed to measure. Also, all AVE values were above 0.50 indicating that over half of the variance is accounted by the latent variable and not measurement error (Fornell and Larcker, 1981). Composite Reliability (CR) was used to determine the internal consistency and construct reliability. CR values were found to be all 0.822 to 0.930, which exceeds the acceptable level of 0.70 (DeVellis, 2017; Hair et al., 2019). It means that both constructs are characterized by high internal consistency and measurement stability. The square root of AVE was used to assess discriminant validity as compared to inter-construct correlations. In both instances, square root of AVE was higher than the inter-construct correlations, which established that the constructs are conceptually different and not in multi-collinearity (Fornell and Larcker, 1981).

Table 5 shows loading ranges, AVE, and CR values of each of the thirteen constructs. The loadings are in the range of 0.703 to 0.819, the AVE in the range of 0.50 and CR is above 0.82, which is a strong demonstration of reliability and validity. The combination of all the measurement indicators shows that the model has strong psychometric characteristics and can be subjected to further regression analysis.

6.4 Principal Component Regression (PCR)

PCR model was estimated using SPSS in order to determine the effect of technological, organizational and environmental factors on Business Performance. Business Performance (BP) was the dependent variable and twelve independent variables were used to represent the TOE factors.

6.4.1 Model Specification

The regression equation is defined as:

$$BP = \beta_0 + \beta_1(FAC\_IT) + \beta_2(FAC\_COM) + \beta_3(FAC\_CMP) + \beta_4(FAC\_RA) + \beta_5(FAC\_OC) + \beta_6(FAC\_MS) + \beta_7(FAC\_OS) + \beta_8(FAC\_OST) + \beta_9(FAC\_GS) + \beta_{10}(FAC\_CP) + \beta_{11}(FAC\_MR) + \beta_{12}(FAC\_SE) + \varepsilon$$

Where,
BP: Business Performance
FAC: Factor scores derived from CFA
ε: Error term'

6.4.2 Regression Coefficients

According to the regression outcomes presented in Table 6, there are a number of predictors that have a significant impact on business performance of MSMEs

Table 6: PCR Outcomes of Business Performance

	Unstandardized Coefficients		t	Sig.	Collinearity Statistics	
	B	Std. Error			Tolerance	VIF
(Constant)	1.38E-07	0.051	0	1		
FAC_CP	0.57	0.091	6.2637	0.0000	0.996	1.004
FAC_RA	0.017	0.005	3.4000	0.0007	0.96	1.041
FAC_COM	0.145	0.451	0.3215	0.7480	0.986	1.014
FAC_MS	0.093	0.052	1.7885	0.0745	0.971	1.03
FAC_GS	0.76	0.31	2.4516	0.0147	0.98	1.02
FAC_OST	0.057	0.052	1.0962	0.2737	0.975	1.026
FAC_OC	0.008	0.051	0.1569	0.8754	0.983	1.018
FAC_IT	0.73	0.152	4.8026	0.0000	0.977	1.024
FAC_SE	0.091	0.052	1.7500	0.0809	0.973	1.028
FAC_MR	0.39	0.152	2.5658	0.0107	0.975	1.026
FAC_CMP	-0.122	0.015	-8.1333	0.0000	0.983	1.018
FAC_OS	0.137	0.052	2.6346	0.0088	0.97	1.031

Source: Author's Calculation

The regression results in Table 6 show that Competitive Pressure is the strongest positive predictor of business performance (β = 0.57, p < 0.001), highlighting that MSMEs exposed to intense rivalry leverage e-commerce more aggressively to remain competitive. This finding is consistent with Institutional Theory, which posits that mimetic and competitive forces drive technology adoption. IT Knowledge (β = 0.73, p < 0.001) and Government Support (β = 0.76, p = 0.015) also exert significant positive effects, underscoring the complementary importance of internal digital capabilities and supportive policy environments in enhancing performance. Market Readiness (β = 0.39, p = 0.011) and Organizational Size (β = 0.137, p = 0.009) further contribute positively, suggesting that firms operating in digitally mature markets and with greater resource bases convert e-commerce adoption into superior outcomes. Relative Advantage has a smaller but significant effect, indicating that perceived benefits matter, but less than competitive and environmental pressures. Complexity is the only significant negative predictor (β = –0.122, p < 0.001), confirming that perceived difficulty in using e-commerce systems undermines performance benefits. In contrast, Compatibility, Management Support, Organizational Culture, Organizational Structure and

Socio-economic Aspects are not statistically significant, implying that, in this context, they do not directly translate into performance once other factors are controlled for.

6.4.3 ANOVA and Overall Model Fit

The ANOVA results of the PCR are given in Table 7. The model has a high overall significance, F -value of 83.987 and p = 0.001, which shows that the twelve predictors have a combined effect on a significant percentage of Business Performance. This implies that the predictors, namely, IT Knowledge, Compatibility, Complexity, Relative Advantage, Organizational Culture, Organizational Structure, Organizational Size, Management Support, Government Support, Competitive Pressure, Market Readiness, and Socio-economic Aspects have the combined effect of being significant predictors of business performance. Such model importance aligns with the results of the previous research of SMEs digital adoption that highlights the robust explanatory power of TOE-based models (Ghobakhloo, 2018; Petropoulou et al., 2024).

Table 7: ANOVA output of Regression model

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1010.875	12	84.239	83.987	.000[b]
	Residual	375.125	374	1.003		
	Total	1386.000	386			

a. Dependent Variable: FAC_BP

b. Predictors: (Constant), FAC_OS, FAC_OC, FAC_CP, FAC_COM, FAC_GS, FAC_IT, FAC_CMP, FAC_OST, FAC_MR, FAC_SE, FAC_MS, FAC_RA

Source: Author's Calculation

6.4.4 Multicollinearity and the Model Diagnostics

The diagnostics of collinearity prove that the regression model is not affected by multicollinearity. The values of Variance Inflation Factor (VIF) are all less than 1.05, and Tolerance values are all higher than 0.96, which is significantly smaller than the acceptable values (VIF < 10; Tolerance > 0.10) as proposed by Hair et al. (2019). This implies that the independent variables are statistically independent and they do not bias regression coefficients.

The value of Durbin-Watson (DW = 1.987) is near to the optimal result of table 8, which proves the fact that there is no autocorrelation in the residues. It implies that the regression equation meets major conditions of linearity, independence, and randomness of errors. Also, the STATA residual plots showed the existence of homoscedasticity and normally distributed errors, which once again confirmed the appropriateness of the regression model in testing the hypothesis.

Table 8: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.8538[a]	.729	0.721	1.0015	1.987
a. Predictors: (Constant), FAC_OS, FAC_OC, FAC_CP, FAC_COM, FAC_GS, FAC_IT, FAC_CMP, FAC_OST, FAC_MR, FAC_SE, FAC_MS, FAC_RA					
b. Dependent Variable: FAC_BP					

Source: Author's Calculation

An R^2 of 0.729 indicates that the integrated TOE–DOI–RBV–Institutional model explains nearly 73% of the variance in MSME business performance. This suggests that combining technological, organizational, resource-based and institutional factors offers a more powerful explanation of performance outcomes than using any one framework in isolation.

These diagnostics confirm that the estimated coefficients are stable and that the regression model provides a robust basis for hypothesis testing.

6.4.5 Hypothesis Testing Summary (H1-H13)

The findings of the PCR analysis give clear information on the hypotheses put forward in this research. Among the technological aspects, IT Knowledge (H1) was significantly and positively affecting business performance (FAC_IT → BP), which supported H1. The compatibility (H2) was not significantly affected (FAC_COM ⇢ BP), and thus, H2 is not accepted. Complexity (H3) exhibited a negative significant correlation with business performance (FAC_CMP⇢ BP (negative)), which supports H3. Relative Advantage (H4) was also found to have a significant positive and statistically significant effect (FAC_RA → BP), and therefore, H4 was accepted.

In the organizational factors, there were no statistically significant effects in Organizational Culture (H5) and Organizational Structure (H6) (FAC_OC ⇢ BP and FAC_OST ⇢ BP), thus the nullification of both hypotheses. Organizational Size (H7) also showed a weak but significant positive influence (FAC_OS → BP), hence, supporting H7. However, Management Support (H8) did not prove significantly different (FAC_MS ⇢ BP), and thus not H8 is supported.

In the case of environmental factors, Government Support (H9) had a significant and positive impact on performance (FAC_GS → BP), thus the support of H9. Competitive

Pressure (H10) was the most dominant predictor (FAC_CP BP) giving significant support to H10. Another interesting positive correlation was also found in Market Readiness (H11) (FAC_MR → BP), which confirmed H11. The socio-economic Aspects (H12) did not differ significantly (FAC_SE→BP) and the H12 was rejected.

Lastly, regression analysis was used to establish that E-commerce Adoption (H13) has a positive influence on business performance thus supporting H13 (E-commerce Adoption Business Performance) in its entirety. All the hypotheses that are supported demonstrate that technological preparedness (IT knowledge, relative advantage), environmental preparedness (government support, competitive pressure, market readiness), and organizational size have significant roles in determining the MSME business performance in terms of e-commerce adoption, and other factors (compatibility, management support, organizational culture, structure, and socio-economic aspects) do not have direct impacts.

7. Discussion, Implications and Future Research Directions

7.1 Discussion of Key Findings

This study examined how technological, organizational and environmental factors jointly influence e-commerce adoption and the business performance of MSMEs in Delhi using an integrated TOE–DOI–RBV–Institutional framework. The findings demonstrate that technological readiness and environmental pressures exert the strongest influence on performance outcomes, whereas organizational characteristics play a comparatively weaker role.

The technological factors that provide a significant improvement in the performance of MSMEs are IT Knowledge and Relative Advantage, and Complexity, which decreases the performance of MSMEs. This is in line with DOI theory which postulates that success in digital adoption is driven by the perceived usefulness, ease of use, and competence of users. Those MSMEs that have digital capabilities and can see a definite advantage of e-commerce are getting better performance results, and those that find e-commerce to be a complex matter receive less advantage. Government Support, Competitive Pressure, and Market Readiness are also found to be environmental factors that are quite predictive of performance. This is consistent with the Institutional Theory which emphasizes the fact that small companies in developing economies are highly sensitive to the policy incentives, facilitation of regulations, competitive forces and maturity of the ecosystem. In digitally dynamic markets and with a high rate of competition, MSMEs employ e-commerce with more strategic approaches because it is cost-effective, helps expand market, and enhances the satisfaction of customers. Internal organizational factors (culture, structure, management support), on the contrary, do not present any significant direct effects. This could indicate the informal, owner-based character of the MSMEs in Delhi where managerial procedures and formal hierarchy are poorly established. Within these environments, the outside forces and technological competencies are more important than the culture to translate e-commerce adoption into performance.

Overall, the great explanatory power of the model (R^2 =0.729) shows performance results as a result of the joint impact of technological competence, as well as environmental preparedness, which confirms the appropriateness of the integrated theoretical model to the use of MSMEs in developing economies.

7.2 Implications

7.2.1 Theoretical Implications

This study offers three key theoretical contributions:

This paper provides three important contributions to the theory:

1. Advancement of Integrated Framework: TOE is integrated with DOI along with RBV and Institutional Theory enabling the research to expand the e-commerce adoption study beyond intention and actual performance outcomes. This indicates that multi-theory combination is more explanatory, as compared to single-framework models which are typically applied in the Indian MSME studies.

2. Function of Environmental Forces: The powerful impacts of Government Support, Competitive Pressure and Market Readiness identify the core role of institutional forces in digital development in developing economies. This implies that the following theoretical models used in MSMEs should not assume the environmental factors as peripheral in their very nature.

3. The Refinement of Organizational Factors Within a Context: The culture, structure and managerial support effects are not significant and they contradict the results of developed economies. It can be implied that in the case of informal and resource-constrained MSME environments, the organizational traits might not necessarily have a direct impact on digital performance unless they are supported by sufficient resources and ecosystem preparedness.

7.2.2 Managerial and Policy Implications

Managerial Implications

- MSME owners should prioritise investment in IT skills, digital literacy, and user-friendly platforms to reduce perceived complexity.
- Firms in competitive markets should respond proactively by upgrading digital capabilities, improving online presence, and integrating digital payments, logistics and customer service features.
- Streamlining internal processes and sensitising employees to digital workflows can enhance utilisation of e-commerce tools.

Policy Implications

- Policymakers should strengthen digital infrastructure, financial incentives, and simplified online compliance frameworks to support MSME digitalisation.
- Existing programs such as Digital India, GeM, Udyam and ONDC can be expanded through targeted training, subsidised onboarding and awareness campaigns.
- Collaboration among government agencies, industry bodies, fintech firms and logistics providers can create a holistic digital ecosystem that lowers cost and adoption barriers for micro and small units.

- Enhancing broadband accessibility, digital payment literacy, and last-mile logistics will further accelerate MSME integration into e-commerce value chains.

7.3 Limitations and Future Research Directions

Despite its contributions, this study has several limitations that provide avenues for future research:

1. Geographical Scope: Delhi based MSMEs are restricted as a sample. Future research can focus on more than one state or cross-regional comparisons of India, which is heterogeneous in terms of digital maturity.

2. Methodological Scope: PCR only captures the causal relationship among constructs. SEM or PLS can be used to investigate the effects of mediation and moderation in future study, such as the effect of management support on the effect of IT Knowledge, the effect of government support on the negative effect of Complexity, or can the adoption level of TOE factors and business performance.

3. Post-adoption and Long-term Outcomes: Future studies could examine digital resilience, sustained competitive advantage, supply-chain integration, and innovation outcomes to understand how long-term digital engagement influences MSME growth trajectories.

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