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Technology Adoption Among SMEs: How Is It? And What Can Be Done to Strengthen It?

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ABSTRACT

Businesses have benefited tremendously from technological advancements, particularly in production, outsourcing, logistics, and marketing. Although large firms and Multinational Companies (MNCs) are in a better position concerning the use and adoption of technologies, small and medium-sized enterprises (SMEs) have both the agility and potential to leverage their resources, market conditions, globalization's opportunities, and networks to improve the way they use technology and ultimately enhance their competitiveness. As seen in the literature, most research that has addressed the topic of technology adoption among SMEs has emphasized specific issues such as digitalization, information technology, cloud computing, cybersecurity, and Industry 4.0. This paper has gone beyond such a limited view to touch upon different technological aspects that are important to the functioning and/or survival of SMEs and the conditions surrounding the implementation and use of technologies. Specifically, this study examines the realities of SMEs' technology adoption and draws lessons for policymakers in developing countries.

Keywords: Technology; SMEs; adoption; use; business; government; support; developing countries

INTRODUCTION

Technology has had a considerable impact on the way we live and behave. The technology scale extends to elements other than people, including firms, governments, animals, and nature, and can be both positive and negative. Businesses have benefited tremendously from technological advancements, particularly in terms of production, outsourcing, logistics, procurement, and marketing. One reality that marks the application of technology in business is that large firms and Multinational Companies (MNCs) are always in a better position concerning the adoption of technologies because they have various resources at hand. Small and Medium Enterprises (SMEs), on the other hand, are challenged with multiple constraints that impede or delay the adoption of technologies (Masood and Sonntag, 2020; Shaikh et al. 2021). However, their agility and potential to leverage the most relevant resources, market conditions, opportunities for globalisation, networks, and institutional support (Mosbah and Debili, 2014) are key to improving the adoption and use of selected technologies to enhance their competitiveness (Mosbah et al. 2023) and facilitate access to international markets.

Meanwhile, many studies and reports have pointed to SMEs' increased interest in technologies and their use in business operations. This is evidenced in Ramdani and Kawalek (2017) and Haddara and Zach (2011), who noted a move towards the adoption of enterprise systems and Enterprise Resource Planning (ERP) systems which were once used by large firms only. As it shall be argued, one reason for this move relates to the benefits that SMEs generate when proper technological systems and platforms are engaged. Banerjee and Openshaw (2014) add that competitive requirements and market pressures have also altered SMEs' expectations regarding technology products and services. Two other factors are crucial for the growing shift towards technologies. The first is customer reliance on the Internet which obliges SMEs to adopt the IoT (Internet of Things) concept and related ICT technologies. The second is the declining costs of Internet-based technologies, with many open-source platforms and applications available for business use and directly facilitating marketing, purchasing, and data management

tasks.

Until a few years ago, SMEs' approaches to technology implementation varied between pro-action and reaction, but Covid-19 lockdowns with the resulting social distancing restrictions forced firms to fundamentally rethink their business models to rely specifically on digitalisation. However, while SMEs follow different strategies to acquire and manage technologies, SMEs and startups in many developing countries are increasingly turning to skilful migrants, while some leading emerging markets count on high-tech individuals, including returning migrants and students, to take advantage of technology expertise (Mosbah and Daghrir 2017; Mosbah et al. 2018).

Most research that addressed the topic of technology adoption among SMEs emphasised specific issues such as digitalisation, information technology (OECD 2021a; Kergroach 2021; Telukdarie et al. 2023), cloud computing (Attaran and Woods 2018), cybersecurity (Pawar and Palivela 2023) and industry 4.0 (Mouef et al. 2017). Therefore, questions such as what characterizes the realities of technology adoption among SMEs? What are the challenges and barriers facing the technology adoption of SMEs? and how developing countries can boost technology adoption among their SMEs remains unanswered.

Thus, this study attempts to touch upon different technological aspects that are important to the functioning and/or survival of SMEs and the conditions surrounding the implementation as well as the use of technologies. Furthermore, our study provides an overview of the trends, impacts, and benefits, as well as barriers and challenges facing SMEs in their process of technology adoption. The paper also showcases the futuristic technological outlook of SMEs and ends by presenting some country-specific cases of support for SMEs' technology adoption with remarks made for policymakers, particularly in developing countries. To this end, the evidence, views, and statistics presented herein address this topic from a wholistic perspective.

METHODOLOGY

The current study is a narrative review approach to examines the state of affairs of SMEs in their reliance on technologies and, ultimately, draw lessons for policymakers in developing countries on how strengthen SMEs use of technologies. Narrative reviews are useful in analyzing the existing evidence on a niche topic. They are also flexible as they allow researchers to collect, evaluate, and synthetize various findings to provide relevant answers to the underlying research questions. In the current study we provide an overview of the trends, impacts, and benefits, as well as barriers and challenges facing SMEs in their process of technology adoption. The paper also showcases the futuristic technological outlook of SMEs and ends by presenting some country-specific cases of support for SMEs' technology adoption with remarks made for policymakers, particularly in developing countries. To this end, the evidence, views, and statistics presented herein address this topic from a wholistic perspective.

RESULTS AND DISCUSSION

TECHNOLOGY ADOPTION AMONG SMES: TRENDS AND IMPACT

Although SMEs are comparatively disadvantaged in terms of the implementation and use of technologies in business operations (Masood and Sonntag, 2020), recent statistics show an increased interest in technological aspects. The reasons may vary depending on the push-to-pull factors. However, as confirmed in the literature, one of the reasons is that vendors of organizational systems, such as ERP, have recently turned to SMEs (Ramdani & Kawalek 2017). For instance, in the United States, Figure 1 clearly shows the extent of SMEs' growth in technology spending. Gartner (2013) has forecasted an expected growth rate of 4.8% in the period of 2011-2017 and another increase to 7.5% by 2021. These rates are further expected to reach 11.4 in 2025 (Gartner 2021).

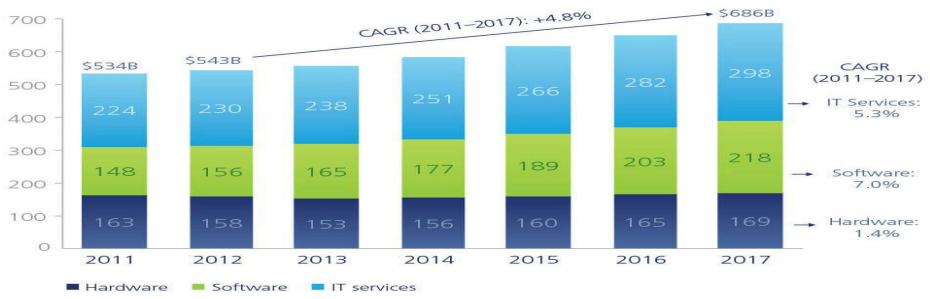

FIGURE 1. Spending trends of North American SMEs on technology ($ Billion)
Source: Gartner (2013)

This rate eventually varies across regions, with SMEs in developing countries expected to showcase lower rates of technology implementation. For example, McKinsey (2014) acknowledges that the ratio of SMEs' Internet adoption in China was 20–25%, compared to 72–85% in the US. According to Fong (2011), the low rate of technology adoption among Chinese SMEs is generally attributed to access to financing constraints and a lack of tech-related skillful talent. In Latin America, although the OECD (2019) report on the SME Policy Index notes that there is good support for firms through the establishment of incubators, technology transfer centres, accelerators, innovative venture support, and R&D incentives, it urges governments of the region to encourage innovative SMEs and entrepreneurship within their national innovation systems and provide a structured mechanism to share information related to innovation programs.

Figure 2 shows that the gaps in technology adoption trends are not just apparent between developed and developing countries, but also within developed countries. In Europe, however, only 55% of SMEs have reached a basic level of digital intensity compared to 88% of large companies (Eurostat 2022).

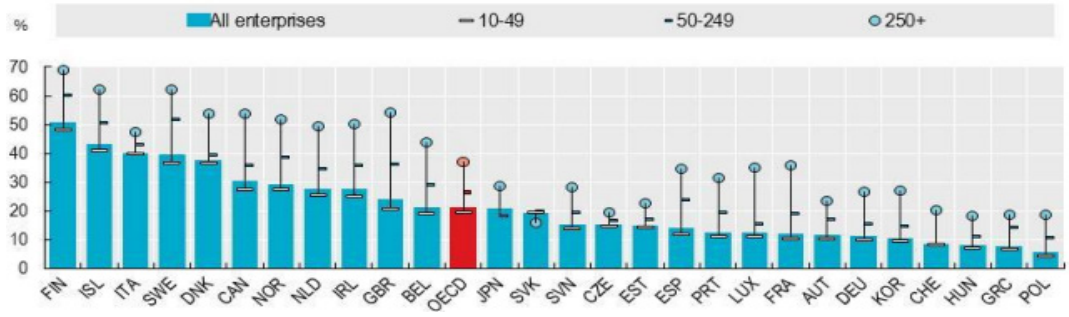

FIGURE 2. Usage of cloud computing services by size
Source: Source: OECD (2017)

In fact, SMEs seem to have realised the positive impact of different technologies on their performance and competitiveness and are increasingly deploying efforts to match the costs and benefits related to technology adoption. The mixed-method study of Masood and Sonntag (2020) on 271 SMEs in the UK with regard to the adoption of Industry 4.0, the Internet of Things, and Cyber Physical Systems found that flexibility, cost, efficiency, quality, competitive advantage, time-to-market, reduced stockholding, and tighter supply chains are the main benefits. Further empirical evidence from the U.S. through surveys conducted in the U.S. The Chamber of Commerce has suggested that not only have various technology platforms been critical in helping SMEs run and grow their operations and survive economic turbulence, but also indicate that full embracement of technology enables SMEs to outcompete their rivals and depicts a more optimistic future (USCC, 2022a). The USCC survey (2022a) revealed that technology platforms such as delivery applications, digital advertising, and business software have boosted operational efficiencies and granted firms increased access to clientele. Social media platforms such as Facebook, Twitter, and Instagram were the most frequently used platforms across these businesses. Similarly, it was found that 93% of the surveyed SMEs used at least one technology platform, whereas 86% believed that technology was among the factors that led to business survival during COVID (USCC 2022b).

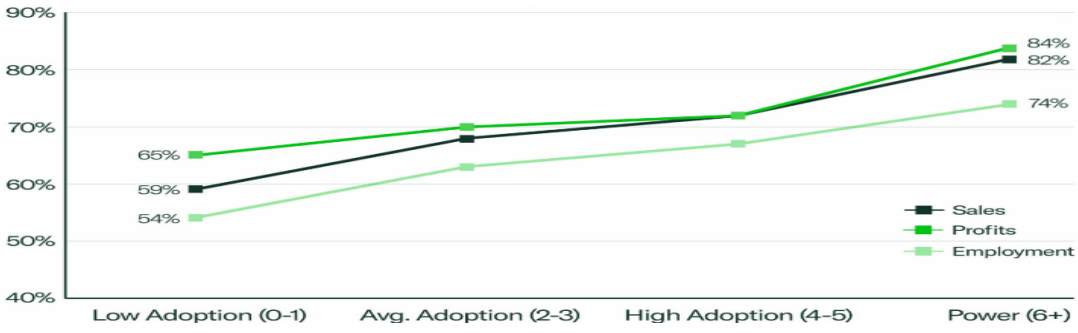

FIGURE 3. The impact of technology adoption on business performance
Source: USCC (2022b)

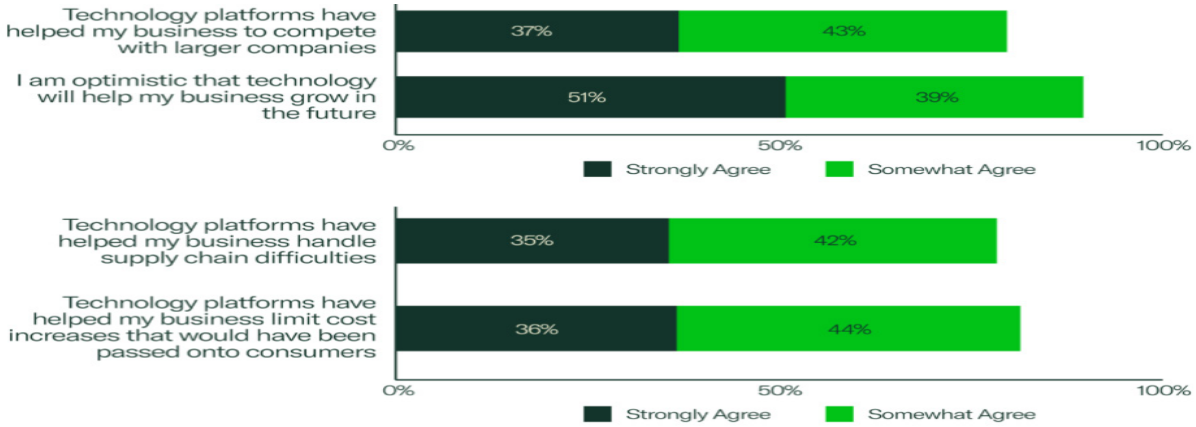

FIGURE 4. The impact of technology adoption on small business operations and competitiveness
Source: USCC (2022b)

Furthermore, the correct adoption of technology has a direct impact on SMEs and indirect benefits to societies and economies. McKinsey's (2019) report on rebooting inclusive growth in Latin America contends that the successful digital transformation of SMEs will lead to 50% growth in Latin America's GDP by 2030. Chege and Wang (2020a) concluded in their systematic review that the use of technology among SMEs boosts job creation.

BENEFITS OF TECHNOLOGY ADOPTION

From the SMEs perspective, technology appears indispensable to their functioning. It provides them with solutions to improve performance and endure competition in the marketplace. For example, digitalisation includes services, platforms, and marketplaces used by firms to manage internal activities and processes, market products, communicate with customers, perform logistics, and execute sales and payments. Similarly, in Industry 4.0, technologies boost innovation capacity, improve collaboration with suppliers and customers, enhance process controls, and lessen risks and errors. It is worth noting that SMEs should not be concerned with simultaneous implementation of all Industry 4.0 technologies because they are costly, but the piecemeal implementation of distinct technologies is likely to have a considerable impact towards enhancing competitiveness and performance (Ghobakhloo et al. 2022).

The survey of the U.S. Connected Commerce Council (CCC, 2019) on business digitalisation among over 1000 U.S. SMEs revealed that 99% of all SMEs utilised at least one digital tool, 85% of SMEs found these tools helpful to their business in one way or another, more than 40% highlighted customer growth, 70% reported revenue growth, and 90% stated that digital tools boosted innovation in their firms. More importantly, digital tools have played a role in all of these rates. Notably, 70% of the surveyed SMEs plan to intensify the use of digital tools in the future.

For instance, in the case of China, McKinsey's (2014) report confirmed that the Internet can lower SMEs' barriers to entry into international markets and boost their productivity. Many Chinese SMEs have grown into multinationals over the last two decades thanks to exports which has, in turn, been facilitated by digital tools such as Alibaba website. The report further contends that the Internet cannot only be seen as an automation tool, but also as a catalyst for the introduction of new products and services, a means to allocate resources more efficiently, and a mechanism to boost demand within the economy. Through the positive impacts of the Internet, SMEs could additionally increase employment by another 1–1.5% and add some five–11 million jobs.

FACTORS INFLUENCING THE ADOPTION OF DIFFERENT TECHNOLOGIES: EMPIRICAL EVIDENCE

Multiple factors affect the adoption of technologies. Table 1 summarises the key findings from various empirical studies with regard to what affects the adoption of different kinds of technologies, such as enterprise systems, digitalisation, information technology, cloud computing, cybersecurity, Internet of Things, and Industry 4.0.

TABLE 1. Factors influencing the adoption of different technology aspects

Technological aspects	Influential factors (Sources)
ICT	- Organisational factors (age of the owner, owner's attitude towards IT, technology preparedness for sustainability, pressure from customers, and sales) have more impact compared to technological and environmental factors (Nair et al. 2019). - Aligning productive and organizational processes with ICT platforms, and providing adequate implementation conditions (Consoli, 2019).
Digitalization	- Technological, organizational, and environmental factors (Alraja et al. 2019). - Requirements and configuration, corporate culture, availability, compatibility with business goals and vision, data protection and privacy, information security, and compliance (Hentschel et al. 2019).
Cloud computing	- Know-how of managers on cloud computing, and perceived implementation cost (Dinca et al. 2019). - People-related factors, and compliance (Gupta and Misra, 2016).
Cybersecurity	- *Implementation:* Resource availability, and heightened situational awareness (Renaud and Ophoff, 2021). - *Threat reduction:* government policies and processes, and collaboration (Rawindaran et al. 2021).
Internet of Things	- Role of management skills, and implementation transparency (Kulkarni et al. 2022). - Lightweight flexibility, market opportunity, real-time decision making of the top management, and new HCI's non-monotonous task (Jiwangkura and Sophatsathit, 2020). - Social influence, and facilitating conditions (Grandon et al. 2018).
Artificial intelligence and Industry 4.0.	- Expanding IT-related infrastructure, alteration in the structure of the organization, and the ability to analyze the main performance indicators (Karuppiah and Sankaranarayanan, 2023). - complexity of the technologies, perceived benefits, stakeholder pressure, digitalization technical competency, and managerial properties (Ghobakhloo et al. 2022). - Readiness (Stentoft et al. 2019).
Enterprise system	- Environmental, technological, and organizational factors (Ramdani & Kawalek, 2017). - Top management support, relative advantage, and technological readiness (Tarani et al. 2021).
Readiness for technology adoption	- Pressure from customers, ease of use, need, capital and urgency (Nugroho et al. 2017).

CHALLENGES AND BARRIERS

Although SMEs in the developed world enjoy relatively better institutional support for the use and adoption of technology, their counterparts in developing countries lack comparative support. Such a scenario is likely to widen the technological gap and put the latter group of MSEs at a competitive disadvantage. Scholars have also pointed to the fact that SMEs are way behind large firms in adopting and benefiting from fundamental technological aspects such as Industry 4.0, artificial intelligence, virtual reality, Internet of Things, blockchain, simulation and CPS- (Ghobakhloo et al. 2022), and cybersecurity implementation (Pawar and Palivela, 2022). These scenarios eventually exacerbate in case of the SMEs in developing countries. With this regard, it is argued that many SMEs continue to struggle with the issue of initial adoption decisions concerning the shift towards technology adoption (Ghobakhloo et al. 2022).

According to Shaukh et al. (2021), technology and infrastructure costs, efficiency, technical skills, implementation issues, and a lack of both corporate and government support are key challenges in technology adoption among SMEs. In the same vein, Masood and Sonntag (2020) found that financial constraints and limited technology knowledge and awareness are the main factors for the adoption of technology. Similarly, Osorio et al. (2010) found the following factors as impediments to the adoption of ICT in Colombian SMEs: lack of confidence in ICT's security and privacy, and ICT cost-benefit imbalance. In line with this observation, the move to digitalisation seems not without risks and costs. For example, SME's lack of preparedness is a weakness that could be taped by hackers to cause harm to the firm systems. Cybercrimes, scams and phishing campaigns have witnessed a rise during Covid-19. For this, the OECD (2021a) believes that the costs of such malicious events can be large for SMEs and often exceed their average available cash reserves. Technology adoption is also challenged by resistance to change from employees because new technology implementation requires additional commitment and shifts to unusual job methods and procedures.

In ASEAN, the challenges are not much different from those faced by their counterparts in other developing countries. The OECD (2021b) report on promoting the productivity of SMEs in ASEAN countries reveals that these firms have not properly grabbed the opportunities

allowed by the "next production revolution" and the current digital transformation, and recommends that policy makers: i) support SME access to broadband networks and lower the inter-country digital divide, ii) diffuse new technologies to SMEs, and iii) help them engage with digital transformation. Figure 4 shows the barriers to technology adoption in a sample of over 1000 SMEs in the US, where more than 75% of them reported that they face a minimum of one barrier to growing the implementation of digital tools (CCC 2019).

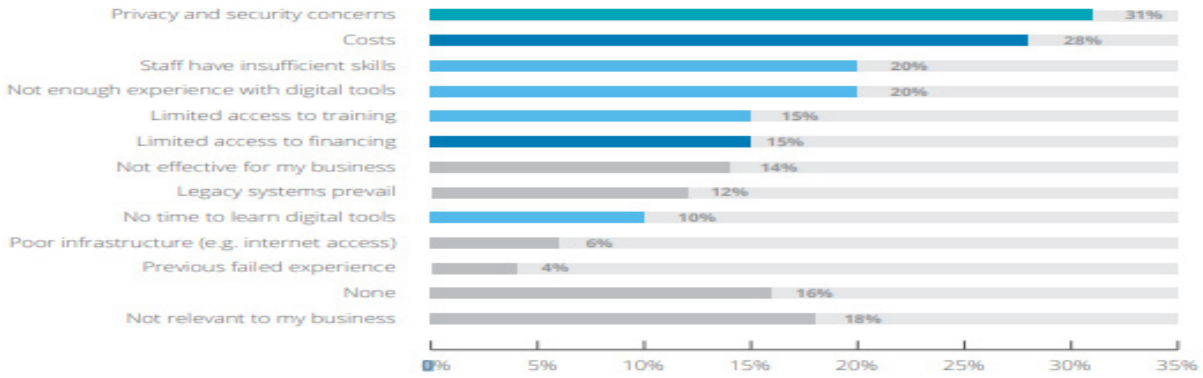

FIGURE 5: Barriers of Technology adoption.
Source: Connected Commerce Council - CCC (2019)

THE FUTURISTIC OUTLOOK OF SMES TECHNOLOGY USAGE

While future technological advancement will certainly impact the levels of technology adoption and the ultimate competitiveness of SMEs, one can argue that, at least in the next one or two decades, much of the SMEs' technological outlook will be largely captured within the different aspects of Industry 4.0, including, but not limited to, Artificial Intelligence (AI), metaverse, natural language processing, Internet advances, Internet of things, robotics and automation, blockchains, cloud, quantum computing, cybersecurity, machine learning, datafication, 5G and faster connectivity, social media, and personal devices.

For instance, AI applications, such as ChatGPT, which have already been used by firms of different types and sizes, have facilitated task automation and improved customer service. The tasks in question include translation, content writing, customer support chatbots, translation, personalised marketing, automated email responses, and data analysis. Lu et al. (2022) believe that AI technology will have an impact on work, organizations, and performance but also provide opportunities for SMEs to alleviate the negative outcomes of Covid-19. Likewise, the metaverse – as a three-dimensional web-powered space that relies on Augmented Reality (AR) and Virtual Reality (VR)– enables users to meet in a digital universe to perform different tasks. Metaverse is used in various sectors such as gaming, travel, tourism, education, remote working, real estate, healthcare, banking and finance, social media, and entertainment (Sarivastava 2023). However, in developing countries, many challenges may continue to pose problems for SMEs on their journey towards technology adoption. This includes scarcity of specialised expertise, quality and availability of data, Internet connectivity, cost, training and customisation, privacy and security, and potential for errors (Navarro 2023).

INSTITUTIONAL SUPPORT: CASE AND NOTES FOR POLICY MAKERS IN DEVELOPING COUNTRIES

Given the difficulties SMEs face in their technology adoption process, governmental support aimed at serving in this regard will result in significant effects. As stated earlier, SMEs in developed countries receive considerable technology support from multiple key organisations created for this purpose (Tofaris 2023). This includes the Organization for Small and Medium Enterprises and Regional Innovation (OSMERI) in Japan, the Fraunhofer Society in Germany, the Industrial Research Assistance Programme in Canada, and the Manufacturing Extension Partnership (MEP) in the U.S. While, on the one side, the strength of this support has been attributed to the comparatively higher levels of technology in these countries and their orientation towards innovation as a masterpiece of entrepreneurial engagement and success. Support, on the other side, takes different forms, including financial grants and loans, consultancy, and free online platforms (Dreyer & Nygaard 2020), as well as linkages with research centres and large firms, intellectual property protection, and tax reduction/exemption for technology imports, among others.

The Fraunhofer Society in Germany serves as a good

example of the institutional support. Fraunhofer is the largest applied research organisation in Europe that works with an entrepreneurial spirit. It has 76 research institutes in Germany and around 30800 staff to conduct socially relevant technological research and help bridge the gap between university and industry. It uses a research budget of 3.0 billion euros per year; of which 2.6 billion euros are designated for contract research. One-third of the funding originates from the state government, whereas two-thirds is generated from research with industry, IP revenues, and publicly financed research projects (Fraunhofer website). Fraunhofer collaborates with businesses of all sizes, from small ones as butcher shops to assist them in developing fat-free sausage to the largest ones, such as electronics and automotive companies. However, approximately 60 percent of these businesses are SMEs (Jewell, 2017). To support technology transfer to SMEs and the development of innovation products and systems, Fraunhofer relies on three main methods: contract research, patenting and technology licencing, and through spin-offs. It transfers technology to approximately 25 spinoffs annually (Jewell, 2017). In addition to its role as booster of SMEs' digital transformation, Fraunhofer recently launched an AI Kick-Starter Bundle to offer SMEs the opportunity to implement AI technology in their business practice following a three-stage process: (i) defining strategic goals for the AI systems for the company in question, (ii) formulating concrete areas of application, and (iii) examining the suitability of the company based on a holistic view of the success factors.

In developing countries, however, support for technology use and adoption remains modest and needs to be intensified (Busaidi et al. 2019). This need becomes crucial in these countries given the role that SMEs are expected to play in improving income distribution, creating jobs, reducing poverty, and growing exports (Pandya 2012). Several recent studies (e.g. Lokunga 2020; Wege and Wang 2020; UNCTAD, 2022) have noted the tardiness of technology adoption among SMEs in developing countries and have called for urgent policy actions.

Thus, a policy framework is needed to encourage SMEs as well as large forms' adoption of technology. This should be prioritized and given equal consideration with financial support. There is also an urgent need to enhance the regulatory environment by simplifying bureaucratic processes, reducing regulatory barriers, and strengthening data protection and cybersecurity policies. A key player in this regard would certainly be the creation of a government body that specializes in technology empowerment among business entities. Many developing countries fall short in this. The body should be in charge of a formulating and implementing a national strategy of technology adoption by businesses. define the priorities and requirements per sector, types of technologies to be emphasised, intervention programs and strategies with the necessary budgets. Conducting awareness campaigns and training and ensuring collaboration and networking through industry partnership are crucial events that will underpin the success of this body.

Furthermore, given the importance of infrastructure, we would encourage further upgrading of the existing infrastructure particularly digital Infrastructure such as high-speed internet and cloud computing services. In this context we find it important to build on the recommendation of Mosbah et al. (2023b) that denotes the establishment of technology parks and incubators (such Zhongguancun in China, Hsinchu in Taiwan, Cyberjaya in Malaysia) to surround SMEs with the necessary tech infrastructure, and give them easy access to key technology players. As SMEs grow in their use of technologies and become more mature, the framework should needs to consider "how" to help SMEs move from mere technology adoption to technology diffusion and innovation.

CONCLUSION

The fundamental aim of this study is to provide insights into technology adoption by SMEs. Despite lagging behind large firms in the use of technology, SMEs have the agility and potential to leverage their resources, market conditions, opportunities, and networks for the better implementation of technology. SMEs are indeed making way towards increased usage of technologies in their business operations through the adoption of digitalisation, information technology, cloud computing, cybersecurity, Industry 4.0, Internet of Things, artificial intelligence, and enterprise systems such as Enterprise Resource Planning (ERP) systems, which were once dominantly used by large firms.

Given the fact that previous researchers have focused on the adoption and implementation of specific technologies, questions such as what characterizes the realities of technology adoption among SMEs? What are the challenges and barriers facing the technology adoption of SMEs? and how developing countries can boost technology adoption among their SMEs remains unanswered. Therefore, the emphasis in this study is on the realities of technology adoption among SMEs and how it could be strengthened for their enhanced functioning and/or survival. It can be concluded that SMEs have different trends in how they perceive and use technology. There are also variations between SMEs in developing countries and their peers in developed countries. SMEs lag behind their larger counterparts in this regard. This is primarily because of a lack of resources and preparedness. As seen in many reports, policymakers play an important role. Their support

to SMEs in the process of technology adoption is crucial to not only boost the competitiveness of these firms, but also ultimately strengthen their contribution to the economies.

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DECLARATION OF COMPETING INTEREST

None

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