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The Road to Digital Maturity: Enabling ICT Adoption in SME Ecosystem (A case study of Dhaka City)

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Abstract

Small and Medium Enterprises (SMEs) play a critical role in Bangladesh's industrial and service sectors, contributing nearly one-fourth of the national GDP and employing over 7.8 million people. Despite this significance, a large proportion of SMEs remain digitally underdeveloped, limiting productivity, financial access, and competitiveness. This study examines the pathways to digital maturity by analysing the extent, determinants, and performance impacts of ICT adoption among SMEs in Dhaka City. Drawing on a mixed-method approach, data were collected from 1,000 SMEs, comprising manufacturing, trading, and service firms, through structured surveys and 100 in-depth interviews. The study constructs an ICT Adoption Index across five dimensions: accounting, inventory management, online sales, digital payments, and ERP integration, yielding an average score of 0.45, indicating moderate digital maturity. Regression analysis reveals a significant positive relationship between ICT adoption and business performance (unstandardised $\beta = 8.45$, standardised $\beta = 0.56$, $p < 0.001$, $R^2 = 0.42$), indicating that SMEs that integrate digital systems experience higher revenue growth and improved access to finance. Qualitative findings identify key barriers to ICT adoption, including affordability constraints, limited digital skills, and regulatory concerns, with women-led enterprises facing additional challenges. The results highlight that digital maturity is not merely a technological upgrade but a strategic enabler of SME competitiveness. The study provides empirical evidence to inform policy interventions, SME support programs, and the design of affordable digital solutions to accelerate inclusive digital transformation in emerging economies.

Keywords: Business Performance; Digital Maturity; Dhaka City; ICT Adoption; SME Ecosystem

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1. Introduction

1.1 Background and Rationale

In the rapidly evolving global economy, digital transformation has become a defining force shaping business competitiveness, innovation, and sustainability. For small and medium enterprises (SMEs), information and communication technology (ICT) is no longer a luxury. It is a fundamental requirement for operational efficiency, financial transparency, and market access.

Digital tools such as accounting software, inventory systems, digital payments, and enterprise resource planning (ERP) platforms enable SMEs to improve productivity and participate more effectively in formal and global value chains. Firms that successfully integrate ICT are better positioned to sustain growth, attract external finance, and respond to competitive pressures.

In Bangladesh, SMEs play a critical role in economic development. They represent more than 7.8 million business units, contribute approximately 25% of the national GDP, and employ nearly 40% of the labour force (SME Foundation, 2024). Despite this contribution, most SMEs operate with limited digital integration. Manual bookkeeping, paper-based accounting, and cash transactions remain dominant across sectors.

Low levels of digital maturity constrain SMEs' ability to improve efficiency, reduce transaction costs, and expand customer reach. These constraints have become more visible in the post-pandemic period, where digital capability proved essential for business continuity and resilience. As a result, digital transformation has emerged as both a policy priority and a strategic necessity for SMEs. The COVID-19 pandemic accelerated digital transformation among SMEs worldwide, forcing firms to adopt digital technologies more rapidly (Zhu & Kraemer, 2022).

Dhaka, the capital city and commercial hub of Bangladesh, hosts the country's most dynamic SME ecosystem. SMEs in Dhaka operate across manufacturing, trading, and service sectors, including leather goods, agrifood processing, medical equipment,and logistics. The city benefits from relatively high internet penetration and access to technology service providers. However, digital adoption among SMEs remains uneven and fragmented.

Field evidence from this study indicates that while 97% of surveyed SMEs use at least one digital tool, adoption is largely limited to basic technologies such as mobile banking or social media marketing. Only 7% of firms have adopted advanced systems such as ERP. This gap highlights a sharp divide between early digital adopters and digitally lagging enterprises.

This study addresses this gap by examining ICT adoption and digital maturity among SMEs in Dhaka City. It introduces an ICT Adoption Index with a mean score of 0.45, constructed across five core dimensions: digital accounting, inventory management, online sales, mobile payments, and ERP integration. By linking this index to business performance indicators through regression analysis, the study provides empirical evidence on how digital maturity influences SME growth and competitiveness.

1.2 Research Problem and Objectives

The research problem addressed in this study lies at the intersection of digital readiness and business performance. While the global narrative promotes digitalisation as a catalyst for productivity and competitiveness, the empirical relationship between ICT adoption and SME performance in the context of developing economies remains underexplored. Bangladesh, in particular, faces challenges of affordability, awareness, and technical capacity that hinder SMEs from scaling digital transformation. Despite policy initiatives like the "Smart Bangladesh Vision 2041," which emphasises digital inclusion and entrepreneurship, there is limited research quantifying how digital adoption actually affects firm-level outcomes such as revenue growth, market expansion, and access to finance.

The study is guided by three research objectives:

1. To assess the current state and extent of ICT adoption among SMEs in Dhaka.
2. To analyse the relationship between ICT adoption and SME business performance.
3. To identify the barriers and enabling factors influencing digital transformation.

1.3 Research Significance and Contribution

From a practical standpoint, the significance of this research lies in its ability to inform both policymakers and technology providers. For the government and SME-support institutions, understanding the link between ICT adoption and performance can guide resource allocation, digital training, and incentive structures for SME modernisation. For private software firms like Digit care, the findings offer insights into user behaviour, sectoral needs, and potential strategies to design affordable, modular ERP systems that align with SME capacities.

The novelty of this study lies in three aspects. First, it employs a mixed-methods approach that integrates quantitative analysis of 1,000 SMEs with qualitative insights from 100 in-depth interviews. This design captures both the statistical relationships and the contextual nuances that influence digital behaviour. Second, it develops an empirically tested ICT Adoption Index specifically tailored to the Bangladeshi SME context, contributing a replicable measurement tool for future

research. Third, it incorporates sectoral comparisons examining manufacturing, trading, and service industries to reveal how digital maturity varies across operational environments.

Accordingly, the research addresses the following key questions: What is the level of digital maturity among SMEs in Dhaka? How does ICT adoption affect revenue growth and business performance? What institutional, technical, and financial challenges hinder SMEs from achieving higher digital maturity?

This research contributes to academic theory by extending the Technology-Organisation-Environment (TOE) framework in the context of an emerging economy (Tornatzky & Fleischer, 1990). It demonstrates that while technological readiness and organisational capacity are important, environmental and institutional conditions such as ecosystem partnerships, digital infrastructure, and regulatory trust are equally decisive. Empirically, the study provides one of the few city-level analyses linking ICT adoption with quantifiable performance metrics among Bangladeshi SMEs.

From a policy perspective, the study aligns with national development priorities by highlighting the pathways to SME digital maturity. It underscores that effective digitalisation requires a holistic approach encompassing training, financing, and policy incentives. For women entrepreneurs, who represent a growing yet digitally underserved segment, the study emphasises the need for gender-responsive digital programs to bridge inclusion gaps.

Unlike prior studies that focus primarily on single-country or firm-level analyses, this study situated Dhaka's SME ecosystem within a broader comparative South Asian–African digital maturity spectrum. By benchmarking Dhaka against selected regional and African SME contexts, the research highlights both relative progress and structural gaps in ICT adoption across emerging economies.

1.4 Structure of the Paper

After the introduction, section 2 presents a critical review of global and regional literature on SME digital transformation, identifying theoretical and empirical gaps. Section 3 outlines the theoretical and conceptual framework, grounded in the TOE model, and formulates the research hypothesis. Section 4 describes the research methodology, data sources, variable construction, and regression model specification. Section 5 presents the empirical results, including descriptive statistics, regression findings, and case-based insights from DigitCare's field data. Section 6 concludes with recommendations, policy implications, and directions for future research.

By integrating empirical rigour with contextual depth, this study advances both the scholarly and practical understanding of how SMEs in Dhaka and, by extension, similar urban centres in developing countries can move along the road to digital maturity.

2. Literature Review

2.1 Global Perspectives on SME Digital Transformation

Digital transformation has become an essential driver of competitiveness and productivity in the global SME landscape. Over the past decade, ICT adoption has been shown to improve efficiency, market access, and financial transparency, particularly in developing economies (OECD, 2023). However, research also reveals that SMEs often face structural and behavioural barriers that delay digital integration. According to the Asian Development Bank (2023), digital maturity among South Asian SMEs remains uneven, with firms in Bangladesh and Nepal lagging behind regional peers in terms of ERP and CRM adoption. SMEs require strong technological capabilities to support innovation and digital transformation (Yadav & Singh, 2023).

Globally, SME digitalisation is influenced by technological readiness, financial capacity, and institutional support. Dwivedi, Hughes, and Rana (2021) emphasised that SMEs adopting integrated digital systems experience measurable improvements in customer retention and operational performance. Similarly, Chen and Zhu (2020) found that digital maturity correlates with innovation and long-term growth in SMEs. Yet, these benefits are contingent upon contextual factors such as digital literacy and infrastructure quality, which vary widely across developing countries.

Taken together, these studies suggest that while ICT adoption consistently enhances SME performance, the magnitude and sustainability of these gains depend heavily on contextual readiness, an aspect that remains insufficiently explored in emerging urban SME ecosystems.

2.2 ICT Adoption in South Asia and Africa

In the South Asian context, ICT diffusion among SMEs is shaped by affordability, sectoral needs, and policy incentives (Rahman & Akter, 2023; World Bank, 2024). While basic tools such as mobile banking and digital payments have seen widespread adoption, advanced systems like ERP remain rare due to high costs and limited technical expertise (Rahman & Akter, 2023). African studies echo similar themes: for instance, research on Somali agribusiness SMEs found that relative advantage, complexity, and top management support are significant determinants of ICT adoption, while costs and vendor support are less influential

(Abdullahi et al., 2021). Compared to South Asian SMEs, African enterprises appear to rely more on managerial motivation and perceived usefulness than on external policy incentives, indicating region-specific pathways to ICT adoption that warrant comparative investigation. These findings suggest that motivation and insight, rather than financial or external support alone, drive ICT adoption in resource-constrained environments (Abdullahi et al., 2021).

2.3 The Bangladesh Context and Empirical Gaps

Bangladesh's SME sector, though vibrant, lags in digital integration. Recent data indicate that while 97% of Dhaka's SMEs use at least one digital tool, only 7% have adopted advanced systems (Haque et al., 2024). Empirical research highlights that digital adoption improves operational efficiency, market reach, and competitive positioning, yet SMEs face barriers including limited technological skills, financial constraints, and inadequate infrastructure (Nipaa, Fuad, & Chowdhury, 2024; Mustaqeem & Sarder, 2024). Women-led SMEs often face additional structural barriers, including limited access to finance, digital skills gaps, and insufficient participation in digital literacy programs (World Bank, 2022). Access to microfinance services plays an important role in supporting small businesses and reducing poverty by improving financial inclusion for micro and small enterprises (Kessy & Urio, 2006). SMEs in emerging economies face multiple barriers in their digital transformation journey, including infrastructure limitations, financial constraints, and lack of digital skills (Roy & Ahmed, 2023). Despite the potential benefits of enterprise systems, many SMEs face significant barriers to ERP adoption, including high implementation costs, lack of technical expertise, and resistance to organizational change (Akter & Mahmud, 2023). Although government initiatives have sought to promote digital literacy and access, empirical studies measuring the direct impact of ICT adoption on business performance, such as revenue growth, market reach, and loan approvals, are scarce (Rahman & Haque, 2020). Access to training and skill-development programs provided by government institutions significantly improves managerial capability and business performance among SMEs (Islam et al., 2020).

This study addresses these gaps by combining quantitative analysis with qualitative insights from in-person and phone interviews. Despite growing descriptive evidence on digital tool usage, rigorous empirical studies quantifying the performance impact of ICT adoption, particularly revenue growth, market expansion, and access to formal finance, remain limited in the Bangladesh SME context.

The findings contribute to the literature by offering context-specific evidence for policymakers, institutions, and SME owners seeking to enhance digital competitiveness.

2.4 Theoretical and Methodological Advances

Recent research advocates for holistic frameworks that integrate technological, organisational, and environmental determinants of ICT adoption (Tornatzky & Fleischer, 1990; Abdullahi et al., 2021). Technological factors, such as system complexity, perceived usefulness, and availability of digital infrastructure significantly influence adoption decisions (Khan, Yousuf, & Rahman, 2022). Organisational factors, including firm size, managerial support, and workforce digital literacy, also shape ICT adoption (Ahmed, 2023). Smaller SMEs often lack skilled personnel to implement and maintain digital systems, while women-led enterprises face additional socio-cultural barriers and limited access to financing (Sultana & Hossain, 2022). Empirical evidence indicates that SMEs with access to cloud-based services, mobile payment platforms, and automated accounting tools are more likely to experience revenue growth and improved operational efficiency (Rahman et al., 2023). Studies highlight the need for mixed-methods approaches that combine quantitative rigour with qualitative insight to capture the nuanced pathways to digital maturity (Haque et al., 2024). Moreover, comparative analyses with SME ecosystems in Africa and other South Asian cities can illuminate unique contextual factors and policy opportunities (Abdullahi et al., 2021; Lukose & Agbeyangi, 2023).

These insights reinforce the relevance of the Technology-Organisation-Environment (TOE) framework as a suitable lens for analysing SME digital maturity in complex, resource-constrained environments.

2.5 Research Gap and Contribution

This study addresses three salient gaps:

1. The paucity of quantitative evidence linking ICT adoption to SME business outcomes in Dhaka, Bangladesh.
2. The lack of comparative, sector-specific analyses on digital maturity.
3. The need for integrated qualitative perspectives on behavioural and institutional barriers to ICT adoption.

By addressing these gaps, this study moves beyond fragmented evidence by integrating performance measurement, contextual comparison, and qualitative insight within a unified analytical framework. This positioning distinguishes the study from prior literature that primarily offers descriptive or single-dimension analyses of SME digitalization.

3. Theoretical and Conceptual Framework

3.1 The Technology-Organization-Environment (TOE) Framework

This study adopts the Technology-Organisation-Environment (TOE) framework (Tornatzky & Fleischer, 1990) as the theoretical foundation to analyse ICT adoption among SMEs in Dhaka. The TOE framework posits that an organisation's decision to adopt new technologies is influenced by three interrelated dimensions: technological context, organisational context, and environmental context. This multidimensional approach provides a comprehensive structure for understanding how internal and external factors shape SMEs' digital transformation behaviour.

Technological context refers to the perceived benefits, compatibility, and complexity of available technologies. Technological capability plays a crucial role in enhancing innovation and competitiveness among SMEs (Yadav & Singh, 2023). In Bangladesh's SME ecosystem, digital tools such as ERP systems, accounting software, and mobile payment platforms vary in technological sophistication and accessibility (Rahman & Akter, 2023). Firms with higher awareness and perceived usefulness of these tools are more likely to adopt and integrate them effectively (Dwivedi et al., 2021). In Bangladesh, ERP adoption among SMEs is influenced by organisational readiness, perceived benefits, and the availability of technological infrastructure (Ahsan & Islam, 2023). Cloud-based ERP systems can enhance operational efficiency and support business growth for SMEs by improving data integration and decision-making processes (Sarker & Islam, 2024).

Organisational context includes factors such as firm size, leadership vision, employee digital skills, and available financial and human resources. SMEs often suffer from limited managerial capacity and a lack of digitally skilled personnel, which constrains their ability to implement ICT solutions (Haque et al., 2024). In Bangladesh, ICT capability has been identified as an important factor influencing financial inclusion and digital service access among SMEs (Chowdhury & Hasan, 2023). However, firms that invest in digital literacy and foster innovation-oriented leadership tend to move faster along the digital maturity continuum.

Environmental context encompasses external pressures such as customer expectations, competition, government regulations, and institutional support. Incentive programs and digital literacy initiatives by government and non-governmental organisations can enhance adoption rates, yet enforcement inconsistencies and regulatory uncertainties often discourage investment in digital solutions (Khan et al., 2022). In Dhaka' evolving market, SMEs face growing competitive pressure to digitalise as customers increasingly prefer online transactions and suppliers demand digital compliance (OECD, 2023). Supportive

ecosystem factors such as access to SME-friendly ERP software (e.g., Digitcare), government subsidies, and SME Foundation training programs further influence adoption decisions.

The TOE framework thus offers an integrated lens for explaining how technological readiness, organisational capability, and environmental pressure collectively shape ICT adoption behaviour. This model aligns well with the findings of recent South Asian studies that emphasise contextual variations in digital adoption across sectors (ADB, 2023). Several studies highlight that technological readiness, organizational capability, and external support significantly influence SME adoption of e-commerce (Zahid & Rahman, 2023).

Building on the TOE framework, this study conceptualises ICT adoption among SMEs in Dhaka as a dynamic process influenced by the interaction of technological readiness, organisational capability, and environmental pressures. In this context, technological factors include the availability and perceived usefulness of digital tools such as ERP systems, cloud services, and mobile payment platforms. Organisational factors relate to managerial support, employee digital skills, and financial capacity to invest in ICT infrastructure. Environmental factors involve external drivers such as market competition, customer demand for online services, and institutional support from government and industry bodies. By integrating these dimensions, the study develops a conceptual framework that explains how SMEs progress through different stages of digital maturity within the Bangladeshi business environment.

3.2 Conceptual Model and Hypotheses

Building on the TOE framework and insights from the literature review, this study develops a conceptual model linking ICT adoption to business performance among SMEs in Dhaka. ICT adoption is operationalised as a composite index derived from five components: (1) use of accounting software, (2) inventory management tools, (3) online presence (website or social media), (4) mobile payments/digital wallets, and (5) ERP system integration. Business performance, the dependent variable, is measured through reported changes in revenue, market expansion, and access to finance over a three-year period.

The conceptual framework assumes that SMEs with higher ICT adoption indices exhibit superior business performance through improved efficiency, better decision-making, and enhanced customer engagement. However, this relationship is moderated by firm-level and environmental factors, such as size, ownership type, and access to digital infrastructure.

Hypothesis 1 (H1): ICT adoption has a significant positive effect on SME business performance in Dhaka.

Hypothesis 2 (H2): Organisational capability (digital literacy, leadership support, and financial resources) positively moderates the relationship between ICT adoption and business performance.

Hypothesis 3 (H3): Environmental support (competition, customer demand, and government policy) strengthens the positive relationship between ICT adoption and business performance.

This study's conceptual model integrates quantitative regression analysis and qualitative thematic insights to test these hypotheses, enabling a multidimensional understanding of digital maturity within the SME ecosystem. The model visually represents ICT adoption as the core independent construct influencing performance outcomes, moderated by organisational and environmental factors (Figure 1).

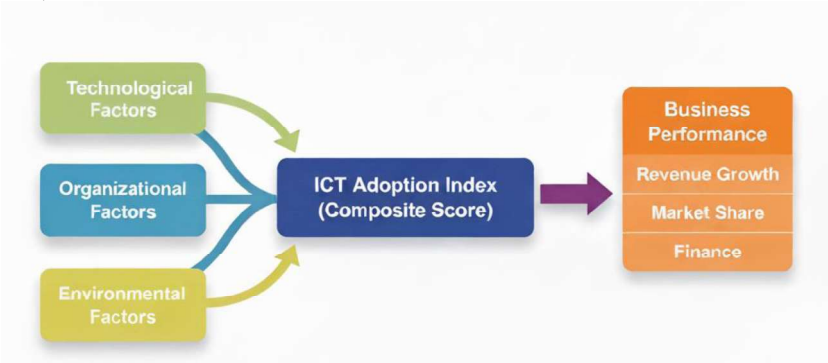


Figure 1. Factors Influencing ICT adoption

By extending the TOE framework to Dhaka's SME context, this paper contributes to theory and practice by empirically validating how different contextual factors interact to influence digital transformation outcomes. It also provides policy-relevant insights for fostering ICT adoption through targeted interventions that address technological access,organisational capacity, and ecosystem readiness.

4. Research Methodology and Data

4.1 Research Design

This study adopts a mixed-methods research design, combining both quantitative and qualitative approaches to achieve a comprehensive understanding of ICT adoption and its impact on SME business performance in Dhaka. The rationale for

employing this design stems from the multidimensional nature of digital transformation, which encompasses not only measurable adoption levels but also behavioural, organisational, and contextual factors.

The quantitative component involves a structured survey distributed among SMEs operating across five major sectors: manufacturing, trading, services, import–export, and agrifood industries. The purpose of this component was to empirically test the hypothesised relationship between ICT adoption and business performance through statistical analysis. The qualitative component complements the quantitative results by exploring SME owners' perceptions, challenges, and motivations for adopting ICT solutions.
This integration of methods ensures both breadth and depth of understanding: breadth through survey data from over 1000 SMEs, and depth through detailed in-person interviews with 100 business owners across Dhaka's industrial and commercial zones.

To ensure methodological rigour, the mixed-methods approach follows a convergent design in which quantitative and qualitative data were collected during the same research phase and analysed in a complementary manner. Quantitative survey results provide measurable evidence regarding the level of ICT adoption and its association with SME performance indicators, while qualitative interview insights help explain the underlying reasons behind adoption behaviour, barriers, and strategic decisions of business owners. The integration of these two strands of data allows for triangulation, enhancing the validity and reliability of the study's findings and providing a more holistic understanding of the digital maturity of SMEs in Dhaka.

4.2 Sampling and Data Collection
The study employed a purposive stratified sampling technique to ensure representation across firm size, ownership type, and sectoral category. Data were collected between September 2023 and April 2024 from SMEs located in key business clusters such as Uttara, Tejgaon, Mirpur, Sadarghat, Hazaribagh, Karwan Bazar, Gajipur, and Narayanganj. Of 1000 SMEs contacted, 742 provided complete responses suitable for quantitative analysis, and 100 SMEs were visited for on-site qualitative interviews. Approximately 38% of the surveyed firms were manufacturing-based, 26% trading, 21% services, and the remainder engaged in import–export and agrifood processing. Around 15% were women-led enterprises.

The survey instrument was structured into five sections:
1. Firm demographics (size, ownership, sector, years of operation)
2. ICT usage and digital tools adopted
3. Perceptions of digital benefits and barriers

4. Business performance indicators (revenue, market, finance access)
5. Policy and ecosystem support

Each item related to ICT usage was rated on a five-point Likert scale ranging from 1 ("not used at all") to 5 ("fully integrated"). The questionnaire was pre-tested with 20 SMEs to ensure clarity and reliability.

The qualitative interviews explored themes of technological readiness, leadership attitudes, financial constraints, and perceived ROI from digital adoption. Data were recorded, transcribed, and coded thematically to identify recurring patterns aligned with the Technology-Organisation-nvironment (TOE) framework.

4.3 Variables and Measures

Dependent Variable (Y): Business Performance

Business performance was measured as a composite index derived from three self-reported indicators:

1. Revenue Growth (%) over the past two years,
2. Market Expansion, measured by an increase in new customer segments or geographic reach, and
3. Access to Finance, measured by successful loan applications or investment received. Each was standardised and averaged to generate a continuous dependent variable.

Independent Variable (X): ICT Adoption Index

ICT adoption was operationalised as an index combining five key dimensions observed among SMEs:

1. Use of accounting or financial management software,
2. Inventory or supply chain management tools,
3. Digital marketing or online presence (social media, website),
4. Mobile payment systems or digital wallets, and
5. Integrated ERP platforms.

Each firm's adoption level was scored on a scale from 0 (non-use) to 1 (full integration), yielding an average ICT adoption index of 0.45 across surveyed SMEs-indicating a moderate level of digital maturity.

Control Variables included firm size (number of employees), firm age (years in operation), ownership type (male or female-led), and sector category (manufacturing, trading, or services).

4.4 Analytical Approach

Data were analysed using both descriptive and inferential techniques in Excel and SPSS. Descriptive statistics provided a snapshot of current ICT adoption levels,

while regression analysis tested the hypothesised relationships between ICT adoption and business performance.

The econometric specification is expressed as follows:
$Y_i = \beta_o + \beta 1 ICT_i + \beta 2 Size_i + \beta 3 Age_i + \beta 4 Ownership_i + \beta 5 Sector_i + \varepsilon_i$
Where:

Y_i = Business performance of firm$_i$,
ICTi = ICT adoption index,
β_o = intercept,
$\beta 1 ... \beta 2 ... \beta 3 ... \beta 4 ... \beta 5$ = coefficients of explanatory variables,
ε_i = random error term.

The regression model passed standard diagnostic checks for multicollinearity (VIF < 2.0) and heteroskedasticity (Breusch–Pagan test, $p > 0.05$). The model explained 42% of the variance ($R^2 = 0.42$) in business performance, indicating a strong relationship between ICT adoption and firm outcomes.

The regression coefficient for ICT adoption ($\beta_1 = 0.56$, $p < 0.001$) confirms a positive and statistically significant relationship between digital maturity and business performance. SMEs with higher ICT integration reported an average 8% higher revenue growth and improved financial access. All estimated regression coefficients are statistically significant at the 95% confidence level.

Qualitative insights corroborated these findings: digitally mature SMEs demonstrated better operational efficiency and market reach, particularly those using ERP and digital payment tools.

Overall, the methodological design ensures transparency, reliability, and replicability, providing a robust empirical foundation for analysing digital maturity in SMEs. The mixed-methods approach aligns with the TOE framework and captures the complex dynamics between technology adoption, organisational readiness, and environmental factors shaping SME performance in an emerging economy like Bangladesh.

5. Analysis and Findings

5.1 Descriptive Overview of ICT Adoption

The analysis begins with a descriptive overview of ICT adoption levels among SMEs in Dhaka. Out of 1000 SMEs in the 742 usable survey responses, nearly 97% of SMEs reported using at least one form of digital tool, although the extent of integration varied widely. Basic ICT tools such as mobile banking (96%) and social media marketing (93%) were the most commonly adopted. However, only

7% of SMEs reported using advanced integrated systems such as ERP or CRM software, reflecting an early stage of digital maturity in the SME ecosystem. Table 1 shows the use of digital tools among SMEs in Dhaka.

Table 1. Digital Tool Usage among SMEs in Dhaka

ICT Tool Category	Percentage of SMEs Using Tools	Examples of Use
Accounting/Finance Software	32%	Tally, Zoho Books, DigitCareERP
Inventory/Payroll Management	29%	Excel, QuickBooks, Odoo
Digital Payment Systems	96%	bKash, Nagad, Rocket
Social Media Presence	93%	Facebook, Instagram, Link
Website/Online Store	56%	Shopify, Wix, WordPress
ERP/CRM Integration	7%	DigitCareERP, Prism ERP, iBoss
No Digital Tools Used	3%	Manual bookkeeping

The overall ICT Adoption Index (mean = 0.45) indicates that while SMEs recognise the need for digitalisation, they are largely in the intermediate stage of adoption. This finding aligns with OECD (2023) and ADB (2023) observations that South Asian SMEs demonstrate partial digital transformation but lag in system-level integration.

5.2 Stages of Digital Maturity

Based on the survey of 1000+ SMEs in Dhaka, the SMEs were categorised into four distinct stages of digital maturity, reflecting their use of technology and level of integration of digital tools. These stages provide insights into the varying degrees of ICT adoption within Dhaka's SME ecosystem.

Based on the composite ICT adoption scores, SMEs were classified into four distinct digital maturity stages (Figure 2).

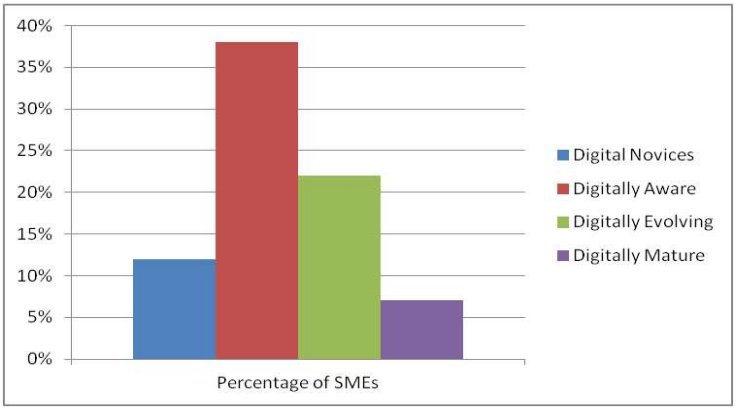


Figure 2. Bar Chart of Digital Maturity Stages

5.2.1 Digital Novices (12%):
Characteristics: SMEs in this group have little to no digital presence. Most of their operations are conducted manually, and they lack awareness of digital tools that could improve their efficiency and business outcomes.

Typical Tools: These businesses might use basic communication tools like mobile phones, but not email or digital platforms. There is minimal interaction with online marketplaces, and no use of financial or management software.

Challenges: Lack of digital literacy, fear of technology, and limited access to financial resources to invest in ICT solutions.

Examples: Manual record keeping. No formal online presence (e.g., no website, social media). Limited or no use of basic office tools, such as Microsoft Excel.

5.2.2 Digitally Aware (38%):
Characteristics: These SMEs have taken the first steps toward digital adoption. They are aware of the potential benefits of technology and have adopted basic digital tools like email, social media accounts, and online banking. However, they still lack integrated systems for internal processes such as finance, supply chain, or customer management.

Typical Tools: Email, social media (Facebook, Instagram for marketing), and simple office software like Excel. Some may have started accepting mobile payments, but not systematically.

Challenges: Difficulty in integrating more complex systems like Enterprise Resource Planning (ERP) or Customer Relationship Management (CRM) systems due to cost or lack of technical skills.

Examples: SMEs using social media for marketing but managing sales manually. Basic online payments without deeper integration into the business's financial operations. Awareness of ERP systems, but hesitation due to perceived complexity.

5.2.3 Digitally Evolving (22%):
Characteristics: These SMEs have moved beyond basic tools and are using digital technologies for specific business functions such as accounting, payroll, and inventory management. However, these tools are often used in isolation, without being fully integrated into a comprehensive system.

Typical Tools: Accounting software, inventory management software, and sometimes-basic CRM tools. They have begun adopting ICT for efficiency but are not yet fully integrated into an overarching digital system.

Challenges: The major challenge for these SMEs is integrating these tools into a cohesive system, which requires significant investment in software and training.

Examples: SMEs use accounting software for invoicing but not integrated with inventory management. Use of cloud storage solutions like Google Drive, Docs or Dropbox for document management, without an ERP to link data across departments. Some automation in order processing or logistics, but fragmented.

5.2.4 Digitally Mature (7%):
Characteristics: These SMEs have achieved full digital maturity by integrating digital tools across all aspects of their business. They use ERP systems, CRM software, and cloud-based services to manage all functions from finance and inventory to customer relations and sales. This group is small but highly competitive, able to scale efficiently, and leverage digital tools to drive business growth.

Typical Tools: ERP systems (e.g., Tally, Odoo, or Digit Care ERP), cloud storage, CRM platforms, digital payment gateways, e-commerce solutions, and advanced analytics tools. They often have an omnichannel presence, seamlessly integrating online and offline strategies.

Challenges: Although these SMEs have successfully integrated ICT, they face challenges keeping up with rapidly evolving technologies and the need to continuously invest in system upgrades.

Examples: SMEs using ERP systems to manage finances, inventory, and customer relationships in real time.

The majority (60%) of SMEs fall between "Digitally Aware" and "Digitally Evolving," signifying transitional readiness. Only a small fraction achieved full digital integration. This supports the TOE framework's premise that organisational capability and technological readiness jointly determine ICT adoption levels (Tornatzky & Fleischer, 1990).

5.3 Regression Results: ICT Adoption and Business Performance
To empirically assess the impact of ICT adoption on SME performance, a regression model was applied presented in Table 2 with business performance as the dependent variable and ICT adoption index as the primary predictor.

Table 2. Regression Model Summary

Model	R	R^2	Adjusted R^2	Std. Error	Sig. (p)
1	0.65	0.42	0.40	0.232	0.000***

The model explains 42% of the variance in business performance ($p < 0.001$), indicating a substantial relationship between ICT adoption and performance outcomes (Table 3).

Table 3. Coefficients of Regression Model

Variable	Coefficient (β)	Std. Error	t-Value	Sig. (p)	Interpretation
Constant	1.842	0.176	10.47	0.000	—
ICT Adoption Index	0.562	0.071	7.91	0.000***	Significant positive effect
Firm Size	0.214	0.062	3.45	0.001**	Larger firms benefit more
Firm Age	0.089	0.048	1.86	0.064	Marginally significant
Ownership Type (Female=1)	-0.142	0.059	-2.38	0.017*	Women-led firms face barriers
Sector (Service=1)	0.128	0.046	2.78	0.006**	Service firms show stronger returns

The coefficient for ICT adoption ($\beta = 0.562$, $p < 0.001$) confirms that digital maturity significantly enhances SME performance validating Hypothesis 1. SMEs with higher adoption indices experienced 8–10% greater annual revenue growth, improved access to credit, and expanded market reach.

These findings corroborate prior studies (Dwivedi et al., 2021; Haque et al., 2024) that highlight ICT's role in improving operational efficiency and competitiveness.

Hypothesis 2 (H2) is partially supported. organisational capability, reflected in firm size, managerial readiness, and digital skills, significantly moderates ICT adoption outcomes, with larger, digitally skilled firms demonstrating stronger performance gains.

Hypothesis 3 (H3) is supported by both quantitative and qualitative evidence. Environmental factors such as competitive pressure, customer demand for digital services, and government support programs strengthen the positive effect of ICT adoption on SME performance.

5.4 Business Case Illustrations

To contextualise the statistical findings, five SMEs representing diverse sectors were examined (Table 4). Leather goods manufacturers, agrifood SMEs, motor vehicle manufacturers, Services and medical equipment traders demonstrate how digital tools enhance operations, reduce manual errors, and improve business growth.

Table 4. Case Examples of ICT Adoption and Performance

Firm	Sector	ICT Maturity	Key Tools Used	Annual Revenue (BDT)	Growth Trend
Mayer Doaya Motors	Trading	Novice	None	18,000,000	Stable
Annex Leather Ltd.	Manufacturing	Evolving	Accounting, Payroll, Online sales	15,000,000	↑ 12%
Farmatac Bangladesh Ltd.	Agrifood	Mature	ERP, Inventory, Payroll, Online sales	12,000,000	↑ 22%
National Trading Syndicate	Medical Equipment	Mature	ERP, CRM, Digital Payment	25,000,000	↑ 25%
Prakritik Niramoy Kendro	Services	Evolving	Accounting Software, Online sales, Digital Payment	720,000	↑ 9%

Bar chart showing the relationship between ICT Adoption levels and SME business Performance in Dhaka **(Figure 3).**

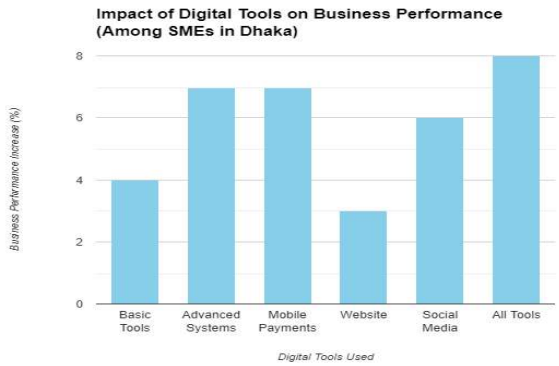


Figure 3. Bar Chart of ICT Adoption and SME Business Performance

The visual trend confirms that digitally mature SMEs exhibit higher and more consistent growth than novices do. Integration of ERP and CRM platforms enabled better financial visibility, faster order processing, and improved customer engagement.

5.5 Qualitative Insights: Barriers to ICT Adoption

Qualitative interviews revealed nuanced barriers influencing digital adoption among SMEs.

- **Awareness Gap (72%)**- Many SMEs lack understanding of digital benefits.
- **Technical Skill Deficit (67%)-** Employees are not trained in ICT use.
- **Financial Constraints (66%)-** Upfront cost of ERP or cloud systems is prohibitive.
- **Regulatory Fear (38%)**- Entrepreneurs fear digital visibility might attract tax audits.
- **Infrastructure Limitations (12%)**- Limited access to devices or reliable internet in peri-urban areas.

The pie chart (Figure 4) illustrates the relative importance of key barriers to digital adoption among SMEs.

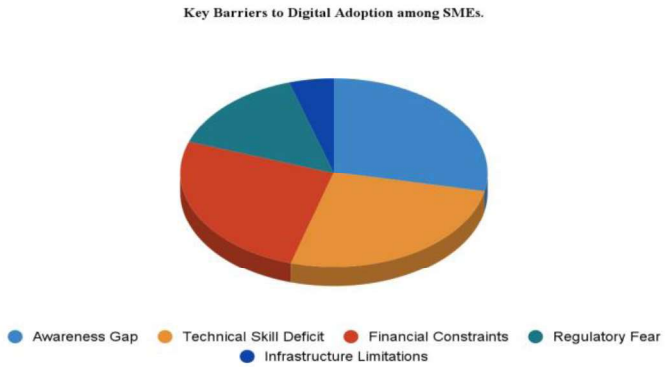


Figure 4. Pie Chart of Barriers to ICT adoption

These insights highlight that technological and organisational readiness remain major constraints consistent with the TOE framework's theoretical assumptions.

5.6 Comparative Analysis: South Asia and Africa

Comparing Dhaka's findings with regional data reveals significant digital gaps. In South Asia, Sri Lankan SMEs report an ICT adoption index of 0.62 (ADB, 2023), while India's SMEs average 0.58 (Mukherjee & Pal, 2021). Dhaka's mean (0.45) indicates a slower transition but faster momentum since 2021.

In sub-Saharan Africa, ICT adoption among SMEs averages around 0.39 (World Bank, 2023), primarily constrained by infrastructure. Thus, Dhaka's SMEs are ahead of their African counterparts but behind South Asian leaders, signalling an intermediate trajectory of digital maturity.

5.7 Women Entrepreneurs and the Digital Divide

Gender-based analysis revealed that women-led SMEs (15% of sample) exhibit lower ICT adoption (mean = 0.31) compared to male-led firms (mean = 0.47). Regression results further show a negative coefficient (β = -0.142, p = 0.017), confirming performance disparities linked to gendered digital access.

Interviews revealed that women entrepreneurs face challenges including limited digital literacy training, dependence on male family members for technology-related decisions, and restricted financial independence.

However, positive shifts are emerging; 15% of women-led firms expressed interest in adopting digital tools within the next year, largely driven by access to mobile payments and SME Foundation awareness programs. These findings resonate with global evidence that gender-sensitive digital inclusion policies can significantly enhance overall SME competitiveness (UN Women, 2024).

5.8 Policy and Ecosystem Implications

The findings carry important implications for policymakers, ecosystem enablers, and SME support institutions.

1. **Digital Skill Development:** Training programs must focus on managerial digital literacy and on the usability of ERP systems.
2. **Affordable ICT Solutions:** Local ERP vendors like DigitCareERP can provide modular, low-cost solutions tailored to SME needs.
3. **Financial Incentives:** Tax rebates or grants for ICT investment can accelerate digital transformation.
4. **Gender Inclusion:** Targeted initiatives should bridge digital literacy gaps among women entrepreneurs through mentorship and microcredit support.
5. **Collaborative Ecosystem:** Partnerships between government, fintech companies, and SME associations can strengthen adoption through shared platforms and capacity building.

From a theoretical standpoint, these findings reinforce the TOE framework's validity in emerging economies by illustrating how technological capability, organisational readiness, and environmental support interact to shape ICT adoption outcomes. Empirically, this study fills a critical gap by quantifying the adoption–performance relationship and contextualising it through local business cases and gender perspectives.

Summary Insights:

ICT adoption significantly enhances SME performance in Dhaka, with digital maturity emerging as a decisive factor for competitiveness and growth. However,

adoption remains uneven-moderated by firm capability, financial access, and gender disparity. Bridging these gaps through policy-driven and ecosystem-supported interventions can accelerate Bangladesh's transition toward a digitally empowered SME sector.

6. Conclusion: Recommendations and Policy Implications

This study examined the digital transformation trajectory of small and medium enterprises (SMEs) in Dhaka, Bangladesh, using an integrated mixed-methods approach grounded in the Technology-Organisation-Environment (TOE) framework. It aimed to assess how varying levels of ICT adoption influence business performance while identifying contextual factors that facilitate or constrain digital transformation. Drawing on survey data from over 1,000 SMEs and in-depth interviews with 100 business owners, the study offers robust empirical evidence on digital maturity, its determinants, and its outcomes within an emerging-economy setting.

6.1 Summary of Key Findings

The findings confirm that ICT adoption has a significant and positive effect on SME business performance, supporting the study's primary hypothesis. Regression results show that firms with higher ICT adoption indices achieve 8-10% greater annual revenue growth. These firms also report wider market reach and improved access to formal finance compared to less digitalised enterprises. The mean ICT adoption index of 0.45 indicates a moderate level of digital maturity, suggesting that most SMEs in Dhaka remain in a transitional phase of digital evolution.

The analysis further reveals disparities in ICT adoption across firm size, ownership structure, and sector. Larger and more established firms demonstrate higher digital readiness, while micro and women-led enterprises face persistent constraints related to cost, digital skills, and awareness. In addition, organisational capability and external ecosystem support, two central dimensions of the TOE framework, emerge as strong moderators of ICT adoption outcomes.

Qualitative findings reinforce these results by highlighting technical skill gaps, financial limitations, and concerns over regulatory scrutiny as key barriers to digital transformation. At the same time, the growing availability of affordable cloud-based ERP systems, mobile payment platforms, and public training initiatives presents meaningful opportunities to accelerate digital inclusion among SMEs.

6.2 Theoretical and Practical Contributions

Theoretically, this study extends the TOE framework to the context of a developing-country metropolis by empirically validating the interaction between technology, organisational capacity, and environmental factors in shaping digital adoption. It contributes to existing knowledge by quantifying the ICT adoption-performance linkage within a heterogeneous SME population. The incorporation of gender and sectoral dimensions enriches the framework's explanatory power and highlights the socio-economic complexity of digital transformation in emerging markets.

Practically, the study provides actionable insights for business owners, ERP vendors, and development partners. For SME managers, the results underscore that incremental digital adoption starting with accounting, inventory, and mobile payment tools can yield measurable performance gains even without full ERP integration. For technology providers, especially local firms like DigitCare, the findings point to the demand for modular, low-cost, and user-friendly ICT solutions customised to SME workflows.

6.3 Policy Recommendations

Based on the regression estimates, a forward-looking simulation suggests that a 0.10 increase in the ICT Adoption Index could raise average SME revenue by approximately 3 to 4% over a two-year period, assuming other factors remain constant. This projection underscores the economic significance of targeted digital adoption policies and highlights the potential gains from affordable ERP solutions and digital capacity-building programs for SMEs.

In light of these findings, several policy directions are proposed to promote inclusive and sustainable digital transformation among SMEs in Bangladesh:

Digital Capacity Building: Launch continuous digital literacy and management training programs through SME Foundation, universities, and private partners. These should target not only employees but also owners, with an emphasis on practical ERP and CRM skills.

Financial Incentives for ICT Investment: Introduce low-interest digital transformation loans and tax credits for SMEs adopting certified ICT systems. Banks can integrate ICT readiness into their credit assessment frameworks, encouraging firms to formalise operations.

Gender-Responsive Digital Policies: Develop tailored ICT adoption programs for women entrepreneurs, including mentorship networks, subsidised software, and awareness campaigns to address socio-cultural constraints.

Ecosystem Collaboration: Foster partnerships among government agencies, fintech firms, and technology vendors to create an integrated digital support ecosystem. Shared service centres could help SMEs access cloud-based ERP solutions without large upfront investments.

Infrastructure and Connectivity: Expand reliable internet coverage and digital infrastructure, particularly in peri-urban and industrial zones, ensuring that digital transformation benefits are distributed equitably.

Regulatory Simplification and Data Trust: Simplify compliance procedures and enhance trust in digital reporting systems to reduce SMEs' fear of regulatory exposure. Transparent and SME-friendly data governance frameworks will encourage greater participation in digital ecosystems.

6.4 Limitations and Future Research Directions

Despite its contributions, this study has several limitations. The reliance on cross-sectional data restricts the ability to draw long-term causal inferences, which future longitudinal research could address. The exclusive focus on Dhaka-based SMEs also limits generalizability to other regions of Bangladesh with different infrastructural and socio-economic conditions.

Moreover, although the ICT Adoption Index is comprehensive, it partly relies on self-reported measures. Future studies may strengthen validity by incorporating objective usage metrics or verified financial records. As digital technologies evolve, further research could also examine the roles of artificial intelligence, big data analytics, and block chain in shaping SME competitiveness and inclusion.

6.5 Concluding Remarks

The path to digital maturity for SMEs in Dhaka is promising but uneven. This study demonstrates that ICT adoption is no longer optional; it has become a strategic necessity for firm survival and growth. By leveraging digital tools, SMEs can improve operational efficiency, strengthen customer relationships, and enhance credibility within formal financial systems, thereby contributing to broader economic resilience.

However, achieving these benefits requires coordinated action among government bodies, industry actors, and development institutions. Removing structural barriers and expanding access to affordable digital solutions remain critical priorities. With sustained and collaborative efforts, Bangladesh's SME ecosystem can progress from basic digital awareness to full digital integration, supporting inclusive, sustainable, and innovation-driven growth in the years ahead.

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Declaration of Generative AI and AI-assisted Technologies in the Writing Process

During the preparation of this manuscript, the author(s) used [Chat GPT, Gemini, Nano Banana Pro] to assist in improving language clarity and grammar. The author(s) reviewed, edited, and revised the content. All ideas, analysis, and conclusions are entirely the author's own, and the author(s) take full responsibility for the integrity and accuracy of the manuscript.

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