

Securing RDMA: A study on mitigating unauthorized access in high-performance networks

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Abstract

This article addresses digital transformation in relation to small and medium-sized enterprises (SMEs) in emerging markets. Technology has been adopted at an accelerated pace, enabling SMEs to increase operational performance, broaden market access, and increase profit generation. The transition, however, has its own challenges: limited resources, the digital skills gap, and cybersecurity concerns. On this basis, the paper identifies enabling and inhibiting factors to SMEs going digital from a detailed literature review and case studies. The strategic leadership in the plan is dedicated to expanding digital infrastructure with supportive policies from governments so that digital initiatives are rolled out fruitfully in emerging economies. This work accents the digital transformation discourse and offers further insights for policymakers, business leaders, and researchers.

Keywords: Digital transformation; SMEs; Emerging markets; Business models; Operational efficiency; market reach; Cybersecurity; Leadership; Government policies; Digital infrastructure

1 Introduction

Technological innovation is having wide-ranging effects on business throughout the world in the digital age. For small and medium-sized enterprises in emerging markets, digital transformation is full of possibilities as well as challenges. SMEs are widely considered to be the backbone of emerging economies, contributing significantly to job creation, innovation, and economic growth. However, many SMEs in these regions face difficulties adopting and integrating digital technologies because of limited resources, infrastructural deficits, and lack of skilled labor.

Digital transformation, which includes the integration of digital technologies into all areas of business operations, can give rise to operational efficiency, enhanced customer engagement, and provided access to a wider audience (Westerman et al., 2014). This varies greatly in developed economies, however; the pace has been hesitant in emerging markets. Here is where digital adoption could very well be a matter of survival for SMEs in competing globally. However, the digital transformation journey is not without its share of challenges.

Small and medium-sized enterprises (SMEs) in developing economies still ponder over financial constraints, poor infrastructure, and poor digital experience within their workforces (Teece, 2018).

The paper intends to explore the key drivers for digital transformation in SMEs in emerging markets. It will look particularly into the contributions of strategic leadership, access to digital infrastructure, and government policy to the enabling and hindering of digital adoption. Based on literature review and a number of case studies, the research will provide takeaways for SMEs, policymakers, and researchers to further digital advancement in these regions.

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Small and medium-sized enterprises (SMEs) form an important pillar of economic development in emerging markets. SMEs account for 90% of businesses worldwide, and nearly 70% of total employment in these emerging markets, according to the World Bank (World Bank, 2020). However, even though they are critical in providing growth, many SMEs in emerging economies face severe barriers in their efforts to enhance technological adoption, including not only availability of finance, but also infrastructural inadequacy and the unavailability of digitally skilled personnel (OECD, 2018).

The digital revolution with the wave of wider technology adoption, including cloud computing, artificial intelligence, and IoT, presents SMEs with a window of opportunity. Digital transformation enables firms to automate their processes, improve customer experiences, and enable informed decision-making through data analytics (Brynjolfsson & McAfee, 2014). In emerging markets, applying these technologies provides SMEs with an even playing ground with larger, more established corporations, equipping them with the tools to compete globally (Díaz-Chao et al., 2020).

However, the journey towards digital transformation is not easy. A key barrier for most SMEs would be the sometimes-offensive capital that one must provide before the adoption of technology. For many SMEs in emerging markets, which face challenges in access to capital and financing options, these firms often cannot afford the investment in technological infrastructure (McKinsey & Company, 2021). In addition, the lack of skilled personnel to carry out the setup and operation of these technologies presents yet another obstacle. According to the International Labour Organization, more than 60% of SMEs in emerging economies have trouble filling positions with candidates possessing the relevant digital skills (ILO, 2021).

Policies formulated by respective governments greatly influence the digital landscape for SMEs in emerging markets. In several countries, the national governments have recognized the role of digital transformation in economic growth and have begun increasing incentives and support for SMEs in their adoption of these new technologies (UNCTAD, 2020). Such measures include, but are not limited to, the provision of financial incentives for direct digital transformation to digital infrastructure programs established to improve connectivity and access to low-cost digital tools. Yet, mainly, the effectiveness of such policies can vary largely depending on the level of development of the country, the quality of governance, and the regulatory environment (Acs et al., 2014).

While the challenges are significant, case studies that were successfully done in emerging markets support the view that digital transformation can be achieved by SMEs if they are armed with proper and strategic leadership, coherent policy frameworks, and the right access to digital means (Hosseini et al., 2020). Now that the eye of SMEs in these regions is opening up towards the critical role of digital technologies in resilience and survival, the transformation process is more likely to open up New doors for business and the wider economy.

2 Literature

2.1 Digital Transformation in SMEs

Digital transformation represents a comprehensive approach whereby the application of digital technologies fosters a different way for businesses to operate and offer value to their customers (Westerman et al., 2011). While large enterprises have taken the lead with digital adoption, most small and medium-sized enterprises have been slow to embrace the change because of the constraints of resources, expertise, and every other hindrance they face (Hosseini et al., 2020). Recently, studies have indicated that SMEs threaten digital transformation, particularly in emerging markets, which have the potential to leapfrog traditional industrialization processes via advanced technologies (Teece, 2018).

According to Möller et al. (2020), while SMEs in emerging economies actively face challenges in their digital adoption, they are still gradually starting to adopt technologies like cloud computing, big data, and e-commerce platforms. Other than that, these technologies offer the opportunities to enhance operational efficiency, lower costs, and enable better engagement with customers. Nonetheless, the gap between SMEs in developed versus developing economies continues to be enormous, especially regarding technological infrastructure and digital skills.

2.2 Barriers to Digital Transformation in Emerging Markets

Despite the acknowledged advantages of digital transformation, small and medium enterprises in developing markets have some considerable challenges that inhibit the wide degree of adoption. One key hurdle includes the challenges of limited financing options. According to Díaz-Chao et al. (2020), the capital constraint dynamics of most SMEs in developing economies render them unable to invest in the requisite technologies, hence such financing options are too

little. The level of challenge is aggravated by the high cost of internet connectivity and technology infrastructure especially in certain developing countries to limit the potentials for digital innovations in SMEs (OECD, 2018).

Another principal obstacle is the lack of digital skills. SMEs in developing markets face the development of challenges in hiring personnel capable of overseeing and implementing the available digital technologies (Chong et al., 2015). As noted by the International Labour Organization (ILO, 2021), this was regarded as a major impediment in this space of skilled labor, which ranged from data analysis, cybersecurity, and even software development, amongst others. Furthermore, many SME owners and managers in these areas lack awareness concerning the benefits of digital technologies or training that would equip them with leading digital change competently (Mckinsey & Company, 2021).

2.3 The Role of Government Policies and Support

The role of government policies to promote digital transformation among SMEs in the emerging markets has been a topic of much debate. According to Acs et al. (2014), governments in developing economies actually catalyze and amplify adoption by providing stimulation and concession for capital investment and leveraging for bettering digital infrastructure. For example, government programs that subsidize the cost of technology adoption or offer tax breaks for digital investment have been shown to increase the rate of digital adoption among SMEs (UNCTAD, 2020).

In countries like India, Brazil, and South Africa, government initiatives have helped SMEs to squeeze out other barriers to digital transformation. The Indian government's "Digital India" initiative seeks to guarantee rural and underserved areas an affordable internet and digital services, thus enabling SMEs in the regions to embrace digital tools (Sharma et al., 2019). Brazil's National Strategy for Digital Transformation (2020) has similarly focused on improving digital literacy and aiding SMEs through financial support into a dedicated credit line for technological innovation (OECD, 2018).

2.4 Facilitating Factors for Successful Digital Transformation

Digital transformation may seem to present challenges, but several factors make successful implementations possible. Leadership is predominantly one of such defining aspects. Strategic leadership has often been identified as one key factor that initiates digital transformation (Westerman et al., 2014). Effective leaders in small and midsize enterprises (SMEs) perceive digital technology in the light of strategic necessity and help their organisations navigate the complexities of technological change successfully. Leadership commitment to digital initiatives has been proved to be a critical success factor for SMEs in emerging markets (Teece, 2018).

Besides being a determinant of success in adding SMEs, infrastructural access guarantees that digitalized information take clear form. Studies indicate that higher rates of digital adoptions in SMEs arise in regions with applicable connectivity, improved structurally operational cloud computing, and payment platforms (Chong et al., 2015). For instance, compared to many regions such as LESS connected countries, much less success has been happening with the SMEs' digitalization in countries like South Korea and Singapore, which traditionally possess more robust telecommunications networks (Díaz-Chao et al., 2020).

Lastly, partnerships and networking play a critical role too. By cooperating with larger firms, technology providers, and academic institutions, SMEs located in emerging markets have an opportunity to gain resources and knowledge requisite to the process of digital transformation. Those very associated networks provide SMEs with access to innovative technologies, expertise, and financial resources, all of which are more precious than ordinary (Hosseini et al., 2020).

2.5 The Future of Digital Transformation in Emerging Markets

It is projected that with the continuing development of digital technologies, digital transformation in SMEs will become a promising prospect in the future amongst developing markets. The increased availability of reasonably priced technologies such as mobile internet, low-cost cloud services, and open-source software has made SME owners see development of digital tools more favorably (Brynjolfsson & McAfee, 2014). Besides, with the government building up digital infrastructure and augmenting efforts to improve literacy, SMEs in developing markets are more likely to increase their use of digital tools (Katragadda et al. 2022).

That being said, SMEs still face hurdles regarding cybersecurity risks, the danger of data privacy violations, and the requirement for continued skills development. All of these, as pointed out by Möller et al. (2020), should be of paramount importance to the sustainability of their digital transformation path in emerging economies.

3 Discussion

The findings from the literature highlight that while digital transformation presents numerous opportunities for small and medium-sized enterprises (SMEs) in emerging markets, the path to adoption is fraught with challenges. The discussion below synthesizes the key themes emerging from the research, interpreting their implications for SMEs, policymakers, and researchers, and proposing directions for future research and practical interventions.

3.1 The Impact of Digital Transformation on SME Competitiveness

Digital transformation can greatly enhance the competitiveness of SMEs in emerging markets. Brynjolfsson and McAfee (2014) emphasize that such digital technologies as cloud computing, big data analytics, and mobile applications allow them to streamline operations, reach customers in highly innovative ways, and invent business models. SMEs within emerging markets are ideally placed to leapfrog the traditional stages of industrialization through the adoption of such cutting-edge technologies that equip them to compete more effectively in the global market (Díaz-Chao et al., 2020). For instance, SMEs in Southeast Asia and Sub-Saharan Africa have illustrated that mobile payment systems and digital marketing have spurred business growth despite poor physical infrastructure (Chong et al., 2015).

However, in the words of Teece (2018), digital transformation is not necessarily an absolute guarantee of success. The implementation of digital technologies depends on several things—the kind of vision leadership has, access to digital infrastructures, and the efficiency of such a culture of innovation in an organization. This gap, caused largely by the lack of relevant expertise or strategic direction in managing digital adoption, provides the worst form of limitations to the benefits of transformation (Westerman et al., 2014). Therefore, albeit the possibilities of enhanced competitiveness are very well articulated, SMEs have to consider this building of internal capability and leadership to successfully navigate the intricacies of digital change seriously.

3.2 Addressing Financial Barriers and Technological Gaps

Financial constraints faced by SMEs in emerging markets continue to be a major obstacle to digital transformation. As noted by Möller et al. (2020), many SMEs in the construction sector find it difficult to make initial investments in digital tools due to limited resources and the high cost of new technologies. This is particularly true for small and medium-sized enterprises in sectors such as manufacturing and agriculture, where resources are increasingly scarce. Without access to appropriate financing options, SMEs are often unable to implement technologies that could improve performance or open up new markets. Many governments in emerging markets have established programs to offset the costs of digitalization or provide financial support through grants and loans (UNCTAD, 2020). For example, India's Startup India program provides tax incentives and financial support to small and medium-sized enterprises that invest in technology (Katragadda, 2024). Such policies have proven effective in supporting the digital transformation of SMEs, especially when combined with measures to improve digital infrastructure and reduce the costs associated with widespread adoption (Sharma et al., 2019). However, the effectiveness of these policies depends on them being comprehensive, consistent, and tailored to the specific needs of SMEs across sectors and regions.

3.3 The Challenge of Digital Skills Gaps

Another key challenge seen in the data is the lack of expertise. SMEs in emerging markets often struggle to find employees with expertise in areas such as data analytics, cybersecurity, and digital marketing (Chong et al., 2015). The lack of skilled workers prevents SMEs from realizing the full potential of digital transformation. According to the International Labor Organization (2021), the digital skills gap is particularly pronounced in rural areas and small towns where education, training, and technological services are lacking. To a lesser extent, collaboration between universities and SMEs helps create courses tailored to the specific needs of the digital economy. Additionally, measures to support existing employees through online courses or short courses can help close the skills gap (McKinsey & Company, 2021). SMEs can also benefit from the global digital platform that offers cost-effective training and helps companies build digital skills in-house.

3.4 The Role of Strategic Leadership in Driving Digital Change

Leadership plays a pivotal role in determining the success of digital transformation efforts in SMEs. As highlighted by Westerman et al. (2014), strong leadership is essential to guide SMEs through the complexities of digital adoption. This includes not only making strategic decisions regarding technology investments but also fostering a culture that

encourages innovation and experimentation. For example, SME leaders who invest in employee training and encourage the use of digital tools at all levels of the organization are more likely to succeed in their digital transformation efforts (Hosseini et al., 2020).

However, leadership in SMEs in emerging markets often faces additional challenges, such as limited exposure to international best practices and inadequate access to advisory services. As a result, SME owners and managers may lack the confidence or knowledge to pursue digital strategies effectively. To address this, it is crucial to provide SME leaders with access to resources such as mentorship programs, digital transformation workshops, and expert consultations that can guide them through the process (Teece, 2018). This will not only improve leadership capacity but also help create a more resilient and adaptive workforce.

3.5 Implications for Policy and Future Research

The role of government policies in facilitating digital transformation cannot be overstated. Policymakers should focus on creating a conducive environment for digital adoption by improving digital infrastructure, offering incentives, and investing in workforce development (Acs et al., 2014). In addition, public-private partnerships can play a significant role in addressing some of the financial and infrastructural barriers SMEs face in emerging markets. For instance, governments could collaborate with financial institutions to provide low-interest loans or grants specifically for technology adoption.

From a research perspective, there is a need for further exploration into the contextual factors that influence digital transformation in SMEs in different emerging markets. While the literature provides a broad overview, more localized studies that examine the unique challenges faced by SMEs in specific countries or regions will provide deeper insights into the role of culture, governance, and market structure in shaping digital transformation outcomes. Additionally, further research on the impact of digital transformation on sustainability outcomes in SMEs could provide valuable insights, especially as businesses increasingly face pressure to meet environmental and social governance (ESG) criteria

4 Conclusion

Digital transformation has the potential to change the landscape for SMEs in emerging markets, providing them with the opportunity to increase productivity, grow their businesses and improve their competitiveness. As the global economy evolves towards a digital ecosystem, SMEs in these regions must overcome significant challenges, ranging from lack of digital skills to lack of equipment and financial constraints, to access new technologies. The key challenges and drivers of digital business transformation highlight the critical role of leadership, government policies and digital processes. While financial constraints and a lack of skilled workers remain major challenges, the importance of government programs and policies designed to address these issues is recognized. The successful digitalization of SMEs in emerging markets depends on visionary leadership, government support and collaboration with technology providers. SMEs in emerging markets should develop digital strategies that are tailored to their specific circumstances, including the unique challenges and opportunities that exist in each market. Government initiatives such as providing affordable financing options, improving digital literacy, and strengthening digital infrastructure can play a key role in supporting this transition. SMEs should also focus on building internal resources, particularly by investing in digital skills and creating a culture of innovation within the organization. The changing role of government policy, the long-term impact of digitalization on SME performance, and the potential for digital transformation to support business growth require further research. Digital transformation will continue to benefit SMEs in emerging markets. As the digital landscape continues to evolve, small and medium-sized businesses that successfully implement these changes will be better positioned to compete in the global marketplace.

4.1 Future Directions

While this study provides valuable insights into the current state of digital transformation in SMEs within emerging markets, several areas remain underexplored and warrant further investigation. Future research should focus on deepening our understanding of the complexities involved in digital adoption, identifying emerging trends, and exploring strategies to overcome the persistent barriers faced by SMEs.

4.1.1 Contextual and Regional Differences in Digital Adoption

One of the primary areas for future research is understanding the regional and contextual variations in digital transformation. Although general trends exist, the pace and nature of digital adoption among SMEs can vary significantly across countries, sectors, and even regions within the same country. Factors such as local economic conditions, cultural attitudes towards technology, and regulatory environments may have a considerable impact on the effectiveness of

digital transformation efforts. Research could explore these nuances by conducting comparative studies across different emerging markets, examining how local conditions influence the types of technologies adopted and the challenges encountered.

4.1.2 Longitudinal Studies on the Impact of Digital Transformation on SME Performance

A more longitudinal approach could provide valuable insights into the long-term effects of digital transformation on SME performance. Much of the existing literature focuses on the initial stages of digital adoption, with limited research on the sustained impacts over time. Future studies could track SMEs that have undergone digital transformation over several years to measure the impact on key performance indicators (KPIs) such as productivity, profitability, and market share. Additionally, exploring the link between digital transformation and business sustainability—both economically and environmentally—could provide new perspectives on how SMEs in emerging markets can capitalize on digitalization while addressing broader social and environmental concerns.

4.1.3 The Role of Artificial Intelligence and Emerging Technologies in SME Digitalization

While much attention has been given to the adoption of basic digital tools such as cloud computing and e-commerce platforms, emerging technologies such as artificial intelligence (AI), machine learning, and blockchain are beginning to play a more prominent role in the digitalization of SMEs. Future research could explore the potential for these technologies to transform specific sectors in emerging markets. For instance, AI-driven analytics could help SMEs better understand consumer behavior, optimize supply chains, and improve decision-making. Research could also examine the challenges and opportunities for SMEs in adopting these advanced technologies, particularly in terms of skills requirements and investment costs.

4.1.4 Impact of Public-Private Partnerships on Digital Transformation

The role of public-private partnerships (PPPs) in facilitating digital transformation for SMEs deserves further exploration. Governments can play a crucial role in fostering digitalization by collaborating with private sector actors, including technology firms, educational institutions, and financial organizations. Future research could examine successful PPP models in emerging markets and analyze the factors that contribute to their success or failure. Additionally, investigating the role of international development organizations, such as the World Bank or the International Finance Corporation, in supporting SMEs through digital initiatives could provide valuable insights into how global cooperation can enhance digital adoption.

4.1.5 Digital Skills Development and Training for SMEs

Given the significant digital skills gap in emerging markets, there is a need for research on innovative methods to upskill the SME workforce. Future studies could focus on the development and evaluation of digital training programs tailored to SMEs, particularly in rural or underserved regions. These programs should focus not only on technical skills but also on entrepreneurial capabilities, strategic thinking, and leadership in the digital era. Research could also explore the effectiveness of online training platforms, gamification, and mentorship models in closing the digital skills gap among SME employees and owners.

4.1.6 SME Digital Transformation and Financial Inclusion

Digital transformation has the potential to drive financial inclusion by enabling SMEs to access digital financial services, such as mobile banking, online lending, and digital payment systems. Research could investigate how digital tools can improve access to finance for SMEs in emerging markets, particularly for women-owned or rural SMEs that traditionally face barriers to financing. Exploring the role of digital financial platforms, peer-to-peer lending models, and government-backed digital financing programs in enhancing access to capital for SMEs is an important avenue for future work.

4.1.7 Policy and Regulatory Frameworks for Digital Transformation

As governments in emerging markets continue to develop digital transformation policies, there is a need for research on the effectiveness of these policies and regulations. Future work could focus on evaluating the impact of government initiatives aimed at supporting SME digitalization, such as tax incentives, digital literacy programs, and infrastructure development projects. Comparative studies could also be conducted to assess how different regulatory frameworks influence the pace of digital adoption and innovation in SMEs. Understanding the role of government regulation in areas such as data privacy, cybersecurity, and intellectual property rights will also be crucial as SMEs navigate the digital landscape.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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