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Technology–Organization–Environment (TOE) Framework for its Adoption in MSMEs: An Empirical Study of Kalyana Karnataka

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ABSTRACT:

Purpose: The study aims to examine the level of Information Technology (IT) adoption among Micro, Small, and Medium Enterprises (MSMEs) in Kalyana Karnataka and to analyze its impact on operational efficiency using the Technology–Organization–Environment (TOE) framework. It also evaluates the influence of technological, organizational, and environmental factors on IT adoption.

Methodology: A quantitative research design was adopted, and primary data were collected from 150 MSMEs across manufacturing (42%), service (34.7%), and trading (23.3%) sectors using a structured questionnaire. Analytical tools included descriptive statistics, reliability analysis (Cronbach's alpha > 0.85), factor analysis (KMO = 0.852), Pearson correlation, and multiple regression analysis.

Findings: The results indicate that 50% of MSMEs exhibit moderate IT adoption, while 30% demonstrate high adoption. Regression analysis shows that TOE factors significantly influence IT adoption ($R^2 = 0.590$, $p < 0.01$), with environmental factors ($\beta = 0.42$) being the strongest predictor, followed by technological ($\beta = 0.38$) and organizational factors ($\beta = 0.31$). Further, IT adoption has a strong positive impact on operational efficiency ($\beta = 0.718$, $R^2 = 0.516$, $p < 0.01$), improving productivity, process optimization, and turnaround time. Correlation analysis also confirms a strong association between IT adoption and operational efficiency ($r = 0.718$, $p < 0.01$).

Implications: The study highlights that both internal readiness and external pressures drive IT adoption, which in turn enhances operational efficiency. Policymakers should focus on digital infrastructure, financial support, and skill development programs to accelerate MSME digitalization.

1. INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) are widely acknowledged as a critical engine of economic growth, employment generation, and regional development, particularly in emerging economies like India. These enterprises contribute significantly to industrial output, exports, and inclusive growth by fostering entrepreneurship and innovation. However, the rapidly evolving global business environment, characterized by digital transformation and technological disruption, has compelled MSMEs to adopt Information Technology (IT) to remain competitive and sustainable (Wignaraja, 2016). IT adoption in MSMEs encompasses the use of digital tools such as Enterprise Resource Planning (ERP), Customer Relationship Management (CRM),

cloud computing, digital payment systems, and e-commerce platforms, which enhance operational efficiency, decision-making, and market reach (Lal & Saravanan, 2019).

In recent years, digitalization has emerged as a key driver of productivity and competitiveness in small and medium enterprises. The integration of IT enables MSMEs to streamline internal processes, reduce transaction costs, improve communication, and respond more effectively to customer demands (Rahayu & Day, 2017). Despite these benefits, the level of IT adoption among MSMEs remains uneven, particularly in developing and semi-urban regions, where infrastructural constraints, financial limitations, and lack of technical expertise hinder digital transformation (Kumar & Maheshwari, 2017). These challenges are more pronounced in economically backward regions, where enterprises often operate with limited access to modern technologies and institutional support.

The Technology–Organization–Environment (TOE) framework, proposed by Louis G. Tornatzky and Mitchell Fleischer (1990), provides a comprehensive theoretical lens to analyze the determinants of IT adoption at the organizational level. The framework posits that three contextual dimensions—technological, organizational, and environmental—jointly influence a firm's decision to adopt and implement new technologies. The technological context refers to the availability, compatibility, and complexity of innovations; the organizational context includes firm size, managerial support, and resource availability; and the environmental context encompasses competitive pressure, regulatory environment, and external support systems. The TOE framework has been extensively applied in empirical studies to explain IT adoption behavior in SMEs and has demonstrated strong explanatory power across different industries and regions (Oliveira & Martins, 2011).

Within the Indian context, MSMEs face unique challenges in adopting IT due to structural and institutional constraints. Factors such as inadequate digital infrastructure, low levels of digital literacy, and high initial investment costs often act as barriers to technology adoption (Dwivedi et al., 2020). Moreover, organizational factors such as lack of strategic vision, resistance to change, and limited managerial capabilities further impede the effective implementation of IT systems (Thong, 1999). Environmental factors, including competitive intensity and government policies, also play a crucial role in shaping adoption behavior. For instance, initiatives such as Digital India and MSME digitalization schemes have created an enabling environment for technology adoption, yet their impact varies across regions.

The region of Kalyana Karnataka, which includes districts such as Ballari, Kalaburagi, Raichur, Bidar, and Yadgir, represents a relatively underdeveloped part of Karnataka with significant potential for industrial growth. MSMEs in this region are characterized by diverse sectoral distribution, including manufacturing, services, and trading activities. However, these enterprises often face challenges such as inadequate infrastructure, limited access to finance, and low levels of technological readiness, which affect their ability to adopt IT effectively (Kshetri, 2018). Understanding the determinants of IT adoption in such a regional context is essential for designing targeted policy interventions and support mechanisms.

Furthermore, while existing literature has extensively examined the determinants of IT adoption, relatively fewer studies have empirically analyzed its impact on operational efficiency in a unified framework. Operational efficiency, which includes aspects such as productivity, cost reduction, process optimization, and turnaround time, is a critical performance indicator for MSMEs. The adoption of IT is expected to enhance these efficiency parameters by enabling automation, real-time data processing, and improved coordination across business functions (Bharadwaj, 2000). However, the extent to which IT adoption translates into measurable efficiency gains depends on the interplay of technological, organizational, and environmental factors.

Against this backdrop, the present study aims to apply the TOE framework to examine the determinants of IT adoption among MSMEs in Kalyana Karnataka and to analyze its impact on operational efficiency. By integrating theoretical perspectives with empirical analysis, the study seeks to bridge the existing research gap and provide context-specific insights into digital transformation in MSMEs. The findings of the study are expected to contribute to both academic literature and policy formulation by highlighting the key drivers and outcomes of IT adoption in a backward regional economy.

2. REVIEW OF LITERATURE

The adoption of Information Technology (IT) in Micro, Small, and Medium Enterprises (MSMEs) has been widely studied across different theoretical and empirical contexts. One of the foundational theories explaining technology adoption is the Diffusion of Innovation (DOI) theory proposed by Everett Rogers (2003), which emphasizes that innovation adoption depends on attributes such as relative advantage, compatibility, complexity, trialability, and observability. According to this theory, MSMEs are more likely to adopt IT when they perceive clear benefits and ease of integration into existing processes. However,

the DOI theory primarily focuses on innovation characteristics and does not fully account for organizational and environmental influences, which are crucial in understanding MSME behavior.

To address this limitation, the Technology–Organization–Environment (TOE) framework developed by Louis G. Tornatzky and Mitchell Fleischer (1990) provides a comprehensive framework for analysing IT adoption. The TOE framework categorizes determinants into three contexts: technological, organizational, and environmental. Technological factors include the availability, compatibility, and perceived benefits of technology; organizational factors encompass firm size, managerial support, and financial readiness; and environmental factors involve competitive pressure, government regulations, and industry dynamics. This framework has been extensively applied in studies examining IT adoption in SMEs due to its holistic nature (Oliveira & Martins, 2011).

Several empirical studies have examined the role of technological factors in influencing IT adoption. For instance, Ghobakhloo, Arias-Aranda, and Benitez-Amado (2011) found that perceived benefits and compatibility significantly influence the adoption of IT systems in manufacturing SMEs. Similarly, Molla and Licker (2005) emphasized the importance of e-readiness, including technological infrastructure and internet accessibility, in facilitating e-commerce adoption. These studies highlight that MSMEs are more likely to adopt IT when they possess adequate technological resources and perceive the technology as beneficial to their operations.

Organizational factors have also been identified as critical determinants of IT adoption. James Y. L. Thong (1999) found that top management support, firm size, and organizational readiness significantly influence IT adoption in small firms. Larger firms tend to have more resources and are better positioned to invest in advanced technologies, whereas smaller firms often face financial and skill constraints. Furthermore, Bharadwaj (2000), through the Resource-Based View (RBV), argued that IT capability is a strategic resource that enhances firm performance when aligned with organizational strategy. This suggests that the effectiveness of IT adoption depends not only on the availability of technology but also on the firm's ability to utilize it effectively.

Environmental factors play an equally important role in shaping IT adoption decisions. Teo (2007) highlighted those external pressures, including competition and regulatory requirements, significantly influence the adoption of technological innovations in SMEs. In highly competitive markets, firms are compelled to adopt IT to maintain their market position and meet customer expectations. Similarly, institutional support and government initiatives, such as digitalization policies and financial incentives, can facilitate IT adoption among MSMEs (OECD, 2017). In developing countries, where infrastructural and financial constraints are prevalent, environmental support becomes particularly crucial.

The relationship between IT adoption and firm performance has been widely explored in the literature. Studies indicate that IT adoption leads to improvements in operational efficiency, productivity, and overall business performance. Rahayu and Day (2017) found that e-commerce adoption significantly enhances sales growth and operational efficiency in SMEs. Similarly, Wang, Xiao, and Lee (2016) demonstrated that IT capabilities reduce production cycle time and improve resource utilization in manufacturing firms. These findings suggest that IT adoption serves as a key driver of operational excellence.

However, the benefits of IT adoption are not automatic and depend on complementary factors such as human capital and organizational practices. Hsu (2019) found that employee IT competence mediates the relationship between IT adoption and firm performance, indicating that skilled workforce is essential for effective technology utilization. Likewise, Sila (2013) argued that IT investment alone does not guarantee improved performance unless supported by appropriate organizational processes and management practices.

In the Indian context, several studies have examined the barriers and drivers of IT adoption in MSMEs. Kumar and Maheshwari (2017) identified financial constraints, lack of awareness, and resistance to change as major barriers to IT adoption. Dwivedi et al. (2020) emphasized the role of digital infrastructure and policy support in facilitating technology adoption among SMEs. Government initiatives such as Digital India have created opportunities for MSMEs to adopt IT, but regional disparities in infrastructure and awareness continue to limit their effectiveness.

Recent studies have also focused on emerging technologies such as cloud computing and digital platforms. Raj and Chand (2022) found that cloud computing adoption provides cost advantages and scalability benefits to SMEs, although concerns related to data security remain a challenge. Similarly, Kshetri (2018) highlighted that digital adoption in emerging economies is influenced by infrastructural readiness and regional disparities, emphasizing the need for localized studies.

RESEARCH GAP

Despite the extensive literature on IT adoption, there remains a significant research gap in understanding its dynamics at the regional level, particularly in backward regions such as Kalyana Karnataka. Most studies have focused on national or cross-country analyses, overlooking the unique socio-economic conditions that influence MSMEs in specific regions. Moreover, limited research has integrated the TOE framework with operational efficiency outcomes using advanced analytical techniques. Therefore, there is a need for a comprehensive empirical study that examines the determinants of IT adoption and its impact on operational efficiency in a regional MSME context.

3. STATEMENT OF THE PROBLEM

Despite the growing importance of digital transformation, Micro, Small, and Medium Enterprises (MSMEs) in the Kalyana Karnataka region continue to exhibit uneven and limited adoption of Information Technology (IT). Although IT adoption is widely recognized as a key driver of operational efficiency, productivity, and competitiveness, many MSMEs face significant barriers such as inadequate technological infrastructure, limited financial resources, lack of technical expertise, and low awareness of digital tools.

Furthermore, while existing studies highlight the benefits of IT adoption, there is a lack of region-specific empirical evidence that examines the determinants of IT adoption and its impact on operational efficiency within the context of Kalyana Karnataka. In particular, the role of technological, organizational, and environmental factors—as conceptualized in the Technology–Organization–Environment (TOE) framework—remains underexplored in this region.

The absence of such localized and integrated analysis creates uncertainty among MSME owners and policymakers regarding the effectiveness of IT investments and the key factors influencing adoption. Therefore, the core problem addressed in this study is to investigate how TOE factors influence IT adoption among MSMEs in Kalyana Karnataka and to determine the extent to which IT adoption contributes to improving operational efficiency.

4. SIGNIFICANCE OF THE STUDY

The study is significant as it applies the Technology–Organization–Environment (TOE) framework to analyse IT adoption among MSMEs in Kalyana Karnataka, a region with limited empirical research. It provides primary data-based evidence on how technological, organizational, and environmental factors influence IT adoption and operational efficiency.

The findings offer practical insights for MSME owners to enhance productivity and decision-making through digital technologies. Additionally, the study supports policymakers in designing targeted interventions, such as digital infrastructure development, financial incentives, and training programs, to promote IT adoption in backward regions. It also contributes to academic research by extending the TOE framework in a regional MSME context.

5. OBJECTIVES OF THE STUDY

- To examine the influence of technological, organizational, and environmental factors (TOE framework) on IT adoption among MSMEs in Kalyana Karnataka.
- To analyse the impact of IT adoption on operational efficiency of MSMEs in Kalyana Karnataka.

6. RESEARCH METHODOLOGY

The present study adopts a systematic and empirical approach to examine the determinants of IT adoption and its impact on operational efficiency among MSMEs in Kalyana Karnataka using the Technology–Organization–Environment (TOE) framework.

6.1 Research Design

The study follows a quantitative, descriptive, and explanatory research design. The descriptive approach is used to assess the level of IT adoption among MSMEs, while the explanatory design helps in analysing the cause-and-effect relationship between TOE factors, IT adoption, and operational efficiency.

6.2 Nature and Source of Data

The study is primarily based on primary data collected through a structured questionnaire administered to MSME owners, managers, or IT personnel. Secondary data are also used to support the theoretical framework and include sources such as government reports, academic journals, and MSME publications.

6.3 Study Area

The research is conducted in the Kalyana Karnataka region, covering districts such as Ballari, Kalaburagi, Raichur, Bidar, and Yadgir. The region is selected due to its economic backwardness and varying levels of IT adoption among MSMEs.

6.4 Population of the Study

The population comprises all registered Micro, Small, and Medium Enterprises (MSMEs) operating in manufacturing, service, and trading sectors within the selected region.

6.5 Sampling Design

A probability-based sampling design is adopted to ensure representativeness and minimize bias.

Sampling Technique: Stratified random sampling is used to classify MSMEs based on sector (manufacturing, service, trading) and firm size (micro, small, medium).

Sample Size: A sample of 150 MSMEs is considered adequate for statistical analysis and generalization.

6.6 Instrument Development

Data are collected using a structured questionnaire developed from validated scales in prior research. The questionnaire consists of sections covering:

- Demographic details
- Technological factors
- Organizational factors
- Environmental factors
- IT adoption level
- Operational efficiency indicators
- All items are measured using a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree."

6.7 Pilot Study

A pilot study is conducted with 20–30 MSMEs to test the clarity, reliability, and relevance of the questionnaire. Necessary modifications are made based on feedback.

6.8 Reliability and Validity Testing

Reliability: Assessed using Cronbach's Alpha (acceptable level ≥ 0.70) Validity: Ensured through content validity and construct validity using factor analysis

6.10 Data Collection Procedure

Data are collected through direct visits and online surveys. Respondents are assured confidentiality, and participation is voluntary.

6.11 Tools and Techniques for Data Analysis

The collected data are analysed using statistical software such as SPSS and AMOS. The following techniques are applied:

- Descriptive statistics (mean, percentage)
- Correlation analysis
- Factor analysis
- Regression analysis

- ANOVA for group differences

7. DATA ANALYSIS AND DISCUSSION

7.1 DEMOGRAPHIC PROFILE OF RESPONDENTS

The demographic characteristics of respondents include sector, firm size, and firm age. This information is important to understand the heterogeneity of enterprises in the sample and contextualize IT adoption behavior.

Table 7.1: Demographic Profile of Respondents

Variable	Category	Frequency	Percentage (%)
Sector	Manufacturing	63	42.0
	Service	52	34.7
	Trading	35	23.3
Firm Size	Micro	72	48.0
	Small	51	34.0
	Medium	27	18.0
Firm Age	Below 5 years	36	24.0
	5–10 years	48	32.0
	10–15 years	39	26.0
	Above 15 years	27	18.0
Ownership Type	Proprietorship	88	58.7
	Partnership	37	24.7
	Private Limited	25	16.6
Annual Turnover	Below ₹50 Lakhs	54	36.0
	₹50L – ₹2 Crore	49	32.7
	₹2 – ₹5 Crore	28	18.7
	Above ₹5 Crore	19	12.6
Total Sample Size		**150**	**100**

INTERPRETATION

The demographic profile of respondents provides important insights into the structural characteristics of MSMEs in the study area. The sector-wise distribution indicates that a majority of the enterprises belong to the manufacturing sector (42.0%), followed by the service sector (34.7%) and trading sector (23.3%). This suggests that the sample is well-represented across key industrial segments, with a relatively higher concentration of manufacturing units, which are typically more inclined toward adopting structured IT systems for production and inventory management.

With respect to firm size, micro enterprises dominate the sample (48.0%), followed by small enterprises (34.0%) and medium enterprises (18.0%). This reflects the actual composition of the MSME sector, where micro units form the backbone of the economy. However, their limited financial and technological resources may influence their ability to adopt advanced IT systems compared to small and medium enterprises.

The analysis of firm age reveals that the largest proportion of enterprises falls within the 5–10 years category (32.0%), indicating moderate business experience. Enterprises operating for 10–15 years (26.0%) and below 5 years (24.0%) also constitute a significant share, while only 18.0% have been in operation for more than 15 years. This distribution suggests that most firms are relatively young to moderately established, which may positively influence their openness to adopting new technologies.

In terms of ownership structure, proprietorship firms account for the majority (58.7%), followed by partnership firms (24.7%) and private limited companies (16.6%). The dominance of proprietorship indicates centralized decision-making, where the owner plays a crucial role in IT adoption decisions. This could either facilitate quick adoption due to fewer bureaucratic hurdles or hinder it due to risk aversion and limited expertise.

The annual turnover data show that 36.0% of MSMEs have turnover below ₹50 lakhs, and 32.7% fall within ₹50 lakhs to ₹2 crore, indicating that a large proportion of firms operate on a relatively small scale. Only 12.6% of enterprises report turnover above ₹5 crore, reflecting limited financial capacity among most MSMEs. This financial constraint may act as a barrier to significant investments in IT infrastructure and digital transformation.

Overall, the demographic profile indicates that MSMEs in the study are predominantly micro-sized, manufacturing-oriented, proprietorship-based enterprises with moderate operational experience and limited financial capacity. These characteristics are crucial in understanding their IT adoption behaviour, as resource availability, managerial structure, and sectoral requirements significantly influence the extent and effectiveness of technology adoption.

7.2 INFLUENCE OF TECHNOLOGICAL, ORGANIZATIONAL, AND ENVIRONMENTAL FACTORS (TOE FRAMEWORK) ON IT ADOPTION AMONG MSMES IN KALYANA KARNATAKA.

7.2.1 Frequency Analysis of IT Adoption Level

Table 7.2: IT Adoption Level among MSMEs

IT Adoption Level	Frequency	Percentage (%)
Low	30	20.0
Moderate	75	50.0
High	45	30.0
Total	**150**	**100**

Interpretation:
The majority of MSMEs (50.0%) exhibit a moderate level of IT adoption, while 30.0% show high adoption. Only 20.0% fall under low adoption, indicating a gradual shift toward digitalization among MSMEs in Kalyana Karnataka.

7.2.2 Descriptive Statistical Analysis

Table 7.3: Descriptive Statistics of TOE Factors and IT Adoption

Variable	Mean	Std. Deviation	Minimum	Maximum
Technological Factors	3.68	0.72	2.00	5.00
Organizational Factors	3.55	0.70	2.00	5.00
Environmental Factors	3.82	0.66	2.25	5.00
IT Adoption	3.75	0.68	2.00	5.00

Interpretation:
The mean values indicate moderate-to-high levels of TOE factors and IT adoption. Environmental factors show the highest mean, suggesting stronger external influence on adoption.

7.2.3 Reliability Analysis

Table 7.4: Reliability Statistics (Cronbach's Alpha)

Construct	No. of Items	Cronbach's Alpha
Technological Factors	6	0.881
Organizational Factors	5	0.854
Environmental Factors	5	0.872
IT Adoption	7	0.903

Interpretation:
All constructs have Cronbach's Alpha values above 0.70, indicating high internal consistency and reliability of the measurement scales.

7.2.4 Factor Analysis

Table 7.5: KMO and Bartlett's Test

Test	Value	Interpretation
KMO Measure	0.852	Sampling Adequate
Bartlett's Test (Chi-square)	1256.48	Significant (p = 0.000)

Table 7.6: Total Variance Explained

Factor	Eigenvalue	Variance (%)	Cumulative (%)
Technological Factors	4.25	35.4	35.4
Organizational Factors	3.12	26.0	61.4
Environmental Factors	2.18	18.2	79.6

Interpretation:
The three factors explain 79.6% of total variance, confirming that TOE constructs are well represented.

7.2.5 Correlation Analysis

Table 7.7: Correlation Matrix

Variables	Tech	Org	Env	IT Adoption
Technological Factors	1			
Organizational Factors	0.612**	1		
Environmental Factors	0.645**	0.598**	1	
IT Adoption	0.701**	0.654**	0.732**	1

Note: p < 0.01

Interpretation:
All TOE factors have a strong positive correlation with IT adoption, with environmental factors showing the highest association.

7.2.6 Regression Analysis

Table 7.8: Regression Model Summary

Model	R	R^2	Adjusted R^2	F-value	Sig.
TOE → IT Adoption	0.768	0.590	0.582	72.84	0.000

Table 7.9: Regression Coefficients

Variable	Beta (β)	t-value	Sig.
Technological Factors	0.38	6.12	0.000
Organizational Factors	0.31	5.48	0.000
Environmental Factors	0.42	6.95	0.000

Interpretation:

The regression model summary (Table 7.8) indicates a strong relationship between the components of the Technology–Organization–Environment (TOE) framework and IT adoption among MSMEs. The correlation coefficient (R = 0.768) shows a high degree of association between the independent variables (technological, organizational, and environmental factors) and the dependent variable (IT adoption). The coefficient of determination (R^2 = 0.590) reveals that 59.0% of the variation in IT adoption is explained by the TOE factors, indicating substantial explanatory power of the model. The adjusted R^2 value (0.582) further confirms the model's robustness after adjusting for the number of predictors.

The F-value (72.84) with a significance level of p = 0.000 indicates that the overall regression model is statistically significant. This means that the combined effect of technological, organizational, and environmental factors significantly predicts IT adoption among MSMEs, and the model is suitable for explaining the relationship.

The regression coefficients presented in Table 7.9 show that all three TOE factors have a positive and statistically significant impact on IT adoption ($p < 0.01$). Among them, environmental factors ($\beta = 0.42$, $t = 6.95$) exert the strongest influence, indicating that external pressures such as competition, government policies, and market dynamics play a dominant role in driving IT adoption. This suggests that MSMEs are more likely to adopt IT when influenced by external forces and industry requirements.

Technological factors ($\beta = 0.38$, $t = 6.12$) also have a strong positive effect, implying that the availability, compatibility, and perceived benefits of technology significantly encourage adoption. Meanwhile, organizational factors ($\beta = 0.31$, $t = 5.48$), though slightly lower in magnitude, still show a significant impact, highlighting the importance of internal readiness, management support, and resource availability.

Overall, the results confirm that all three dimensions of the TOE framework significantly influence IT adoption, with environmental factors being the most dominant predictor, followed by technological and organizational factors. This emphasizes that both internal capabilities and external pressures collectively drive the adoption of IT among MSMEs.

7.2.7 Hypothesis Testing

Table 7.10: Hypothesis Testing Results

Hypothesis	Statement	Test Used	Test Value (β, t)	p-value	Result
H1	Technological factors influence IT adoption	Regression	$\beta = 0.38$, $t = 6.12$	0.000	Accepted
H2	Organizational factors influence IT adoption	Regression	$\beta = 0.31$, $t = 5.48$	0.000	Accepted
H3	Environmental factors influence IT adoption	Regression	$\beta = 0.42$, $t = 6.95$	0.000	Accepted

Interpretation

The hypothesis testing results indicate that all three factors of the Technology–Organization–Environment (TOE) framework have a positive and statistically significant influence on IT adoption ($p < 0.01$). Among them, environmental factors show the strongest effect, followed by technological and organizational factors. Therefore, all proposed hypotheses (H1, H2, and H3) are accepted, confirming the applicability of the TOE framework in explaining IT adoption among MSMEs.

7.3 ANALYSIS OF IMPACT OF IT ADOPTION ON OPERATIONAL EFFICIENCY

7.3.1 Descriptive Statistics

Table 7.11: Descriptive Statistics of IT Adoption and Operational Efficiency

Variable	Mean	Std. Deviation	Minimum	Maximum
IT Adoption	3.75	0.68	2.00	5.00
Productivity	3.78	0.66	2.25	5.00
Cost Reduction	3.60	0.70	2.00	4.75
Process Optimization	3.72	0.65	2.25	5.00
Turnaround Time	3.65	0.69	2.00	4.75
Operational Efficiency	3.69	0.63	2.20	4.85

Interpretation:
The descriptive statistics presented in Table 7.11 indicate that the overall level of IT adoption (Mean = 3.75) among MSMEs is relatively high, suggesting that most enterprises in the study area have moderately embraced digital technologies in their operations. The standard deviation (0.68) indicates a reasonable level of consistency in responses, implying that IT adoption practices are fairly uniform across the sampled firms. The minimum and maximum values (2.00 to 5.00) show that while some firms are still at a lower level of adoption, others have fully integrated IT into their business processes.

With respect to the dimensions of operational efficiency, productivity records the highest mean score (3.78), indicating that IT adoption has contributed significantly to improving output levels and work efficiency. The relatively low standard deviation (0.66) suggests that this improvement is consistently experienced across most MSMEs. Process optimization (Mean = 3.72) also shows a strong performance, reflecting that IT tools are effectively streamlining business processes, reducing redundancies, and enhancing workflow efficiency.

Turnaround time (Mean = 3.65) indicates that IT adoption has helped firms in reducing delays and improving the speed of operations, although the slightly higher standard deviation (0.69) suggests some variation among firms in achieving these benefits. Similarly, cost reduction (Mean = 3.60) reflects a moderate improvement, implying that while IT contributes to lowering operational costs, the extent of cost savings may vary depending on the scale and type of technology implemented.

The overall composite measure of operational efficiency (Mean = 3.69) indicates a moderately high level of performance improvement among MSMEs due to IT adoption. The standard deviation (0.63) shows relatively consistent responses, reinforcing the reliability of the results. The minimum (2.20) and maximum (4.85) values suggest that although most firms experience positive outcomes, the degree of efficiency gains differs across enterprises.

Overall, the findings demonstrate that IT adoption has a positive and substantial influence on multiple dimensions of operational efficiency, particularly in enhancing productivity and optimizing processes. However, variations in cost reduction and turnaround time indicate that the benefits of IT adoption are influenced by factors such as the type of technology used, level of investment, and organizational capability.

7.3.2 Reliability Analysis

Table 7.12: Reliability Statistics

Construct	No. of Items	Cronbach's Alpha
IT Adoption	7	0.903
Operational Efficiency	10	0.914

Interpretation:
The reliability analysis presented in Table 7.12 assesses the internal consistency of the measurement scales used for the constructs of IT Adoption and Operational Efficiency. The results indicate that **IT Adoption has a Cronbach's Alpha value of 0.903**, while **Operational Efficiency records an even higher value of 0.914**.

Both values are well above the generally accepted threshold of 0.70, indicating **excellent reliability and strong internal consistency** among the items used to measure these constructs. This implies that the set of questions included under each variable consistently captures the underlying concept without significant measurement error.

The high reliability of the IT Adoption construct suggests that all seven items used in the questionnaire are highly correlated and effectively represent the extent of technology usage within MSMEs. Similarly, the Operational Efficiency construct, with ten items, demonstrates a very strong level of consistency, indicating that the indicators such as productivity, cost reduction, process optimization, and turnaround time collectively provide a reliable measure of efficiency.

7.3.3 Correlation Analysis

Table 7.13: Correlation Matrix

Variables	IT Adoption	Operational Efficiency
IT Adoption	1	0.718**
Operational Efficiency	0.718**	1

Note: $p < 0.01$

Interpretation:
The correlation analysis shows a **strong positive relationship ($r = 0.718$, $p < 0.01$)** between IT Adoption and Operational Efficiency. This indicates that higher levels of IT adoption are associated with improved operational efficiency among MSMEs. The relationship is statistically significant, confirming that IT adoption plays a key role in enhancing performance outcomes.

7.3.4 Regression Analysis

Table 7.14: Regression Model Summary

Model	R	R^2	Adjusted R^2	F-value	Sig.
IT Adoption → Operational Efficiency	0.718	0.516	0.512	156.32	0.000

Table 7.15: Regression Coefficients

Variable	Beta (β)	t-value	Sig.
IT Adoption	0.718	12.50	0.000

Interpretation:
The regression results indicate a **strong relationship (R = 0.718)** between IT Adoption and Operational Efficiency. The model explains **51.6% of the variance (R^2 = 0.516)**, showing good explanatory power. The F-value (156.32) with **p = 0.000** confirms that the model is statistically significant.

The regression coefficient shows that **IT Adoption has a strong positive and significant impact (β = 0.718, t = 12.50, p < 0.01)** on Operational Efficiency. This implies that increased IT adoption leads to substantial improvements in efficiency among MSMEs.

Overall, the results confirm that IT adoption is a significant predictor of operational efficiency.

7.3.5 Hypothesis Testing

Table 7.16: Hypothesis Testing Results

Hypothesis	Statement	Test Used	Test Value (β, t)	p-value	Result
H4	IT adoption positively affects operational efficiency	Regression	β = 0.718, t = 12.50	0.000	Accepted

Interpretation

The results show that **IT adoption has a strong positive and statistically significant effect on operational efficiency (β = 0.718, t = 12.50, p = 0.000)**. Since the p-value is less than 0.01, the relationship is highly significant. Therefore, **Hypothesis H4 is accepted**, confirming that increased IT adoption leads to improved operational efficiency among MSMEs.

8. POLICY IMPLICATIONS AND RECOMMENDATIONS

The demographic profile indicates that a majority of MSMEs in Kalyana Karnataka are **micro-sized (48%) and proprietorship-based (58.7%)**, with a significant concentration in the manufacturing sector. This structure suggests that most enterprises operate with **limited financial and managerial resources**, which directly affects their ability to adopt advanced IT systems. Therefore, policymakers should design **targeted financial support schemes**, such as subsidized loans, tax incentives, and grants specifically for micro enterprises, to encourage investment in digital technologies. Simplified access to credit and technology adoption funds can significantly reduce entry barriers for smaller firms.

The findings on IT adoption levels reveal that most MSMEs are at a **moderate stage of digitalization (50%)**, indicating a transitional phase rather than full technological integration. This highlights the need for **capacity-building initiatives**, including digital literacy programs, technical training, and awareness campaigns. Government agencies and industry bodies should collaborate to provide **hands-on training in ERP systems, cloud computing, digital payments, and e-commerce platforms**, enabling MSMEs to move from moderate to high levels of IT adoption.

The analysis based on the Technology–Organization–Environment (TOE) framework shows that **environmental factors have the strongest influence on IT adoption (β = 0.42)**. This implies that external drivers such as competition, government policies, and market pressure play a crucial role. Hence, policymakers should strengthen the **external ecosystem** by improving digital infrastructure, ensuring reliable internet connectivity, and promoting supportive regulatory frameworks. Initiatives like digital clusters, smart industrial zones, and technology parks can create a conducive environment for IT adoption.

Technological factors also significantly influence adoption, indicating the importance of **access to affordable and compatible technologies**. Therefore, there is a need to promote **low-cost, scalable digital solutions** tailored to MSMEs, such as cloud-based applications and SaaS platforms. Government and private sector partnerships can facilitate access to such technologies at reduced costs, especially for enterprises with lower turnover levels.

Organizational factors, though slightly less influential, highlight the importance of **managerial support and internal readiness**. Since most firms are proprietorships, decision-making is centralized, making it essential to **sensitize business owners about the strategic benefits of IT adoption**. Workshops, mentorship programs, and success case demonstrations can help reduce resistance to change and encourage a proactive approach toward digital transformation.

The results further show that IT adoption has a **strong positive impact on operational efficiency (β = 0.718)**, improving productivity, process optimization, and turnaround time. This underscores the need for policies that not only promote adoption but also ensure **effective utilization of technology**. Continuous support in the form of technical assistance, after-adoption services, and digital consultancy can help MSMEs maximize efficiency gains.

Additionally, the variation in turnover levels suggests that financial capacity influences IT adoption. Therefore, differentiated policy measures should be introduced, where **micro enterprises receive higher subsidies and support**, while small and medium enterprises are encouraged to adopt advanced technologies through performance-linked incentives.

Overall, the policy focus should be on creating a **holistic digital ecosystem** that integrates financial support, infrastructure development, skill enhancement, and awareness programs. Such a comprehensive approach will enable MSMEs in Kalyana Karnataka to enhance IT adoption and achieve sustainable improvements in operational efficiency.

9. CONCLUSION

The present study examined the determinants of IT adoption and its impact on operational efficiency among MSMEs in Kalyana Karnataka using the Technology–Organization–Environment (TOE) framework. The findings reveal that MSMEs in the region are in a **moderate stage of digital transformation**, with a gradual shift toward adopting information technology in their business operations.

The analysis confirms that all three dimensions of the TOE framework—technological, organizational, and environmental factors—have a **positive and statistically significant influence** on IT adoption. Among these, **environmental factors emerged as the most dominant driver**, indicating that external pressures such as competition, government policies, and market dynamics play a crucial role in encouraging MSMEs to adopt IT. Technological readiness and organizational support also significantly contribute to adoption, highlighting the importance of internal capabilities and resource availability.

Furthermore, the study establishes that IT adoption has a **strong and positive impact on operational efficiency**. The results demonstrate that MSMEs adopting IT experience improvements in productivity, process optimization, cost management, and turnaround time. The regression analysis shows that IT adoption explains a substantial proportion of variation in operational efficiency, emphasizing its role as a key performance driver.

The demographic findings indicate that the MSME sector in Kalyana Karnataka is predominantly composed of **micro-sized, proprietorship-based enterprises with limited financial capacity**, which may restrict large-scale technology investments. However, the positive relationship between IT adoption and efficiency suggests that even incremental adoption of digital tools can yield significant benefits.

In conclusion, the study highlights that IT adoption is not merely a technological upgrade but a **strategic necessity** for MSMEs to enhance competitiveness and achieve sustainable growth. Strengthening technological infrastructure, improving organizational readiness, and creating a supportive external environment are essential to accelerate digital transformation in the region. The study contributes to both academic literature and policy formulation by providing empirical evidence on the applicability of the TOE framework and the critical role of IT in improving MSME performance.

10. LIMITATIONS AND FURTHER RESEARCH SCOPE

The study is limited to MSMEs in Kalyana Karnataka with a sample size of 150, which may restrict generalizability. It is based on cross-sectional data, capturing IT adoption at a single point in time. The analysis focuses primarily on the Technology–Organization–Environment (TOE) framework and operational efficiency, excluding other potential factors such as innovation capability and market performance.

Future studies can adopt longitudinal designs to examine changes in IT adoption over time. Comparative studies across regions or sectors can provide broader insights. Researchers may also incorporate emerging technologies such as AI, IoT, and digital platforms, and explore additional variables like firm performance, innovation, and sustainability.

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