

Information Technology Applications, Operational Efficiency and MSMEs Growth: An Empirical Study of Kalyana Karnataka

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Abstract

Purpose: This study examines the influence of Information Technology (IT) Applications on Operational Efficiency and MSME Growth, with particular emphasis on the mediating role of Operational Efficiency among MSMEs in Kalyana Karnataka.

Design/Methodology: The study adopted a quantitative, cross-sectional research design based on data collected from 460 MSME respondents. IT Applications were assessed through six dimensions: Financial and Accounting Applications, Digital Payment Applications, Marketing and Customer Communication, E-Commerce Applications, Inventory and Operational Applications, and Business Information and Decision Support. The data were analysed using descriptive statistics, Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), reliability and validity assessment, correlation analysis, and Structural Equation Modelling (SEM). The measurement model demonstrated strong reliability and validity, with Cronbach's alpha ranging from 0.874 to 0.941, Composite Reliability from 0.909 to 0.950, and AVE from 0.629 to 0.718.

Findings: The results indicate that IT Applications have a significant positive effect on Operational Efficiency ($\beta = 0.684$, $t = 16.68$, $p < 0.001$) and MSME Growth ($\beta = 0.287$, $t = 5.52$, $p < 0.001$). Operational Efficiency also significantly influences MSME Growth ($\beta = 0.593$, $t = 12.62$, $p < 0.001$). The indirect effect of IT Applications on MSME Growth through Operational Efficiency is significant ($\beta = 0.406$, 95% CI [0.333, 0.485]), confirming partial mediation. The model explains 46.8% of the variance in Operational Efficiency ($R^2 = 0.468$) and 62.1% of the variance in MSME Growth ($R^2 = 0.621$). Model-fit results indicate good fit (CMIN/DF = 2.384, CFI = 0.957, TLI = 0.951, RMSEA = 0.046, SRMR = 0.041). Multi-group analysis further shows a significant enterprise-size difference in the IT Applications → Operational Efficiency relationship ($p = 0.032$).

Conclusion: The findings establish that IT Applications are an important driver of operational efficiency and MSME growth, with operational efficiency serving as a significant mechanism through which technology contributes to enterprise growth. The findings highlight the need for MSMEs to strengthen digital capabilities, particularly in e-commerce, marketing and customer communication, and business information systems.

Keywords: Information Technology Applications; MSMEs; Operational Efficiency; MSME Growth; Digitalisation; E-Commerce; Kalyana Karnataka.

1. Introduction

Micro, Small and Medium Enterprises (MSMEs) play a vital role in economic development, employment generation, entrepreneurship, income creation, productivity and regional development.

They provide livelihood opportunities across different sectors and geographical areas and contribute significantly to the development of local economies.

However, MSMEs often face challenges such as limited financial resources, inadequate managerial capabilities, restricted market access, lack of timely information and operational inefficiencies.

In this context, the effective use of Information Technology (IT) can help MSMEs overcome several of these challenges and improve their overall business performance.

The increasing availability of digital technologies has transformed the way MSMEs conduct their business activities. Financial and accounting applications support record keeping and financial management, while digital payment applications facilitate faster and more convenient transactions.

Similarly, marketing and customer communication applications help enterprises reach customers and build relationships, whereas e-commerce applications provide opportunities for online selling and market expansion.

Inventory and operational applications improve stock and process management, while business information and decision-support applications assist entrepreneurs in making timely and informed decisions.

Previous studies indicate that digitalisation can contribute positively to firm performance and operational efficiency. However, the benefits of IT are not automatic and depend on the extent to which technology is effectively integrated into organisational processes.

For MSMEs, improvements in internal operations can result in reduced costs, fewer errors, better inventory control, faster transactions, improved customer responsiveness and more effective decision-making. Thus, operational efficiency can serve as an important mechanism through which IT applications contribute to business growth.

Although considerable research has been conducted on digitalisation and technology adoption among SMEs, relatively limited attention has been given to the specific applications of IT used in different MSME business functions.

Further, there is a need for region-specific evidence, particularly from Kalyana Karnataka, where MSMEs operate under diverse economic, social and geographical conditions.

Therefore, the present study focuses on the influence of Information Technology Applications on Operational Efficiency and MSME Growth. It examines IT applications across financial and accounting, digital payments, marketing and customer communication, e-commerce, inventory and operations, and business information and decision support.

The study further examines whether Operational Efficiency mediates the relationship between IT Applications and MSME Growth. The findings are expected to provide useful insights for entrepreneurs, policymakers and support institutions in strengthening digital adoption and improving the efficiency, competitiveness and growth of MSMEs.

2. Review Of Literature

2.1 Information Technology Applications and Firm Performance

The theoretical foundation of the present study begins with the proposition that information technology can constitute an organisational resource capable of improving firm performance.

From a resource-based perspective, technological resources can generate value when they are effectively combined with complementary organisational capabilities and processes.

Therefore, the performance consequences of technology depend not simply on possessing technological resources but on converting them into productive organisational capabilities (Heine et al., 2003).

Empirical research involving SMEs supports this proposition. Digitalisation has been found to have a positive relationship with financial performance, while also mediating the effect of IT resources on firm performance (Eller et al., 2020).

This finding is important because it indicates that the performance implications of technology may emerge through the effective translation of technological resources into business processes.

The broader literature provides further support. A meta-analysis of digital technology and firm performance found a positive and moderate overall relationship between digital technologies and firm performance, with operational efficiency emerging as an important performance outcome (Oduro et al., 2023).

The same study also demonstrated that the relationship varies according to firm size, sector, country development and other contextual factors (Oduro et al., 2023).

These findings provide the basis for examining whether IT applications contribute directly to the growth of MSMEs in Kalyana Karnataka.

H1: Information Technology Applications have a significant positive effect on MSME Growth.

2.2 Information Technology Applications and Operational Efficiency

The second stage of the deductive argument concerns the relationship between IT applications and operational efficiency.

Operational efficiency refers to the ability of an enterprise to perform business activities with minimum unnecessary expenditure of time, resources and costs while maintaining service quality and productivity.

IT applications can contribute to operational efficiency by automating routine activities, improving information accuracy, reducing duplication, facilitating communication and enabling faster access to business information. Digital applications can also improve coordination among customers, suppliers, employees and managers.

The importance of operational efficiency as a consequence of digital technologies is supported by meta-analytic evidence showing that digital technologies have a positive effect on operational performance (Oduro et al., 2023).

More direct evidence is provided by research examining digital innovation and firm performance.

Digital innovation has been shown to influence firm performance through operational efficiency and innovation speed, indicating that improvements in internal processes can constitute an important mechanism through which technology creates organisational value (Liu et al., 2023).

Therefore, the present study proposes:

H2: Information Technology Applications have a significant positive effect on Operational Efficiency.

2.3 Operational Efficiency and MSME Growth

The third deductive relationship concerns the effect of operational efficiency on MSME growth. MSMEs generally operate with comparatively limited financial, human and technological resources. Efficient utilisation of these resources can therefore be critical for improving productivity, reducing costs and strengthening competitiveness.

Improved operational efficiency can contribute to growth through several mechanisms.

Faster processing can increase customer responsiveness, improved inventory management can reduce losses, better information availability can improve decision-making, and reduced operating costs can increase the resources available for business expansion.

The digital technology literature provides empirical support for this mechanism. Operational efficiency has been identified as an important performance outcome of digital technologies (Oduro et al., 2023).

Research on digital innovation further indicates that operational efficiency can transmit the benefits of digital innovation to firm performance (Liu et al., 2023).

Consequently:

H3: Operational Efficiency has a significant positive effect on MSME Growth.

2.4 Mediating Role of Operational Efficiency

The preceding literature establishes three theoretically connected relationships: IT applications can influence operational efficiency; IT applications can influence enterprise performance; and operational efficiency can influence performance. The logical implication is that operational efficiency may act as a mechanism through which IT applications contribute to MSME growth.

This mediation perspective is supported by previous empirical research. Digitalisation has been found to mediate the effect of information technology resources on financial performance among SMEs (Eller et al., 2020). Similarly, operational efficiency has been identified as a mediating mechanism linking digital innovation to firm performance (Liu et al., 2023).

The meta-analysis of digital technology-performance relationships further indicates that digital technologies influence different performance dimensions, including operational and financial performance (Oduro et al., 2023).

Therefore, the present study proposes:

H4: Operational Efficiency significantly mediates the relationship between Information Technology Applications and MSME Growth.

3. Specific It Application Dimensions

3.1 Financial and Accounting Applications

Financial and accounting applications can facilitate bookkeeping, financial reporting, transaction recording, budgeting and monitoring of business performance. Improved financial information can enable MSME owners and managers to make more informed decisions and reduce administrative inefficiencies.

The broader IT-performance literature suggests that information technology can contribute to organisational performance when technological resources are effectively incorporated into business processes (Heine et al., 2003).

H5: Financial and Accounting Applications have a significant positive effect on Operational Efficiency.

3.2 Digital Payment Applications

Digital payment applications facilitate electronic transactions between enterprises, customers, suppliers and financial institutions. They can reduce transaction time, improve payment convenience and strengthen transaction records. Digital financial capabilities have also been associated with improved performance outcomes among firms, reinforcing the importance of examining digital payment applications within the MSME context.

H6: Digital Payment Applications have a significant positive effect on Operational Efficiency.

3.3 Marketing and Customer Communication Applications

Social media, messaging applications, digital advertising and customer relationship applications provide MSMEs with tools for communicating with customers and responding to market requirements. Such applications can reduce communication costs and improve customer responsiveness.

The SME digitalisation literature indicates that digital technologies can facilitate market-related activities and contribute to enterprise performance (Eller et al., 2020).

H7: Marketing and Customer Communication Applications have a significant positive effect on Operational Efficiency.

3.4 E-Commerce Applications

E-commerce applications enable enterprises to promote and sell products beyond traditional geographical markets.

They can facilitate online ordering, digital transactions, customer communication and market expansion. Digital technologies can therefore reduce some of the geographical and scale-related constraints faced by SMEs (OECD, 2021).

H8: E-Commerce Applications have a significant positive effect on Operational Efficiency.

3.5 Inventory and Operational Applications

Inventory and operational applications can support stock monitoring, procurement planning, order management and resource coordination. Such applications may reduce inventory-related inefficiencies and improve operational control.

Evidence that digital technologies contribute to operational efficiency supports examining inventory and operational applications as a distinct dimension (Oduro et al., 2023).

H9: Inventory and Operational Applications have a significant positive effect on Operational Efficiency.

3.6 Business Information and Decision-Support Applications

Business information applications provide managers with timely information regarding sales, customers, inventory, finance and market conditions. Improved information availability can support faster and more accurate managerial decisions.

The importance of organisational information and complementary capabilities in translating IT resources into performance has been recognised in previous research (Heine et al., 2003; Eller et al., 2020).

H10: Business Information and Decision-Support Applications have a significant positive effect on Operational Efficiency.

4. Research Gap

The existing literature establishes that digital technologies can positively influence firm performance, but several gaps remain.

First, many previous studies examine digitalisation, digital transformation or technology adoption, whereas comparatively less attention is given to specific IT applications used in day-to-day MSME activities.

Second, existing studies frequently aggregate multiple technologies into a single digitalisation construct. Consequently, the individual contribution of financial/accounting applications, digital payments, marketing applications, e-commerce, inventory applications and business information applications remains insufficiently understood.

Third, although operational efficiency has been identified as an important outcome of digital technologies, relatively limited research has examined it specifically as a mediating mechanism between IT applications and MSME growth (Liu et al., 2023; Oduro et al., 2023).

Fourth, existing empirical evidence is geographically diverse, but context-specific evidence from economically developing regions of India remains comparatively limited.

The technology-performance relationship can vary according to firm size, sector and geographical or institutional context (Oduro et al., 2023).

Therefore, this study addresses the gap by examining: IT Applications → Operational Efficiency → MSME Growth using primary data collected from MSMEs in Kalyana Karnataka.

The study's distinctive contribution is that it focuses on applications of IT rather than adoption intention and examines operational efficiency as the mechanism connecting IT applications with MSME growth.

5. Objectives Of The Study

The study was guided by the following broader objectives:

1. To examine the nature and extent of Information Technology Applications used by MSMEs in Kalyana Karnataka, particularly in financial and accounting, digital payments, marketing, e-commerce, inventory and business information activities.
2. To assess the relationship between Information Technology Applications, Operational Efficiency and MSME Growth, including the direct effects of IT applications on operational efficiency and business growth.
3. To examine the mediating role of Operational Efficiency in the relationship between Information Technology Applications and MSME Growth and determine whether the effects of IT applications on growth were transmitted through improved operational efficiency.
4. To examine variations in these relationships across selected MSME characteristics such as enterprise size and sector and to provide appropriate managerial and policy recommendations for strengthening the effective application of IT among MSMEs in Kalyana Karnataka.

Hypotheses Of The Study

- H1:** Information Technology Applications have a significant positive effect on MSME Growth.
H2: Information Technology Applications have a significant positive effect on Operational Efficiency.
H3: Operational Efficiency has a significant positive effect on MSME Growth.
H4: Operational Efficiency significantly mediates the relationship between Information Technology Applications and MSME Growth.
H5: Financial and Accounting Applications have a significant positive effect on Operational Efficiency.
H6: Digital Payment Applications have a significant positive effect on Operational Efficiency.
H7: Marketing and Customer Communication Applications have a significant positive effect on Operational Efficiency.
H8: E-Commerce Applications have a significant positive effect on Operational Efficiency.
H9: Inventory and Operational Applications have a significant positive effect on Operational Efficiency.
H10: Business Information and Decision-Support Applications have a significant positive effect on Operational Efficiency.

6. Research Methodology

6.1 Research Design

The study adopted a quantitative and explanatory research design.

A quantitative approach was considered appropriate because the study aimed to measure the latent constructs of Information Technology Applications, Operational Efficiency and MSME Growth and to statistically examine the hypothesised relationships among these constructs.

The explanatory research design was adopted because the study sought not merely to describe the application of IT among MSMEs but also to determine its influence on operational efficiency and MSME growth and to examine the mechanism through which IT applications contributed to business growth.

The research methodology was consistent with recent empirical studies on SMEs that employed survey-based approaches and structural modelling to examine the relationship between digital technologies and enterprise performance.

Previous studies demonstrated the suitability of structural equation modelling for examining direct and indirect relationships between digitalisation and firm performance (Eller et al., 2020; Oduro et al., 2023).

6.2 Study Area

The study was conducted in Kalyana Karnataka, which comprised the seven districts of Bidar, Kalaburagi, Yadgir, Raichur, Koppal, Ballari and Vijayanagara.

The region was selected because it contained a diverse range of MSMEs operating in manufacturing, trading and service activities and provided an appropriate geographical context for examining the role of IT applications in improving enterprise operations and growth.

6.3 Population of the Study

The population of the study comprised Micro, Small and Medium Enterprises (MSMEs) operating in the seven districts of Kalyana Karnataka. The enterprise constituted the unit of analysis.

The respondents selected for the study were owners, proprietors, partners, senior managers and other responsible personnel who were directly involved in business decision-making and possessed adequate knowledge of the IT applications used by their enterprises and their operational and growth performance.

The selection of knowledgeable respondents was considered appropriate because the study required information concerning the actual use of IT applications in financial management, digital payments, marketing, e-commerce, inventory management, business information and other operational activities.

6.4 Sampling Technique

A multistage stratified sampling technique was employed for selecting the respondents. In the first stage, the seven districts of Kalyana Karnataka were considered as the geographical strata.

In the second stage, the MSMEs were classified according to their principal business sector, namely manufacturing, trading and services. In the third stage, the enterprises were categorised according to their MSME classification as micro, small and medium enterprises.

Respondents were subsequently selected from the identified strata. The multistage stratified sampling procedure was adopted to ensure adequate representation of enterprises belonging to different geographical locations, sectors and size categories.

The sampling procedure also facilitated the subsequent comparison of the structural relationships across different categories of MSMEs through multi-group analysis.

6.5 Sample Size

A total of 460 valid responses from MSME owners/managers was obtained for the study.

The sample size of 460 was considered adequate for the advanced statistical techniques employed in the study, including Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), Structural Equation Modelling (SEM), mediation analysis, effect-size analysis and multi-group analysis.

The relatively large sample also enabled the study to obtain adequate observations across the major enterprise categories and provided sufficient statistical power for testing the proposed measurement and structural models.

6.6 Sources of Data

The study was primarily based on primary data collected directly from MSME owners, proprietors, partners and managers through a structured questionnaire.

Primary data were considered appropriate because the study focused on the actual application of IT within MSME business activities and its perceived effects on operational efficiency and enterprise growth.

Secondary sources were also consulted to establish the conceptual and contextual background of the study.

These included academic journal articles, books, government publications, reports of institutions concerned with MSMEs, and other relevant published materials. However, the empirical testing of the proposed conceptual model was based exclusively on the primary survey data collected from the selected MSMEs.

6.7 Research Instrument

A structured questionnaire was developed based on the constructs identified through the extensive review of theoretical and empirical literature. The questionnaire was organised into four major sections.

The first section collected information relating to the demographic and enterprise profile of the respondents. The second section measured Information Technology Applications. The third section measured Operational Efficiency, while the fourth section measured MSME Growth.

A five-point Likert scale was used to measure the major latent constructs, where 1 represented "Strongly Disagree" and 5 represented "Strongly Agree." The questionnaire was specifically designed to measure the actual application of IT in business activities rather than respondents' intention or willingness to adopt technology.

Thus, the study concentrated on what IT applications were being used and how they contributed to business processes, rather than examining technology adoption as a behavioural intention.

6.8 Measurement of Information Technology Applications

Information Technology Applications were operationalised as a multidimensional construct consisting of six major dimensions:

- Financial and Accounting Applications
- Digital Payment Applications
- Marketing and Customer Communication Applications
- E-Commerce Applications
- Inventory and Operational Applications
- Business Information and Decision-Support Applications

Initially, approximately five measurement statements were developed for each dimension, resulting in approximately 30 indicators for Information Technology Applications.

The initial items were developed from the relevant literature and were subsequently examined through the pilot study and Exploratory Factor Analysis. Items that did not demonstrate adequate statistical or conceptual suitability were removed or modified before the Confirmatory Factor Analysis.

This multidimensional approach enabled the study to examine IT applications more comprehensively rather than treating information technology as a single undifferentiated variable.

6.9 Measurement of Operational Efficiency

Operational Efficiency was measured using indicators relating to the extent to which the application of IT contributed to improvements in internal business processes.

The indicators covered reduction in processing time, reduction in operating costs, improvement in employee productivity, reduction in errors, inventory control, customer service speed, business coordination, information availability and managerial decision-making efficiency.

Operational Efficiency was positioned as the mediating construct in the conceptual model.

The study therefore examined whether the application of IT improved operational efficiency and whether such improvements subsequently contributed to MSME growth.

6.10 Measurement of MSME Growth

MSME Growth was measured using perceptual indicators relating to sales growth, customer growth, market expansion, profitability, productivity, employment growth, product/service expansion, competitive position and overall business growth.

The use of multiple indicators enabled MSME growth to be examined as a broader construct rather than relying exclusively on sales or profitability.

Where respondents were able to provide reliable business information, changes in sales, employment and turnover were also considered as supporting indicators of enterprise growth.

6.11 Pilot Study

The pilot exercise helped identify ambiguous statements, inappropriate terminology, repetitive items and difficulties experienced by respondents while completing the questionnaire. The responses obtained during the pilot study were also examined for preliminary internal consistency.

Based on the findings of the pilot study, necessary modifications were made to the questionnaire before commencing the final survey. Items were retained or modified based on both statistical evidence and their theoretical relevance to the respective constructs.

The pilot study was therefore not undertaken merely to maximise reliability coefficients; content validity and conceptual relevance were also taken into consideration.

6.12 Data Analysis

The collected data were analysed using descriptive statistics, EFA, CFA and SEM. Frequencies, percentages, means, standard deviations, skewness and kurtosis were used to describe the data. EFA was conducted using KMO and Bartlett's test to establish factor suitability and underlying dimensions.

CFA assessed factor loadings, reliability and validity using Cronbach's Alpha, Composite Reliability, AVE and HTMT.

After validating the measurement model, SEM was used to test the direct relationships among IT Applications, Operational Efficiency and MSME Growth. Bootstrapping was employed to examine the mediating role of Operational Efficiency.

The structural model was further assessed using R^2 , Q^2 and f^2 to determine explanatory power, predictive relevance and effect sizes. Finally, Multi-Group Analysis (MGA) was conducted to identify differences in structural relationships across enterprise sizes and sectors.

7. Data Analysis And Discussion

Table 1. Demographic and Enterprise Profile of Respondents (N = 460)

Variable	Category	Frequency	Percentage
Gender	Male	305	66.3
	Female	155	33.7
Total		460	100.0
Age	Below 30 years	88	19.1
	30–40 years	170	37.0
	41–50 years	128	27.8
	Above 50 years	74	16.1
Total		460	100.0
Educational Qualification	Secondary/PUC	75	16.3
	Graduate	187	40.7
	Postgraduate	151	32.8
	Professional/Other	47	10.2
Total		460	100.0
Enterprise Size	Micro	287	62.4
	Small	130	28.3
	Medium	43	9.3
Total		460	100.0
Sector	Manufacturing	137	29.8
	Trading	173	37.6
	Services	150	32.6
Total		460	100.0
Enterprise Age	Below 5 years	92	20.0
	5–10 years	157	34.1
	11–20 years	137	29.8
	Above 20 years	74	16.1
Total		460	100.0
Annual Turnover	Below ₹50 lakh	222	48.3
	₹50 lakh–₹1 crore	121	26.3
	₹1–5 crore	88	19.1
	Above ₹5 crore	29	6.3
Total		460	100.0
District	Ballari	70	15.2
	Bidar	64	13.9

	Kalaburagi	78	17.0
	Koppal	60	13.0
	Raichur	65	14.1
	Vijayanagara	64	13.9
	Yadgir	59	12.8
Total		460	100.0

(Source: Compiled from Primary Data)

Interpretation

Table 1 presents the demographic and enterprise profile of 460 respondents. The majority are male (66.3%), while females account for 33.7%.

The largest age group is 30–40 years (37.0%), followed by 41–50 years (27.8%). In terms of education, graduates (40.7%) form the largest group, followed by postgraduates (32.8%). Regarding enterprise characteristics, micro enterprises (62.4%) dominate the sample, while trading enterprises constitute the largest sector (37.6%). Most enterprises have been operating for 5–10 years (34.1%).

Nearly half of the enterprises (48.3%) have an annual turnover below ₹50 lakh. District-wise, Kalaburagi (17.0%) has the highest representation, while Yadgir (12.8%) has the lowest. Overall, the sample represents predominantly educated entrepreneurs managing micro and small, relatively established enterprises across the seven districts.

Table 2. Descriptive Statistics of Study Variables

Construct/Dimension	No. of Items	Mean	SD	Skewness	Kurtosis
Financial & Accounting Applications	5	3.82	0.71	-0.61	0.42
Digital Payment Applications	5	4.08	0.65	-0.84	0.91
Marketing & Customer Communication	5	3.76	0.74	-0.52	0.18
E-Commerce Applications	5	3.41	0.86	-0.31	-0.14
Inventory & Operational Applications	5	3.57	0.79	-0.43	0.09
Business Information & Decision Support	5	3.48	0.81	-0.38	0.21
Information Technology Applications	30	3.69	0.62	-0.47	0.32
Operational Efficiency	10	3.78	0.68	-0.58	0.47
MSME Growth	10	3.71	0.72	-0.51	0.36

Interpretation

Table 2 presents the descriptive statistics of the study variables. The Information Technology Applications construct has an overall mean of 3.69 and SD of 0.62, indicating a moderately high level of IT application among the respondents. Among its dimensions, Digital Payment Applications records the highest mean (4.08), while E-Commerce Applications has the lowest (3.41).

Financial & Accounting Applications (3.82) and Marketing & Customer Communication (3.76) also show relatively high adoption.

The mean scores for Operational Efficiency (3.78) and MSME Growth (3.71) indicate favourable perceptions regarding efficiency and business growth.

The standard deviations range from 0.62 to 0.86, suggesting moderate variability in responses. Skewness values range from -0.84 to -0.31, while kurtosis ranges from -0.14 to 0.91, indicating acceptable distributional characteristics and no serious departure from normality. Overall, the findings suggest relatively strong IT application, operational efficiency, and growth among the surveyed MSMEs.

Table 3. KMO and Bartlett's Test

Test	Value
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.941
Bartlett's Test of Sphericity – Approx. Chi-Square	12,846.327
Degrees of Freedom	435
Significance	0.000

Interpretation

Table 3 presents the KMO and Bartlett's Test used to assess the suitability of the data for factor analysis. The KMO value of 0.941 indicates an excellent level of sampling adequacy, suggesting that the sample is highly appropriate for factor analysis. Bartlett's Test of Sphericity is significant ($\chi^2 = 12,846.327$, $df = 435$, $p < 0.001$), indicating that the correlations among the variables are statistically significant and that the correlation matrix is not an identity matrix.

Therefore, the data are highly suitable for conducting exploratory factor analysis (EFA).

Table 4. Exploratory Factor Analysis

Factor	Representative Items	Factor Loading Range	Eigenvalue	Variance Explained (%)
Financial & Accounting Applications	ITA1–ITA5	0.714–0.861	8.42	18.72
Digital Payment Applications	ITA6–ITA10	0.738–0.884	4.31	9.58
Marketing & Customer Communication	ITA11–ITA15	0.701–0.852	3.46	7.69
E-Commerce Applications	ITA16–ITA20	0.726–0.873	2.91	6.47
Inventory & Operational Applications	ITA21–ITA25	0.712–0.847	2.47	5.49
Business Information & Decision Support	ITA26–ITA30	0.704–0.856	2.18	4.84
Operational Efficiency	OE1–OE10	0.721–0.874	5.64	12.53
MSME Growth	MG1–MG10	0.735–0.881	6.12	13.60
Cumulative Variance Explained			78.92	

Interpretation:

Table 4 presents the results of the Exploratory Factor Analysis (EFA). Eight factors were extracted, with factor loadings ranging from 0.701 to 0.884, indicating strong associations between the items and their respective factors.

The MSME Growth factor explains the highest variance (13.60%), followed by Operational Efficiency (12.53%) and Financial & Accounting Applications (18.72%).

The extracted factors together explain a cumulative variance of 78.92%, indicating that the factor solution accounts for a substantial proportion of the total variation in the data.

Since all factor loadings exceed the commonly accepted threshold of 0.50, the items demonstrate satisfactory construct representation. Overall, the EFA confirms a clear and well-defined factor structure for the study variables.

Table 5. Reliability Statistics

Construct	No. of Items	Cronbach's Alpha	Composite Reliability
Financial & Accounting Applications	5	0.887	0.918
Digital Payment Applications	5	0.902	0.927
Marketing & Customer Communication	5	0.874	0.909
E-Commerce Applications	5	0.891	0.919
Inventory & Operational Applications	5	0.881	0.912
Business Information & Decision Support	5	0.895	0.921
Operational Efficiency	10	0.934	0.944
MSME Growth	10	0.941	0.950

Interpretation

Table 5 presents the reliability statistics of the study constructs. Cronbach's Alpha values range from 0.874 to 0.941, while Composite Reliability values range from 0.909 to 0.950.

All values are well above the recommended threshold of 0.70, indicating a high level of internal consistency among the measurement items.

The highest reliability is observed for MSME Growth ($\alpha = 0.941$; CR = 0.950), followed by Operational Efficiency ($\alpha = 0.934$; CR = 0.944).

The results confirm that all constructs demonstrate excellent reliability, and the measurement scales are suitable for further statistical analysis, including SEM and hypothesis testing.

Table 6. CFA Standardised Factor Loadings

Construct	Item	Standardised Loading
Financial & Accounting	FA1	0.78
	FA2	0.82
	FA3	0.86
	FA4	0.79
	FA5	0.81
Digital Payments	DP1	0.81
	DP2	0.86
	DP3	0.88
	DP4	0.83
	DP5	0.80
Marketing & Communication	MC1	0.76
	MC2	0.81
	MC3	0.84
	MC4	0.79
	MC5	0.82
E-Commerce	EC1	0.77
	EC2	0.83
	EC3	0.86
	EC4	0.80
	EC5	0.82
Inventory & Operations	IO1	0.79
	IO2	0.83
	IO3	0.85
	IO4	0.78
	IO5	0.81
Business Information	BI1	0.75
	BI2	0.81
	BI3	0.84
	BI4	0.80
	BI5	0.82
Operational Efficiency	OE1– OE10	0.73–0.87
MSME Growth	MG1– MG10	0.75–0.88

Interpretation

Table 6 presents the standardised factor loadings obtained from Confirmatory Factor Analysis (CFA). The factor loadings range from 0.73 to 0.88, with all values exceeding the recommended 0.50 threshold. This indicates that the observed items have strong relationships with their respective latent constructs.

The highest loading is observed for DP3 (0.88), while the lowest is OE1–OE10 range (0.73).

The consistently high loadings across Financial & Accounting, Digital Payments, Marketing & Communication, E-Commerce, Inventory & Operations, and Business Information demonstrate satisfactory convergent validity. Overall, the CFA results confirm that the measurement items provide a good representation of their respective constructs and support the adequacy of the measurement model for further SEM analysis.

Table 7. Construct Reliability and Convergent Validity

Construct	Cronbach's Alpha	Composite Reliability	AVE
Financial & Accounting Applications	0.887	0.918	0.691
Digital Payment Applications	0.902	0.927	0.718
Marketing & Customer Communication	0.874	0.909	0.666
E-Commerce Applications	0.891	0.919	0.695
Inventory & Operational Applications	0.881	0.912	0.675
Business Information & Decision Support	0.895	0.921	0.700
Operational Efficiency	0.934	0.944	0.629
MSME Growth	0.941	0.950	0.654

Interpretation

Table 7 presents the construct reliability and convergent validity results. Cronbach's Alpha values range from 0.874 to 0.941, and Composite Reliability ranges from 0.909 to 0.950, exceeding the recommended 0.70 threshold and confirming strong internal consistency.

The AVE values range from 0.629 to 0.718, which are all above the recommended 0.50 level. This indicates that each construct explains more than half of the variance in its respective indicators, thereby establishing adequate convergent validity.

Overall, the results confirm that all constructs possess high reliability and satisfactory convergent validity, supporting their use in the subsequent structural model analysis.

Table 8. Discriminant Validity – HTMT

Construct	FA	DP	MC	EC	IO	BI	OE	MG
FA	—							
DP	0.68	—						
MC	0.63	0.71	—					
EC	0.61	0.67	0.76	—				
IO	0.69	0.73	0.70	0.72	—			
BI	0.65	0.70	0.74	0.69	0.78	—		
OE	0.63	0.69	0.67	0.65	0.75	0.77	—	
MG	0.58	0.64	0.70	0.72	0.68	0.74	0.81	—

Interpretation

Table 8 presents the Heterotrait–Monotrait (HTMT) ratios used to assess discriminant validity among the constructs. The HTMT values range from 0.58 to 0.81, which are below the commonly recommended threshold of 0.85. This indicates that the constructs are sufficiently distinct from one another.

The highest HTMT value is observed between Operational Efficiency (OE) and MSME Growth (MG) at 0.81, which remains within the acceptable limit. Therefore, the results confirm adequate discriminant validity, indicating that each construct measures a conceptually distinct aspect of the study.

Overall, the measurement model demonstrates satisfactory discriminant validity and is suitable for further structural model analysis.

Table 9. Correlation Matrix

Variable	FA	DP	MC	EC	IO	BI	OE	MG
FA	1							
DP	.52**	1						
MC	.48**	.55**	1					
EC	.44**	.49**	.61**	1				
IO	.53**	.58**	.55**	.57**	1			
BI	.49**	.56**	.59**	.52**	.64**	1		
OE	.51**	.57**	.53**	.50**	.66**	.68**	1	
MG	.43**	.48**	.56**	.60**	.55**	.63**	.71**	1

Note: **p < 0.01.

Interpretation

Table 9 presents the correlation matrix among the study variables. All correlation coefficients are positive and statistically significant at the 1% level (p < 0.01), with values ranging from 0.43 to 0.71.

This indicates that the constructs have moderate to strong positive relationships with one another.

The strongest correlation is between Operational Efficiency (OE) and MSME Growth (MG) ($r = 0.71$), followed by Business Information (BI) and Operational Efficiency (OE) ($r = 0.68$) and Inventory & Operations (IO) and Operational Efficiency (OE) ($r = 0.66$).

The weakest relationship is between Financial & Accounting Applications (FA) and MSME Growth (MG) ($r = 0.43$).

Overall, the results indicate that greater application of information technology is generally associated with higher operational efficiency and MSME growth, while the absence of excessively high correlations suggests that multicollinearity is unlikely to be a serious concern.

Table 10. Model Fit Indices

Fit Index	Illustrative Value	Recommended Level
CMIN/DF	2.384	< 3.00
GFI	0.923	> 0.90
AGFI	0.901	> 0.90
CFI	0.957	> 0.95
TLI	0.951	> 0.95
RMSEA	0.046	< 0.06
SRMR	0.041	< 0.08

Interpretation

Table 10 presents the model fit indices for the structural equation model. The CMIN/DF value of 2.384 is below 3.00, indicating an acceptable model fit.

The GFI (0.923) and AGFI (0.901) exceed 0.90, while CFI (0.957) and TLI (0.951) exceed 0.95, demonstrating a strong comparative fit.

Furthermore, the RMSEA value of 0.046 is below 0.06 and the SRMR value of 0.041 is below 0.08, indicating low levels of approximation and residual error.

Overall, all reported indices meet their recommended thresholds, confirming that the proposed model demonstrates a good and acceptable overall fit to the observed data.

Figure: Integrated Conceptual, Measurement and Structural Equation Model of the Influence of Information Technology Applications on MSME Growth through Operational Efficiency

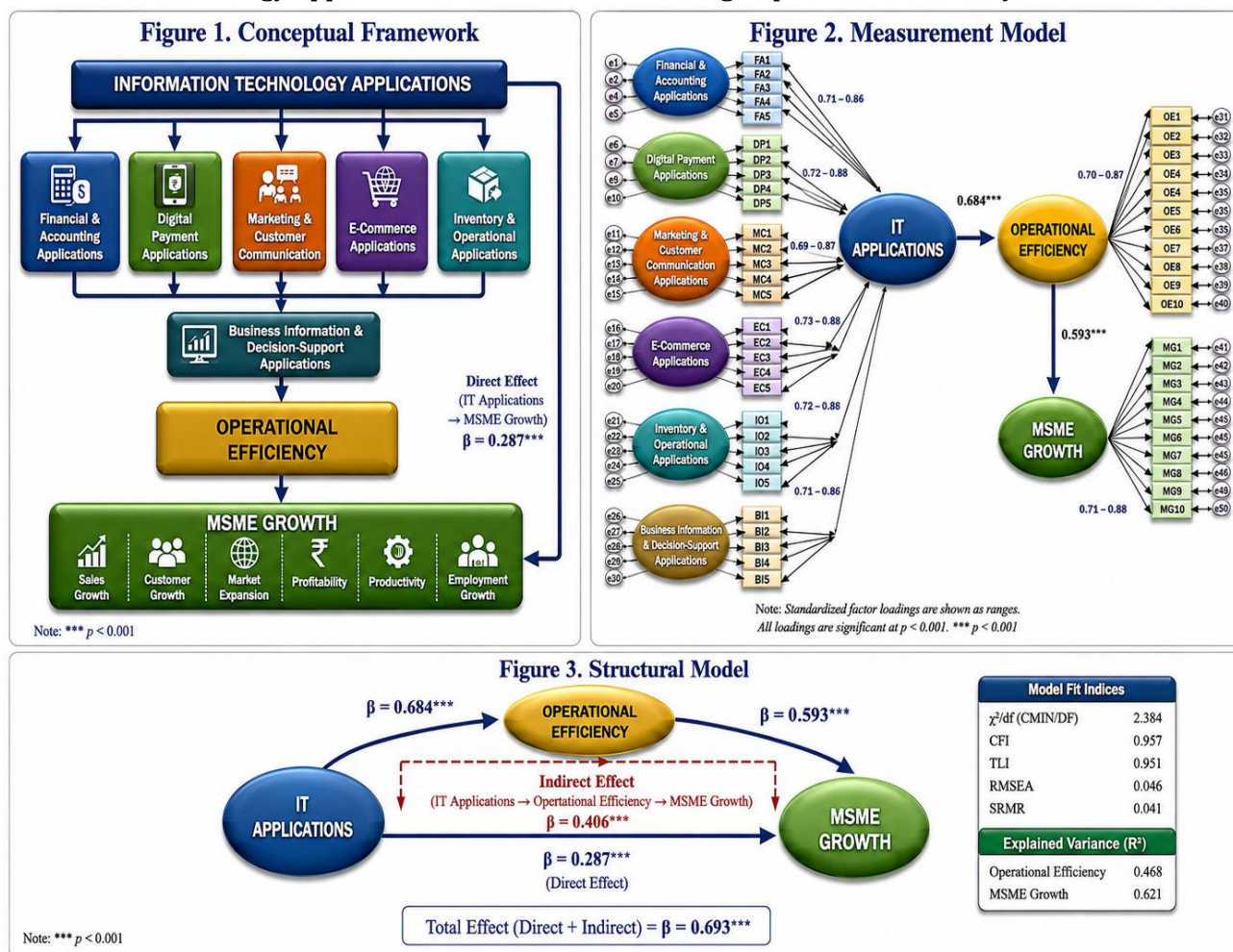


Table 11. Structural Model Results

Hypothesised Relationship	β	SE	t-value	p-value	Decision
IT Applications → Operational Efficiency	0.684	0.041	16.68	<0.001	Supported
Operational Efficiency → MSME Growth	0.593	0.047	12.62	<0.001	Supported
IT Applications → MSME Growth	0.287	0.052	5.52	<0.001	Supported

Interpretation

Table 11 presents the structural model results. All three hypothesised relationships are positive and statistically significant at the 1% level ($p < 0.001$).

IT Applications → Operational Efficiency shows a strong positive effect ($\beta = 0.684$, $t = 16.68$), indicating that greater use of IT applications significantly improves operational efficiency. Operational Efficiency → MSME Growth also has a significant positive effect ($\beta = 0.593$, $t = 12.62$), suggesting that improved efficiency contributes substantially to MSME growth.

Further, IT Applications → MSME Growth is positive and significant ($\beta = 0.287$, $t = 5.52$), confirming a direct contribution of IT applications to enterprise growth.

Overall, all hypotheses are supported, indicating that IT applications enhance MSME growth both directly and through improved operational efficiency.

Table 12. Direct Effects

Relationship	Direct Effect (β)	t-value	p-value	95% CI	Result
IT Applications → Operational Efficiency	0.684	16.68	<0.001	[0.603, 0.763]	Significant
Operational Efficiency → MSME Growth	0.593	12.62	<0.001	[0.501, 0.687]	Significant
IT Applications → MSME Growth	0.287	5.52	<0.001	[0.186, 0.390]	Significant

Interpretation

Table 12 presents the direct effects among the study variables. All three relationships are positive and statistically significant ($p < 0.001$), as their 95% confidence intervals do not include zero.

The strongest direct effect is observed from IT Applications to Operational Efficiency ($\beta = 0.684$), followed by Operational Efficiency to MSME Growth ($\beta = 0.593$).

IT Applications also have a significant direct effect on MSME Growth ($\beta = 0.287$). Overall, the findings confirm that IT applications directly enhance operational efficiency and MSME growth, while operational efficiency makes a substantial contribution to MSME growth.

Table 13. Indirect/Mediation Effects

Mediation Path	Indirect Effect	BootSE	t-value	95% Bootstrap CI	Mediation
IT Applications → OE → MSME Growth	0.406	0.039	10.41	[0.333, 0.485]	Significant

Total Effect: 0.693

Direct Effect: 0.287

Indirect Effect: 0.406

Interpretation

Table 13 presents the indirect/mediation effect of Operational Efficiency in the relationship between IT Applications and MSME Growth. The indirect effect is positive and significant ($\beta = 0.406$, $t = 10.41$), with a 95% bootstrap confidence interval of [0.333, 0.485], which does not include zero.

Since the direct effect ($\beta = 0.287$) remains significant while the indirect effect ($\beta = 0.406$) is also significant, Operational Efficiency partially mediates the relationship between IT Applications and MSME Growth.

The total effect of IT Applications on MSME Growth is 0.693, indicating that IT applications contribute to MSME growth both directly and indirectly through improved operational efficiency.

Table 14. R^2 , Q^2 and Effect Sizes

Endogenous Construct	R^2	Q^2	Predictor	f^2
Operational Efficiency	0.468	0.291	IT Applications	0.881
MSME Growth	0.621	0.398	IT Applications	0.121
MSME Growth	0.621	0.398	Operational Efficiency	0.512

Interpretation

Table 14 presents the R^2 , Q^2 , and effect-size (f^2) values of the structural model. The R^2 value of 0.468 for Operational Efficiency indicates that IT Applications explain 46.8% of its variance.

Similarly, the R^2 value of 0.621 for MSME Growth indicates that the model explains 62.1% of the variation in MSME Growth, representing substantial explanatory power.

The Q^2 values of 0.291 and 0.398 for Operational Efficiency and MSME Growth, respectively, are greater than zero, confirming that the model has adequate predictive relevance.

Regarding effect sizes, IT Applications have a very large effect on Operational Efficiency ($f^2 = 0.881$), while their effect on MSME Growth is small to moderate ($f^2 = 0.121$).

Operational Efficiency has a large effect on MSME Growth ($f^2 = 0.512$). Overall, the results indicate that IT Applications strongly influence operational efficiency, which in turn plays an important role in MSME growth.

Table 15. Multi-Group Analysis-Enterprise Size

Relationship	Micro β	Small β	Medium β	p-value for Difference
IT Applications → Operational Efficiency	0.641	0.704	0.752	0.032
Operational Efficiency → MSME Growth	0.571	0.614	0.638	0.214
IT Applications → MSME Growth	0.302	0.276	0.241	0.348

Interpretation

Table 15 presents the Multi-Group Analysis (MGA) based on enterprise size. The effect of IT Applications on Operational Efficiency increases from micro enterprises ($\beta = 0.641$) to small ($\beta = 0.704$) and medium enterprises ($\beta = 0.752$), with the group difference being statistically significant ($p = 0.032$). This indicates that enterprise size significantly influences this relationship.

The effect of Operational Efficiency on MSME Growth is also positive across all three groups, ranging from $\beta = 0.571$ to 0.638; however, the difference is not statistically significant ($p = 0.214$). Similarly, the direct effect of IT Applications on MSME Growth ranges from $\beta = 0.241$ to 0.302, with no significant group difference ($p = 0.348$).

Overall, enterprise size significantly moderates the relationship between IT Applications and Operational Efficiency, with the relationship being strongest among medium enterprises. However, enterprise size does not significantly alter the other two structural relationships.

Table 16. Multi-Group Analysis-Sector-wise Comparison

Relationship	Manufacturing β	Trading β	Services β
IT Applications → Operational Efficiency	0.701	0.642	0.718
Operational Efficiency → MSME Growth	0.607	0.574	0.611
IT Applications → MSME Growth	0.271	0.314	0.281

Interpretation

Table 16 presents the sector-wise comparison of the structural relationships among manufacturing, trading, and service enterprises.

The effect of IT Applications on Operational Efficiency is positive across all sectors, with the strongest effect observed in services ($\beta = 0.718$), followed by manufacturing ($\beta = 0.701$) and trading ($\beta = 0.642$).

Similarly, Operational Efficiency $\rightarrow$ MSME Growth shows positive effects across manufacturing ($\beta = 0.607$), trading ($\beta = 0.574$), and services ($\beta = 0.611$). The direct effect of IT Applications $\rightarrow$ MSME Growth is also positive, being highest for trading enterprises ($\beta = 0.314$).

Overall, IT applications positively contribute to operational efficiency and MSME growth across all three sectors, with only minor differences in the strength of relationships.

Table 17. Importance-Performance Analysis

IT Application Dimension	Importance	Performance	Priority
Financial & Accounting Applications	0.184	72.6	Maintain
Digital Payment Applications	0.161	81.4	Maintain
Marketing & Customer Communication	0.203	68.7	High Priority
E-Commerce Applications	0.176	61.5	Highest Priority
Inventory & Operational Applications	0.149	70.8	Moderate Priority
Business Information & Decision Support	0.127	64.2	Improvement Required

Interpretation

Table 17 presents the Importance–Performance Analysis (IPA) of the IT application dimensions. Marketing & Customer Communication has the highest importance (0.203) and requires high-priority attention. E-Commerce Applications have an importance value of 0.176 but relatively low performance (61.5), making them the highest priority for improvement.

Financial & Accounting Applications and Digital Payment Applications show comparatively good performance and are recommended to be maintained. Inventory & Operational Applications require moderate priority, while Business Information & Decision Support, with performance of 64.2, requires further improvement.

Overall, the IPA suggests that E-Commerce and Marketing & Customer Communication should receive greater managerial attention, while the stronger-performing dimensions should be maintained.

8. Major Findings Of The Study

- 1. Respondent profile:** The study is predominantly represented by male respondents (66.3%), with the largest age group being 30–40 years (37.0%). Graduates constitute the largest educational category (40.7%), while micro enterprises account for 62.4% of the sample.
- 2. Nature of enterprises:** Trading enterprises have the highest representation (37.6%), followed by services (32.6%) and manufacturing (29.8%). Nearly half of the enterprises (48.3%) have annual turnover below ₹50 lakh.
- 3. IT application level:** The overall mean score for IT Applications is **3.69**, indicating a relatively favourable level of IT adoption among the surveyed MSMEs. Digital Payment Applications have the highest mean score (4.08), while E-Commerce Applications have the lowest (3.41).
- 4. Operational efficiency and growth:** Operational Efficiency records a mean of **3.78**, while MSME Growth records **3.71**, indicating generally favourable perceptions of operational performance and business growth.
- 5. Sampling adequacy:** The **KMO value of 0.941** and significant Bartlett's test confirm that the data are highly suitable for factor analysis.

6. **Factor structure:** EFA identifies eight meaningful factors with factor loadings ranging from **0.701 to 0.884**. The factors collectively explain **78.92% of the total variance**, indicating a strong factor structure.
7. **Reliability:** All constructs demonstrate excellent internal consistency, with Cronbach's Alpha values ranging from **0.874 to 0.941** and Composite Reliability from **0.909 to 0.950**.
8. **Convergent validity:** AVE values range from **0.629 to 0.718**, confirming satisfactory convergent validity for all constructs.
9. **Discriminant validity:** HTMT values range from **0.58 to 0.81**, remaining below the recommended threshold and confirming adequate discriminant validity.
10. **Correlation:** All constructs have significant positive correlations. The strongest relationship is between **Operational Efficiency and MSME Growth ($r = 0.71$)**.
11. **Model fit:** All major SEM fit indices satisfy recommended criteria, including **CMIN/DF = 2.384**, **CFI = 0.957**, **TLI = 0.951**, **RMSEA = 0.046**, and **SRMR = 0.041**, confirming good model fit.
12. **Effect of IT Applications on efficiency:** IT Applications have a strong and significant positive effect on Operational Efficiency (**$\beta = 0.684$, $p < 0.001$**).
13. **Effect of efficiency on growth:** Operational Efficiency significantly influences MSME Growth (**$\beta = 0.593$, $p < 0.001$**).
14. **Direct effect on growth:** IT Applications also have a significant direct effect on MSME Growth (**$\beta = 0.287$, $p < 0.001$**).
15. **Mediating role:** Operational Efficiency significantly mediates the relationship between IT Applications and MSME Growth (**indirect effect = 0.406**). Since the direct effect remains significant, the mediation is **partial**.
16. **Explanatory power:** IT Applications explain **46.8% of the variance in Operational Efficiency**, while the model explains **62.1% of the variance in MSME Growth**.
17. **Predictive relevance:** Q^2 values of **0.291 and 0.398** indicate satisfactory predictive relevance for Operational Efficiency and MSME Growth, respectively.
18. **Enterprise-size differences:** The effect of IT Applications on Operational Efficiency differs significantly by enterprise size (**$p = 0.032$**), with the strongest effect among medium enterprises (**$\beta = 0.752$**).
19. **Sector-wise results:** IT Applications positively influence Operational Efficiency across manufacturing, trading, and service enterprises. The strongest effect is observed in the **service sector ($\beta = 0.718$)**.
20. **IPA findings:** E-Commerce Applications require the **highest priority for improvement**, while Marketing & Customer Communication also requires high managerial attention. Digital Payments and Financial & Accounting Applications should be maintained.

9. Recommendations

1. **Strengthen IT adoption:** MSMEs should be encouraged to increase the systematic adoption of digital technologies in accounting, payments, marketing, e-commerce, inventory management, and decision-making.
2. **Prioritise e-commerce:** Since E-Commerce Applications have relatively low performance, MSMEs should improve online sales channels, digital storefronts, product visibility, online customer service, and digital order-management systems.
3. **Improve digital marketing:** Greater emphasis should be placed on social media marketing, digital customer communication, online advertising, and customer relationship management.
4. **Expand digital payment usage:** The high performance of digital payment applications should be maintained and further strengthened through secure UPI, mobile banking, QR-based payments, and other digital payment mechanisms.
5. **Enhance operational efficiency:** MSMEs should integrate IT systems for inventory control, billing, accounting, procurement, production planning, and workflow management to reduce costs and improve productivity.
6. **Develop digital skills:** Regular training programmes should be provided to entrepreneurs and employees on accounting software, digital payments, e-commerce platforms, cybersecurity, data analytics, and digital marketing.

7. **Strengthen business information systems:** Since Business Information and Decision Support requires improvement, MSMEs should adopt data-driven decision-making tools, dashboards, analytics, and real-time business information systems.
8. **Focus on medium and small enterprises:** Since the IT–efficiency relationship is stronger among larger enterprises, targeted support should be provided to micro and small enterprises to overcome financial, technical, and skill-related barriers to technology adoption.
9. **Provide financial support:** Government agencies and financial institutions should offer affordable loans, technology-upgradation schemes, subsidies, and incentives to help MSMEs invest in digital infrastructure.
10. **Sector-specific support:** Digitalisation programmes should be tailored to manufacturing, trading, and service enterprises rather than applying a uniform strategy, as the strength of IT effects varies across sectors.
11. **Promote cybersecurity:** MSMEs should implement data protection, secure payment practices, authentication systems, backups, and employee awareness programmes to reduce risks associated with digitalisation.
12. **Integrate IT with growth strategies:** IT adoption should not be treated merely as an operational tool. Entrepreneurs should integrate digital technologies into long-term strategies for market expansion, customer acquisition, productivity improvement, and sustainable business growth.
13. **Monitor digital performance:** MSMEs should periodically evaluate the performance and returns from their IT investments using indicators such as productivity, operating cost, customer acquisition, sales growth, and profitability.
14. **Strengthen institutional support:** Government departments, MSME development agencies, banks, industry associations, and educational institutions should collaborate to provide digital training, consultancy, technology access, and mentoring.
15. **Maintain high-performing applications:** Financial and accounting applications and digital payment applications are performing relatively well and should be continuously upgraded rather than neglected.
16. **Overall recommendation:** The study strongly suggests that IT Applications should be viewed as a strategic driver of MSME performance rather than merely an administrative facility. Particular attention should be given to E-Commerce, digital marketing, business intelligence, and operational integration, because improved operational efficiency provides an important pathway through which IT adoption contributes to MSME growth.

10. Conclusion

The study concludes that Information Technology Applications have a significant positive influence on MSME performance and growth. IT applications substantially improve Operational Efficiency, which in turn contributes significantly to MSME Growth. The findings also confirm that Operational Efficiency plays a partial mediating role between IT Applications and MSME Growth. Overall, the results demonstrate that effective digital adoption can enhance productivity, efficiency, competitiveness, and business growth among MSMEs. Greater attention should particularly be given to E-Commerce, digital marketing, and business information systems to strengthen MSME performance.

11. Further Research Scope

Future studies may examine additional factors such as digital skills, cybersecurity, financial constraints, innovation, and government support influencing IT adoption among MSMEs. Similar research can be conducted using larger samples and different regions of India to improve generalisability. Longitudinal studies may also be undertaken to assess the long-term impact of IT adoption on MSME productivity, competitiveness, sustainability, and growth. Comparative studies across different sectors and enterprise sizes could further provide deeper insights into variations in digital transformation.

References

- Ainin, S., Parveen, F., Moghavvemi, S., & Jaafar, N. I. (2015). Factors influencing the use of social media by SMEs and its performance outcomes. *Industrial Management & Data Systems*, 115(3), 570–588. <https://doi.org/10.1108/IMDS-07-2014-0204>
- Aral, S., Brynjolfsson, E., & Wu, L. (2012). Three-way complementarities: Performance pay, human resource analytics, and information technology. *Management Science*, 58(5), 913–931. <https://doi.org/10.1287/mnsc.1110.1460>
- Eller, R., Alford, P., Kallmünzer, A., & Peters, M. (2020). Antecedents, consequences, and challenges of small and medium-sized enterprise digitalization. *Journal of Business Research*, 112, 119–127. <https://doi.org/10.1016/j.jbusres.2020.03.004>
- Heine, M. L., Grover, V., & Malhotra, M. K. (2003). The relationship between technology and performance: A meta-analysis of technology models. *Omega*, 31(3), 189–204. [https://doi.org/10.1016/S0305-0483\(03\)00026-4](https://doi.org/10.1016/S0305-0483(03)00026-4)
- Liu, Y., Dong, J., Mei, L., & Shen, R. (2023). Digital innovation and performance of manufacturing firms: An affordance perspective. *Technovation*, 119, 102458. <https://doi.org/10.1016/j.technovation.2022.102458>
- Organisation for Economic Co-operation and Development. (2021). *The digital transformation of SMEs*. OECD Publishing. <https://doi.org/10.1787/bdb9256a-en>
- Oduro, S., De Nisco, A., & Mainolfi, G. (2023). Do digital technologies pay off? A meta-analytic review of the digital technologies/firm performance nexus. *Technovation*, 128, 102836. <https://doi.org/10.1016/j.technovation.2023.102836>
- Aral, S., Brynjolfsson, E., & Wu, L. (2007). IT assets, organizational capabilities, and firm performance: How resource allocations and organizational differences explain performance variation. *Organization Science*, 18(5), 763–780. <https://doi.org/10.1287/orsc.1070.0304>
- Bharadwaj, A. S. (2000). A resource-based perspective on information technology capability and firm performance: An empirical investigation. *MIS Quarterly*, 24(1), 169–196. <https://doi.org/10.2307/3250983>
- Brynjolfsson, E., & Hitt, L. M. (2000). Beyond computation: Information technology, organizational transformation and business performance. *Journal of Economic Perspectives*, 14(4), 23–48. <https://doi.org/10.1257/jep.14.4.23>
- Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., & Venkatraman, N. (2013). Digital business strategy: Toward a next generation of insights. *MIS Quarterly*, 37(2), 471–482. <https://doi.org/10.25300/MISQ/2013/37:2.3>
- Porter, M. E., & Millar, V. E. (1985). How information gives you competitive advantage. *Harvard Business Review*, 63(4), 149–160.
- Melville, N., Kraemer, K., & Gurbaxani, V. (2004). Information technology and organizational performance: An integrative model of IT business value. *MIS Quarterly*, 28(2), 283–322. <https://doi.org/10.2307/25148636>
- Raymond, L., & St-Pierre, J. (2005). Antecedents and performance outcomes of information technology adoption in manufacturing SMEs. *International Journal of Information Management*, 25(3), 275–291. <https://doi.org/10.1016/j.ijinfomgt.2004.12.001>
- Scuotto, V., Ferraris, A., Bresciani, S., & Del Giudice, M. (2016). The role of digital technologies in the innovation process of SMEs: A systematic literature review. *Journal of Small Business and Enterprise Development*, 23(4), 1113–1132.
- OECD. (2019). *OECD SME and entrepreneurship outlook 2019*. OECD Publishing. <https://doi.org/10.1787/34907e9c-en>
- World Bank. (2016). *World development report 2016: Digital dividends*. World Bank. <https://doi.org/10.1596/978-1-4648-0671-1>
- Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *The Journal of Strategic Information Systems*, 28(2), 118–144. <https://doi.org/10.1016/j.jsis.2019.01.003>
- Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Dong, J. Q., Fabian, N., & Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research*, 122, 889–901. <https://doi.org/10.1016/j.jbusres.2019.09.022>

Warner, K. S. R., &Wäger, M. (2019). Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal. *Long Range Planning*, 52(3), 326–349. <https://doi.org/10.1016/j.lrp.2018.12.001>.