

Research Article

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Assessing the need for the adoption of digitalization in Indian small and medium enterprises

<https://doi.org/10.1515/eng-2024-0072>

received July 21, 2023; accepted July 18, 2024

Abstract: Manufacturing has experienced an immense transformation since the emergence of Industry 4.0. Digitalization has substantially improved production efficiency and product quality, and innovative business models have emerged. The backbone of emerging countries like India comprises small and medium enterprises (SMEs) that provide jobs for millions of families. Small and medium-sized businesses (SMBs) account for around 31% of the nation's GDP and 43% of 2021–2022 exports, both significant contributors to economic growth when there is a substantial labour pool. Therefore, they are often known as India's growth engine. Unfortunately, in today's highly competitive digital market, they fail to keep pace with technological innovations and keep their employees up to date. This article discusses the significance of digitalization for India's SMEs, addressing the hurdles and the methods to remove them. New consumer markets have been established due to government programs like Make in India, Digital India, and E-Government.

Keywords: digitalization, technology, SMEs, IoT, Blockchain

1 Introduction

India ranks fifth globally and second in Asia regarding normal gross domestic product (GDP). According to estimates by the World Bank, by 2023, an estimated 523 million workers will be actively participating in its labour force [1].

Small and medium enterprises (SMEs) played a significant role in the Indian economy in 2022 by providing over 300 million employments nationwide, impacting the global economy, the labour market, social progress, and technical development. In nations like India, where there are vast concentrations of unskilled workers compared to those with par skills, SMEs employ people of various skill levels [2]. The Indian economy is currently facing a crisis. To remain competitive in the global market, SMEs must determine whether to embrace digitization. The SME sector in India is robust and contributes significantly to GDP and employment, but there is still a sizable digital divide. For Indian SMEs to survive and expand in the future, digitization is a necessity. This article examines the compelling arguments favouring digitization for Indian SMEs, emphasizing the challenges encountered and the significant benefits that may be realized. A thorough investigation of the digital tools and technologies that can fundamentally alter several aspects of business operations and the impact of digitalization on various stakeholders of SMEs, including the government, academic institutions, technology suppliers, and the SMEs themselves, is analysed. Given the complexity of this change, SMEs must have a well-thought-out plan for going digital.

The world of trade has changed dramatically in the last few years. Social media, e-commerce platforms, and the widespread mobile Internet use have drastically altered how companies interact with clients. Familiarity with digital technology, modern consumers anticipate seamless online experiences and prompt communication from their chosen brands. To remain competitive, Indian SMEs need to adjust to the changing environment. For SMEs, digitalization possesses many benefits. Digital tools and technologies can boost output and enhance resource allocation. Inventory management systems and data analytics tools offer significant insights that empower SMEs to make informed decisions using real-time data. Social media and Internet advertising allow SMEs to expand their clientele and establish connections with new customers through their marketing strategies [3,4]. Departmental cooperation and

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communication are facilitated by increased organizational responsibility and transparency.

SMEs encounter numerous challenges while attempting to go digital. Accessing capital, technological expertise, and online resources can be challenging for most small and medium-sized businesses (SMBs). SMEs often cannot afford the software, hardware, and training required for a successful digital upgrade. Executives and owners of SMEs may oppose the shift if they are unaware of the benefits of digitization. The digital gap and restricted internet connection in rural areas hinder SMEs from fully engaging in the digital economy. SMEs cannot accomplish digitalization without stakeholder support.

The government's financial incentives, such as tax cuts and subsidies, significantly impact SMEs' technology adoption. Building a robust digital infrastructure is necessary to close the digital divide, especially in rural areas. Academic institutions are critical in providing aspiring entrepreneurs with the foundational digital skills and knowledge to successfully navigate the digital business environment. Technology providers must develop affordable, readily navigable digital solutions tailored to the needs of SMBs in India. To help SMEs overcome obstacles and embrace digital transformation, industry associations, and support networks offer essential information, training, and peer-to-peer learning opportunities. The current state of the economy demands adaptability, ingenuity, and a commitment to customer attention. SMEs can work with the government, academic institutions, and technology companies to create a digital environment that will help SMEs thrive in the twenty-first century. Despite several challenges, digitization has enormous potential to improve India's economy and make it more prosperous and competitive worldwide.

Despite the growing relevance of digitization in business, there remains a void in the literature on SMEs' digitalization. Most research on digitization focuses on large corporations, leaving SMEs' specific difficulties and potential unexplored. Digitalization relies on government backing, yet little is known about how it affects SMEs [5]. This difference is especially evident in emerging countries where digitization may transform SMEs. Therefore, this research aims to fill these gaps by evaluating the SME's level of digitalization,

including digital technologies, employee digital skills, and digital strategy for business. To understand and examine government assistance for SME digitalization and its challenges and assess how well government policies and actions promote SMEs' digitalization. This research will help us understand SME digitization and government support by tackling these goals. Policymakers, SMEs, and researchers will benefit from it [6]. SMEs are generally categorized based on employment, capital investment, and revenue; however, they lack an established definition. The Indian government defines SMEs by the amount spent on machinery or tangible assets as of July 1, 2020. Table 1 defines how SMEs are classified into micro, small, and medium categories in India based on the investment and turnover criterion.

Artificial intelligence (AI), robots, and data analytics have advanced rapidly during the Industrial Revolution, making digitalization crucial for SMEs to thrive. Digitalization can reduce poverty, boost employment, and create skilled jobs. Reducing emissions and resource waste helps the environment. About 46% of SMEs who implemented digitalization technologies increased sales significantly. SMEs may create five times as many jobs with digital technologies, and even tiny enterprises affect the market. Businesses employ digital payments, logistical services, advertising, inventory management, inventory control systems, inventory theft prevention technology, and Fintech institutions. In Industry 4.0 (I4.0), SMEs need cutting-edge digital tools to compete with larger enterprises and industries. Smaller companies are less likely to use digital technologies early on than larger ones. High expenses, limited access to cutting-edge technology, system issues, and lack of upper management support hinder adoption. SMEs' digitalization concerns are data security, internal issues, business culture, skilled labour, economic rewards, clear vision, absence of rules, and internet connectivity. This article covers how SMEs may overcome digitalization barriers and what technology they should employ.

2 Literature review

As part of the Industrial Revolution, fast advances are being made in AI, robotics, and data analytics. Digitalization is one

Table 1: Classification of MSMEs [7]

Classification	Micro	Small	Medium
Manufacturing enterprise and service enterprises	Investment in Plant and Equipment: Not more than Rs. 1 crore and not more than Rs. 5 crore in annual turnover	Investment in Plant and Equipment: Not more than Rs. 10 crores and Rs. 50 crore in annual turnover	Not more than Rs. 250 crores in annual turnover and Rs. 50 crore in investment in plant and machinery or equipment

Table 2: Barriers category to digitalization in SMEs [15]

Barrier's category	Description
Data security	Lack of trust in privacy and data security; unanswered concerns around data privacy and security concerns using external data; IT-related data protection; Many businesses are discouraged from automating their processes due to cybersecurity concerns
Internal problems	Internal bureaucracies and rules, hierarchy, leadership, organization, and conservative business approach: Due to the experimental nature of I4.0 technologies, many businesses hesitate to alter their organizational structure in preparation for digitization
Culture	Corporate culture is lacking in I4.0 concepts
Skilled labour	Absence of skilled or proficient labour; the workforce presents the most significant obstacle for industrial executives, not technology; inadequate ability businesses frequently hesitate to take coordinated action in I4.0 and neglect to evaluate their capacities; The majority of businesses lack the I4.0 knowledge necessary to evaluate their capabilities
Inability to analyse economic benefits	Absence of market necessity; unclear economic benefit: One of the primary causes is that many businesses today are unable to recognize the tangible advantages of I4.0; unclear financial gain and digital expenditure; lack of understanding of I4.0 and doubts regarding advantages and results; SMEs are unsure about where to begin when trying to create new growth prospects
Lack of clear vision	General reluctance and ambiguity; a vague operations vision and a lack of support or guidance from upper management; conceptual complexity
Lack of regulations	Absence of guidelines and conventions; unresolved legal disputes; absence of digital norms, certifications, and standards
Internet connectivity	Insufficient broadband infrastructure; a sluggish pace of technological advancement in broadband infrastructure

tool that assesses various industries for their potential to make doing business easier. Platforms are created for evaluating product marketing efforts, financing transactions, and prospective expansion alternatives for SMEs. Adopting these skills is essential if SMEs wish to prosper and grow. Digitalization can aid in alleviating poverty, increasing employment rates, and creating opportunities for highly skilled workers [8]. Advanced technologies would also benefit the environment by reducing emissions and wasting resources such as water and fuel. About 46% of SMEs who adopted digitalization tools have seen a significant increase in sales [9]. Using digital tools, SMEs can produce five times as many jobs as those without. Even smaller businesses now significantly affect the market [10]. Digitalization is utilized in business-to-business transactions, including digital payments, logistics services, advertising, inventory management, inventory control systems, inventory theft prevention technologies, and Fintech institutions offering access to various financial services. To remain viable, SMEs must equip themselves with cutting-edge digital resources to compete with larger companies and industries in the era of I4.0 [11]. Digitalization offers two benefits – efficiency gains and strengthened relationships with regular customers – in addition to expanding Information and Communications Technology (ICT) infrastructure and injecting fresh ideas into the economy, increasing GDP, per capita income, and employment prospects for their country [12].

The adoption of digitalization by SMEs is significantly influenced by their size, with larger enterprises being more likely to adopt digital technology at an early stage. This may be because larger SMEs typically have greater access to resources, such as IT infrastructure and skilled personnel, which can facilitate the implementation of digital solutions [13]. Enhancing productivity and efficiency, raising sales, profitability, competitiveness, and brand awareness are all aspects that encourage adoption; conversely, issues with the current systems, high prices, a lack of suitable technology, and a lack of support from upper management discourage adoption. The Indian SME industry requires new digital technology like Internet of Things (IoT) and Blockchain [9]. They have increased SMEs' embrace of digital technology by boosting sales, profitability, competitiveness, and brand awareness. How SMEs integrate digital technology into their operations is determined by their size. Larger companies are generally more likely to use digital technologies earlier on. Better sales, more profitability, more competitiveness, better brand awareness, increased productivity, and efficiency are the factors that influence businesses to use digital technologies. Adoption is hampered, nevertheless, by high costs, restricted access to cutting-edge technology, problems with current systems, and a lack of backing from higher management [14]. India's SME sector needs innovative digital solutions to sustain its expansion. SMEs are motivated to investigate digital solutions by

several factors, including increasing sales, enhancing profitability, maintaining competitiveness, and elevating brand recognition. Low technology, excessive costs, a lack of support from upper management, and dissatisfied users of existing systems hamper adoption. SMEs face many challenges in digitalization, ranging from data security to internet connectivity. These challenges are listed in Table 2.

Reviewing literature uncovers many obstacles to incorporating I4.0 technologies in enterprises. Data security is a significant concern. Businesses are reluctant to automate their operations because of cybersecurity risks and ambiguities over data privacy when utilizing third-party information. Internal impediments, including bureaucracies, hierarchy, leadership, organization, and a traditional company orientation, provide substantial barriers. Businesses are typically reluctant to change their organizational structure in anticipation of digitization due to the experimental nature of I4.0 technology.

The corporate culture is equally vital. A business culture that does not incorporate I4.0 concepts can impede the adoption of these technologies. SME resources are crucial in driving digitalization, noting that information technology, employee skills, and digital strategy are essential to successful digital transformation. Enhancing these resources can help SMEs overcome the challenges of adopting new technologies and leverage the benefits of digitalization [16]. The adoption of digital marketing by startups and SMEs is heavily influenced by factors such as the perceived benefits, compatibility with existing business practices, and the availability of resources. Startups and SMEs often have limited resources, which can hinder their ability to implement new digital technologies effectively [17]. Considering these challenges, SMEs must adapt their business models and seize the opportunities presented by digital technologies to achieve sustainable business growth. Digitalization can enable SMEs to streamline their operations, enhance customer engagement, and explore new market opportunities, ultimately contributing to their long-term viability. Industrial leaders face more severe challenges from the workers than from technology. Businesses often hesitate to collaborate in I4.0 and fail to assess their capabilities because they lack expertise. Many businesses cannot identify the concrete benefits of I4.0, resulting in an incapacity to assess economic gains. SMEs frequently lack clarity on how to initiate the development of new growth opportunities.

Challenges may arise from a lack of clear vision, hesitancy, uncertainty, and insufficient support or direction from senior management. The absence of legislation, guidelines, conventions, unresolved legal problems, and the lack of digital norms, certifications, and standards can impede the application of I4.0 technology. Internet connectivity concerns, such as inadequate broadband infrastructure and

slow technological progress in broadband infrastructure, can hinder the adoption of I4.0 technology. Each barrier has distinct hurdles that firms must overcome to integrate and reap the benefits of I4.0 technologies effectively. The existing literature highlights the significant potential for digitalization to benefit Indian SMEs but also underscores the challenges they face in adopting these technologies. Targeted support and policies aimed at addressing the resource constraints and enhancing the digital capabilities of SMEs could play a crucial role in driving the widespread adoption of digitalization within this critical sector [18,19].

Additionally, fostering a supportive ecosystem, including access to digital infrastructure, technical expertise, and financial resources, can further catalyse the digital transformation of Indian SMEs [20]. SMEs that can align their business strategies, models, and processes with digital transformation can also reap substantial benefits [2]. Enhancing SMEs' information technology resources, employee digital skills, and strategic focus on digitalization are all crucial antecedents to successful digital transformation [13,20,21].

This article addresses the methods to remove the hurdles in achieving digitalization in SMEs and discusses the present and future technologies to be adopted by SMEs.

Digitalization is essential in the fast-changing world. However, empirical data on digitalization's benefits for these firms are lacking. Current research generalizes the impact of digitization, ignoring the unique needs and problems of individual SME sectors. This emphasizes the necessity for sector-specific studies to better understand digitalization's effects. Digitalization adoption discrepancies by geography require further study. The causes of these discrepancies are unknown and offer research opportunities. Another area worthy of exploring is how government policies and actions promote digitalization among Indian SMEs [22]. Despite the importance of digitization, little study addresses the challenges to digital adoption in SMEs, such as digital literacy, infrastructure, and finances. Longitudinal research is needed to determine how digitization affects Indian SMEs' growth and sustainability.

Furthermore, research has not sufficiently addressed how digitalization might assist Indian SMEs to compete globally. These areas provide promising research prospects. This article can better comprehend Indian SMEs' digitization and help them benefit from the digital revolution by tackling these drawbacks [23].

2.1 Review methodology

To review the literature, data were gathered from various sources, such as academic journals, conference papers,

industry publications, and government reports. The articles were taken from various databases such as Google Scholar, Web of Science, and Scopus. The search terms to gather literature articles “Digitalization” AND “Industry 4.0” OR “Digital Transformation” OR “4th Industrial Revolution” were used. The search terms are utilized for the compilation of articles, with only articles written in the English language being considered for the study. This article will offer practical instances of effective approaches, tactics utilized, and the effects of going digital on business outcomes. Figure 1 represents the line diagram of the methodology adopted in this article.

The articles were carefully analysed to understand the current trends in digitalization research for SMEs. Additionally, the survey data were collected by government agencies and industry groups to get a direct perspective from Indian SMEs on their digital adoption, the benefits and challenges they face, and their awareness of government programs [24,25]. The study will investigate examples of successful digital transformation efforts by SMEs to enhance the quality of the analysis [15]. The data are analysed to identify the status of digitalization in SMEs, and required solutions will be provided to enhance the pace of digitalization in SMEs. The most recent 73rd NSS survey on MSMEs revealed a sizable portion of the GDP, showing a slight growth rate over the prior years. SMEs’ participation decreased from 30.5% in 2020 to 30% in 2022 [26]. Figure 2 shows the need for digitalization to enhance SMEs’ contribution to the country’s economy.

There are many reasons for the slow growth of SMEs. The fact that SMEs are not moving forward can be attributed to several factors, including a lack of basic infrastructure facilities, a lack of accurate information about financial

transactions, a lack of technological upgrading, the use of outdated machinery and equipment, a lack of skilled labour, inferior products, and so on [11]. Only 34% of SMEs have successfully adapted to technological and digital changes. Although SMEs have already achieved great success, much unrealized potential may be used to propel the sector forward [27].

3 Digital India and SME

The Indian government launched Make in India in 2014 and the Digital India scheme in 2015. Under these programs, India aims to become a more advanced and independent economy by fostering the manufacturing sector (Government of India, 2015). Numerous initiatives and projects have been implemented in various Indian industries,

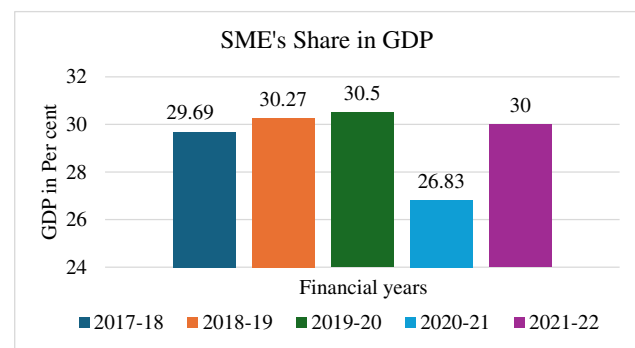


Figure 2: SMEs share in GDP.

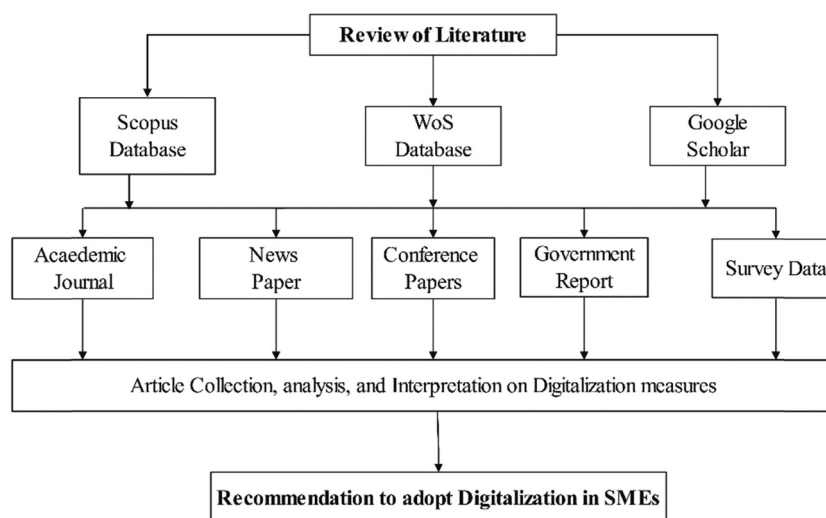


Figure 1: Review methodology.

including SMEs, to achieve this goal successfully [28]. With the digital India initiative, SMBs are experiencing a new upsurge in reaching more customers: Simple financial transactions, increased corporate efficiency, and a platform for joining the international market. Simple financial transactions increased corporate efficiency and provided a platform for entering the global market. Numerous initiatives, including Make in India and e-governance, have supported these efforts. Introducing the latest innovations and ICT approaches is helping to gradually create a new generation of SMEs by replacing outdated business methods [29].

3.1 Digital technologies for SMEs

Indian small and medium-sized enterprises are increasingly adopting a range of digital tools to improve efficiency, streamline operations, and remain competitive. Businesses like Haldiram's, Amul, Grofers, Bharat Forge, Zivame, and OYO Rooms are utilizing technologies such as enterprise resource planning (ERP) systems, digital payment platforms, AI, IoT, customer relationship management (CRM), and cloud computing. These developments provide valuable examples of how Indian SMEs are confronting the challenges and capitalizing on the opportunities presented by digital transformation. In Indonesia, a case study involving seven SMEs demonstrates various strategies for digitization: companies with advanced digital expertise rapidly shifted to complete digitization, while those with limited digital knowledge began by digitizing their sales processes. Some SMEs with lower digital proficiency successfully partnered with tech-savvy firms to leverage their extensive social networks and overcome technological obstacles [30,31]. Critical assets for SMEs, such as information technology, staff skills, and digital strategy, were explored in a different case study in relation to the process of digitization. The findings underscore the importance of tailoring digitalization approaches to the specific circumstances of each SME and emphasize the essential role played by both internal and external resources in enabling successful digital transformations. An extensive digital strategy was implemented by Payal Plastics, a medium-sized business based in Pune, India. This included automated inventory management systems and online sales platforms. Aakar Innovations, an SME located in Bangalore that manufactures sanitary products, utilized data analytics and cloud-based technologies to enhance customer service and streamline its supply chain operations. By leveraging these technologies, SMEs can increase their overall competitiveness within the digital era while enhancing client engagement and streamlining operational processes [30,32,33].

Table 3 represents the various digital tools for SMEs digitalization with projected benefits. In the current digital environment, SMEs are utilizing a range of advanced tools to propel their operations forward. Cloud computing services like AWS and Office 365 remove the need for large initial investments, offering adaptable resources and remote work options. AI automates routine tasks, with chatbots in platforms like Salesforce handling standard customer inquiries. The IoT delivers real-time insights, enabling intelligent inventory systems and data-focused product development. Enterprise resource planning systems such as NetSuite and SAP Business One consolidate various business functions, promoting efficiency and understanding. Customer relationship management software from providers like Salesforce and HubSpot CRM centralizes customer interactions, nurturing stronger connections through data-driven approaches. Data analytics utilities including Tableau and Google Analytics uncover patterns and essential performance metrics to guide well-informed decision-making processes. Lastly, e-commerce platforms such as Shopify and WooCommerce enable SMEs to establish customized online stores while effortlessly managing everything from product listings to transactions [34–36].

3.2 Scope for digital SMEs

The digitalization of the Indian economy is undergoing a wave of transformation. One of the largest internet user networks is forming in India. The number proliferates across the board, from online shopping to digital payments. According to a study by the Internet and Mobile Association of India, there are about 759 million active Internet users in India [13].

Figure 3 depicts how the e-commerce market has grown significantly in recent years. Growth in Internet and smartphone penetration, an increase in digital literacy, and the government's digital push, currently projected to be worth roughly US\$74.8 billion [15], have all contributed to the transformation of how customers buy in India over the past few years. Since 2018, the Indian e-commerce market has grown significantly, from \$50 billion to \$74.8 billion. By 2024, it is anticipated to increase by US \$111 billion [38]; by the end of 2028, it will reach US\$358 billion [39]. The impact of digitalization will generate about 65 million Employment in the manufacturing and service sector SMEs [40]. As some of the largest employers in the country, SMEs have a huge opportunity for growth through the adoption of digitalization [41].

Table 3: Digital tools for SMEs

Digital tool	Benefits		Example
Cloud computing	Allows SMEs to access computing resources like storage, servers, databases, and software without large upfront costs	Enables remote working capabilities	AWS, Microsoft Azure, Google Cloud, Office 365, G Suite, Salesforce
AI	Automate repetitive tasks and workflows	Chatbots can handle simple customer inquiries to free up staff time	
IoT	Track real-time performance data to optimize processes	Integrated systems can automate inventory management	Suggest products based on individual customer data IoT data offer insights to develop new products and services
ERP	Consolidates business operations like accounting, HR, supply chain, inventory, manufacturing, and more into a unified system and shared database	Provides process automation, data insights, and organizational efficiency	Popular options like NetSuite, SAP Business One, Odoo, and Zoho
CRM	Centralizes customer data and interactions across sales, marketing, support, and other teams to build better relationships	Provides automation for communications as well as data to optimize strategies	Salesforce, HubSpot CRM, Zoho CRM, and Freshworks CRM have editions for SMEs
Data analytics	Collects and analyses data from across the business to uncover insights that inform strategy and decision-making. Identifies trends, metrics, and KPIs for performance tracking	Identifies trends, metrics, and KPIs for performance tracking	Tools like Tableau, Looker, Sisense, and Google Analytics offer easy analytics for SMEs
e-Commerce platforms	Enables SMEs to set up customized online stores and sell products or services directly to customers	Handles catalogue management, shopping carts, payments, fulfilment, and more	Shopify, WooCommerce, BigCommerce, and Squarespace are user-friendly options

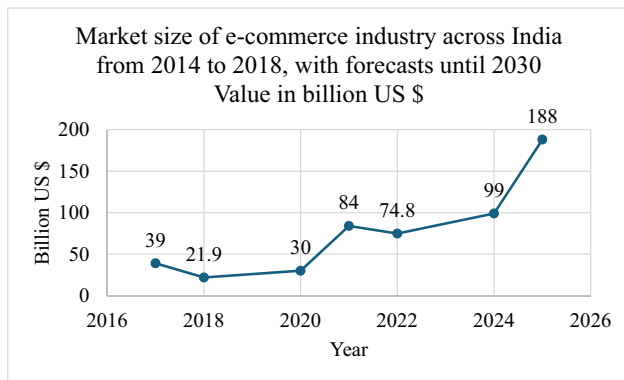


Figure 3: Market size of the e-commerce industry across India from 2014 to 2018, with forecasts until 2030. Value in billion US \$ [37].

4 Need for digitalization

ICT is the way to go in the current trend phase. Digitalization can assist struggling sectors in regaining their footing and inspire new business owners to establish their SMEs in India and reach as many distant clients as possible. About 68% of SMEs are offline and employ conventional business techniques, with only 2% of businesses being digital [42]. They have used the most recent tools like CRM, databases, and other backend software. Approximately 15% of people have enabled various digital devices, and the remaining 15% are connected but not actively using online services. They make use of essential accounting and billing software. Most SMEs use antiquated industrial methods with low production and high expenses. This practice suggests a significant opening for SMEs to implement digital technologies and solutions to enhance performance, broaden their client base, and accelerate expansion [43].

Figure 4 depicts the digital presence of SMEs in India from online to offline mode. It is important to note that many SMEs in India are restricted to local markets, making it difficult to compete with multinational organizations that use the newest concepts and technologies [44]. SMEs must embrace digitalization to expand their industries and improve employment opportunities nationwide. To minimize inequality, this entails motivating young people to take the initiative in developing creative, ICT-enabled business concepts. SMEs can create enterprises that adhere to international standards by adopting digitalization, which is crucial in the current economic environment [45].

Sustainable manufacturing relies heavily on quality control technologies and the digitization of real-time data. Data mining and machine-to-machine telematics allow manufacturers to anticipate quality concerns inside their processes, leading to more efficient manufacturing with zero

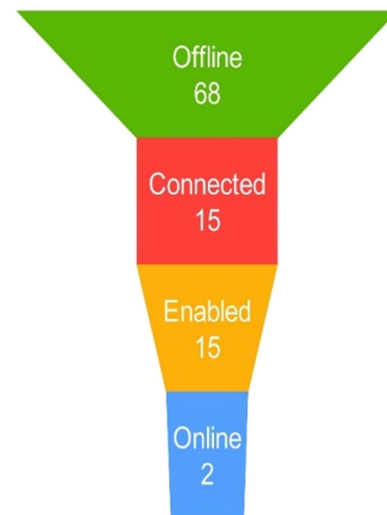


Figure 4: Digital presence of SMEs in India (percent).

defects [46]. To effectively handle sensor data, open-source technologies such as Apache Kafka, Apache Storm, and NoSQL MongoDB can be integrated to analyse data in real-time. In addition, the i4Q Framework guarantees trustworthy industrial data services, which provide precise data analysis, forecasting, and optimization in pursuit of defect-free production [47]. By allowing for digital twin generation for predictive resource consumption and real-time collision prevention, digitalization in smart factories, including self-learning methods and manufacturing data management, improves resource efficiency and supports sustainable production [48]. One way to improve product quality and production efficiency is to implement a real-time quality control system that uses data from the manufacturing process [49].

In the future, there is a strong chance that SMEs will prosper once more, thanks to their ability to reach their ideal production capacity and experience rapid growth. However, this will necessitate a concentrated effort to efficiently deploy digital tools and technology and a readiness to react to shifting consumer preferences and market conditions. By doing this, SMEs can set themselves up for future success and aid in expanding and advancing the Indian economy [50].

5 Influence of digitalization on SMEs

Figure 5 shows how the digitalization of Indian SMEs will influence the makeover of these firms.

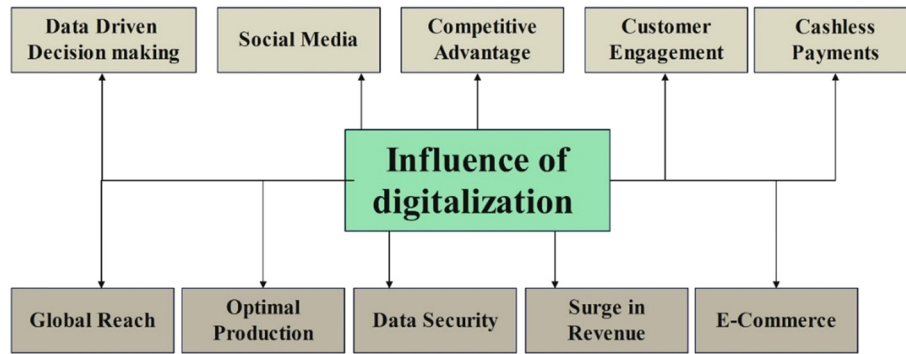


Figure 5: Influence of digitalization on SMEs.

5.1 Surge in revenue

Digitalization may significantly impact the revenue of SMBs. SMEs may streamline operations, boost efficiency, and improve customer service by implementing digital technology and tools, which can ultimately result in higher income [51].

ITC tools can help raise sales profit and access to a larger market. Digitalization is helping to remove the barrier and reach many customers through different online platforms. The KPMG report estimates that SMBs that embraced digital technologies generated 19% higher revenue than SMEs that leveraged traditional tools in fiscal 2016. SMEs embracing digitalization are anticipated to grow four times faster than conventional businesses [52].

5.2 Widespread reach

Digitalization will help to facilitate access to a broad market. The online presence of SMEs on e-commerce platforms can help foster their product sales and reach a broad spectrum of customers. Many SMBs can sell their products online and compare a broad audience. Furthermore, digitalization can also streamline business operations and reduce costs. With the help of digital tools, SMEs can automate inventory management and order processing processes, allowing them to focus on other aspects of their business. Around 4 million medium- and small-sector sellers on Amazon are based in India, primarily female business owners, enterprises, and similar organizations that market their goods internationally [53].

Adopting digital technology demonstrates SMEs' potential to expand their reach and increase sales through e-commerce platforms like Amazon. However, it is vital for SMEs to also invest in digital marketing strategies to effectively promote their products and stand out in a crowded online marketplace. Additionally, Amazon is anticipated to invest

\$20 billion, bringing an estimated 10 million online firms. Additionally, Amazon plans to open 100 digital centres in various parts of India to assist vendors in marketing their goods on the e-commerce site. Digitalization presents a massive opportunity for SMEs to tap into a growing market and leverage Amazon's resources to boost their sales. By combining their presence on e-commerce platforms with effective digital marketing, SMEs can establish a robust online presence and compete with more prominent players in the industry [54].

5.3 Optimal production

Every company wants to optimize production as cost-effectively as possible and, at the same time, make optimal use of its resources. The use of ITC technologies improves manufacturing efficiency while reducing production costs. E-commerce, internet banking, and digital payments have significantly reduced the operating costs of SMEs. The cost of advertising and promotion on numerous social media sites is low. Automated and cloud-based processes facilitate data storage, business analysis, and decision-making for the company. By monitoring customer demand patterns, calculating inventory levels, eliminating risk, and increasing the overall efficiency of the business, digitalization also helps in supply chain assessment [55].

5.4 Cashless payment

Around 94% of small companies accept card payments, and 78% utilize digital wallets, according to a McKinsey & Company survey. The institute conducted surveys of major enterprises with annual revenues over US\$70 billion and small businesses with average annual incomes less than US \$70 billion in 2017. The figure revealed that small businesses use digital payments more efficiently than large

ones. About 80% of small businesses use mobile banking, compared to 75% of large companies. SMEs often use Unified Payment Interface (UPI) transactions and mobile wallets. Processing payments digitally streamlines business transactions. They also leave a trail that can be legally pursued, and financial record keeping is easy.

Additionally, digital payments can help small businesses save time and money by reducing the need for manual processing and paperwork, allowing business owners to focus on other essential aspects of their business and can contribute to overall growth and success. The report also found that small businesses that accept digital payments saw a 5% increase in revenue compared to companies that only accept cash. The study also revealed that mobile payments are becoming increasingly popular among small businesses, with 45% of respondents using mobile payment apps [56].

In Figure 6, the data reveal that the various modes of digital payments, along with traditional methods like cash on delivery and others, are used from 2018 to 2022. In 2018, the share of conventional methods was 33%, and digital payments stood at 67%. In 2022, there is a 5% decrease in traditional payments and a 7% increase in digital payments. Firms' adoption of digital payments indicates the willingness to shift to digital payments.

5.5 Data security

Data security is a necessary component in the digitalization of SMEs as extensive data are accumulated in the form of customer data like name, age, purchase history, invoices, employee data (name, contact information, payroll information), and financial records (bank account, tax information, transaction

detail). All these are sensitive data that need to be taken care of. Negligence in data security may harm SMEs through financial, reputational, and operational losses. Data security is crucial for maintaining customer trust. Data protection laws are to be followed to secure customer data. To address these issues, SMEs must overcome the challenges of budget constraints and lack of expertise and be vigilant of the threats by strengthening security strategies. SMEs need to assess the associated risk and seek experts' help to gain data security.

6 Challenges in achieving digitalization

Despite the urgent need for modernization, many SMEs in India still use outdated production techniques. According to a recent survey by YES Bank, only 5% of SMEs have fully utilized digitization technologies [58]. The survey also highlighted significant barriers to digital adoption, such as a lack of technical knowledge and skills. The survey results suggest a substantial gap between the potential benefits of digitalization and the current level of adoption among SMEs in India. This underscores the urgent need for initiatives and support programs to remove the barriers and provide the necessary training to help SMEs adopt modern production techniques [59].

Figure 7 represents the challenges faced by SMEs on the path to achieving digitalization. SMEs encounter many technological and organizational obstructions while digitizing. Technologies like digital transformation can be too expensive for SMEs. The complexity of digital technologies and the organization's lack of digital capabilities might also be issues. Cybersecurity is another issue for SMEs, who seek to protect their data. Organizational resistance to transformation often emerges from a traditional mindset. A lack of a clear digital transformation plan and management support for digital initiatives could hamper growth. These challenges show that SMEs must tackle both technical and organizational culture and approach when transforming digitally. SMEs can address these problems with digital uptake, training and upskilling, managerial skills, and financial technology policies. This complete approach is essential for SME digital transformation.

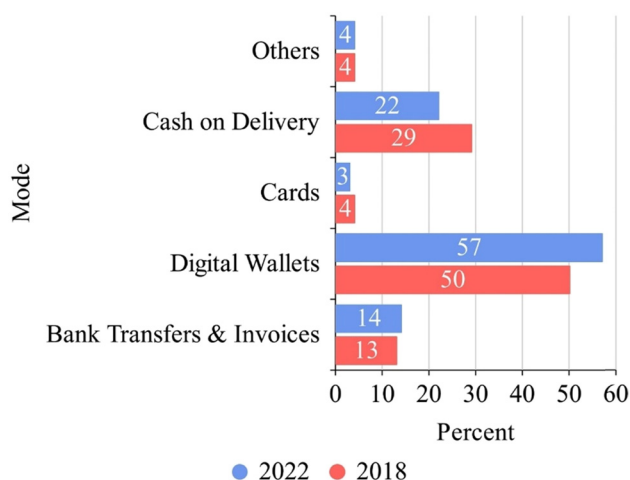


Figure 6: E-commerce modes of payment 2018 vs 2022 in Asia-Pacific [57].

6.1 Skill gap

Most of the low-skilled workforce in India is employed in micro, small, and medium-sized enterprises. They are not

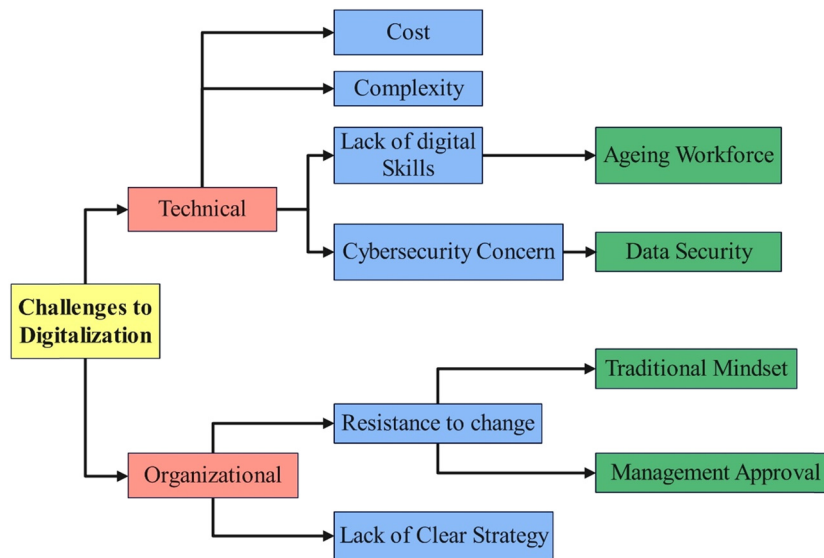


Figure 7: Challenges to digitalization in SMEs (own work).

aware of the technology and adhere to the use of old manufacturing methods. Seasonal employment is the norm for most of these positions. This means that most of the off-season workforce is in SMBs [60]. Most workers are illiterate and poorly educated. This has widened the gap between high-skilled and low-skilled workers. Digital transformation in India's SMEs requires a focus on workforce development. About 43% of India's population is actively employed. States

should work with public institutions to equip their workforces with technical, managerial, and ethical training to reduce the economic disparity between high-skilled and low-skilled workers [61].

The significance of the skill gap for the organization is seen in Figure 8, representing a survey finding by Skillsoft. The survey findings highlight the importance of addressing skill gaps due to their wide-ranging impacts on various

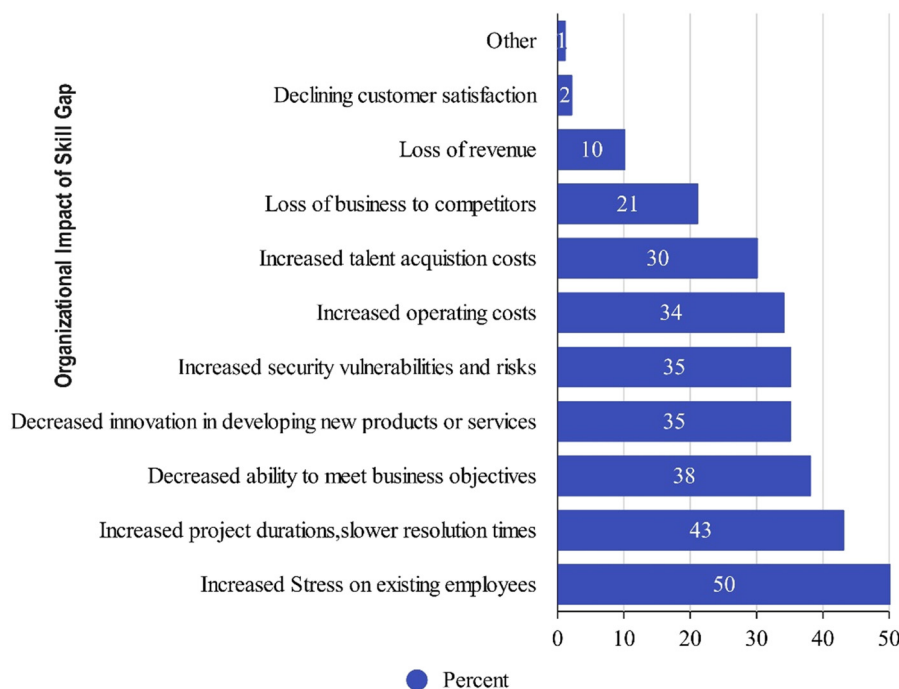


Figure 8: Organizational impacts of skill gaps [62].

aspects of an organization, including employee well-being, operational efficiency, innovation, security, and financial performance. The most significant impact, affecting half of the employees within SMEs, is the increased stress on existing employees due to the additional workload and responsibilities that existing employees must take on to compensate for the skill gaps. About 43% of the employees reported increases in project durations and resolution times. Skill gaps can lead to inefficiencies in project execution and problem-solving. About 38% of the population reported a decreased ability to meet business objectives, indicating that skill gaps can hinder an organization's strategic goals. Other notable impacts, each affecting 35% of the employees, include decreased innovation in developing new products or services, increased security vulnerabilities and risks, and increased operating costs. Financial implications are also evident, with 30% reporting increased talent acquisition costs, 21% experiencing a loss of business to competitors, and 10% seeing a loss of revenue. Interestingly, the least reported consequences of skill gaps are declining customer satisfaction and other impacts, affecting 2 and 1% of the population, respectively. The main effect is that the person becomes more stressed, which lowers their productivity. Both the project's duration and operating costs increase because of the skill gap. There is often a significant difference between the labour capabilities of SMEs and those required to use sustainability and digitization activities properly. This mismatch hinders the adoption of cutting-edge technologies and sustainable practices and harms SMEs' overall productivity and competitiveness in the modern corporate environment. In addition, the skill gap exacerbates operational inefficiencies and limits SMEs' ability to innovate and adapt to shifting market demands. In order to increase productivity, SMEs must permit their employees to participate in government programs that will enhance their efficiency and skill sets [40].

The government of India has launched several initiatives to enhance skills, such as the Skill India Mission (SIM), which aims to upskill, reskill, and skill all young Indians to prepare them for the plethora of opportunities that will arise as the country's economy grows and it rises from being the world's tenth to third largest. Intending to address employability gaps and further enhancing labour productivity, the Ministry of Skill Development and Entrepreneurship implements the SIM by providing skilling, reskilling, and up-skilling youth nationwide through a comprehensive network of skill development centres/institutes under various schemes, such as the Pradhan Mantri Kaushal Vikas Yojana, Jan Sikhshan Sansthan, National Apprenticeship Promotion Scheme, and Craftsman Training Scheme through Industrial Training Institutes.

6.2 Technological gap

The proliferation of new technologies has increased the need to become familiar with the latest digital platforms. Attracting investments through different channels is necessary to increase the visibility of SMEs' technical know-how in other sectors. Even if the cost of using digital channels is no higher than it used to be, promoting the business through digital channels such as e-commerce, social media advertising, and digital payment methods is essential. Due to a lack of knowledge, many companies are still reluctant to apply these strategies [23]. They cling to proven manufacturing practices that have historically led to subpar results, increased costs and wear and tear, and inflexible payment policies. These smaller firms are powerless against multinational corporations selling identical goods to a global customer base. Additionally, these multinationals have the resources to sell at lower prices and higher quality [63].

6.3 Finance gap

The SME Financial Forum report, administered by the International Finance Corporation, found that SMEs' average unmet financial need in developing countries was US\$41 million. These countries are estimated to have an economic deficit of US\$5 trillion. According to the data presented in the study, Indian SMEs face a financing deficit of around 62.26% [64]. SMEs still use outdated production processes due to insufficient funding and unmet financial needs. Due to lacking information and comprehension, SMEs think adopting new digital technology is too expensive and out of their grasp. In rural areas, most SMEs rely on unofficial funding sources, which leads to higher interest rates and more debt. Therefore, Providing sufficient financial support for SMEs is crucial, mainly to close funding gaps and promote future-oriented ICT technologies [65].

6.4 Structural gap

SMEs are prevalent in India and run independently throughout the nation. As a result, they cannot even create the fundamentals of modern technology. Due to a lack of technological know-how, a qualified workforce, and innovation, SMEs are structurally at a severe setback compared to large, well-established businesses. For the digital expansion of SMEs, it is essential to establish efficiency and change business strategies systematically. The Internet, social networks, and e-commerce

sites offer cost-effective solutions to crucial needs. To run an ICT company successfully, specialist knowledge is mandatory. The government has developed initiatives like Digital India to support these companies. However, taking advantage of such government initiatives requires a thorough understanding of available programs and policies [66].

7 Role of government

The Indian government has recently implemented several policies and initiatives to support and help SMEs become more digitally advanced. Government programs like Make in India and Digital India have aided these businesses in overcoming challenges and accelerating their growth. Implementing the Goods and Services Tax, which has streamlined the taxing procedure for SMEs and lessened their compliance burden, is noteworthy. Additionally, the government has started several skill-development initiatives to help SME employees and owners become more digitally savvy and use technology efficiently. These initiatives have improved the SMEs' competitiveness and India's overall [67].

By providing financial assistance through tax refunds to help SMEs cover the costs of upgrading hardware, purchasing software, and other expenses related to digital transformation, the government plays a crucial role in supporting SMEs in their digitalization efforts. Creating a clear and stable legal framework for cybersecurity, e-commerce, and data privacy is essential for building trust and encouraging SMEs to participate in the digital economy. Streamlining regulations and registration processes can reduce bureaucracy and make online business transactions more accessible for SMEs. The government should also offer training programs and workshops to equip SME employees with digital skills, such as e-marketing, data analysis, social media management, and cybersecurity. Universities and vocational schools can create personalized digital skills training programs tailored to small and medium-sized business sectors. By attesting to their acquired digital skills, industry-accepted skill certifications increase SME employees' employability. Government provision of enhanced technology and infrastructure is required. Increasing broadband internet connectivity is necessary to encourage SMEs to participate in the digital economy, especially in distant and rural areas. SMEs can take advantage of robust software and computer capabilities without making significant upfront financial investments, thanks to cloud-based solutions. Governments can incentivize the adoption of cloud technologies by providing subsidies or tax incentives. The government may provide funding for research and development initiatives. The government may assist

in the sharing of information and best practices for SMEs through awareness campaigns and industry group networks. The government can create an impact measurement framework to assess the effectiveness of different programs. Fostering creativity and conducting experiments in a secure environment may also be advantageous [38,44,45].

7.1 Digital India

Indian Prime Minister Narendra Modi launched Digital India in July 2015. The program aims to improve digital infrastructure and connectivity and to increase the general level of digital literacy. The program aims to connect rural India to the Internet and transform the country into a leading digital powerhouse. There are numerous advantages for SMEs. With the help of Digital India, SMEs gain access to modern information and communication technologies that enable innovative business practices. The policy also promotes domestic production and aims to reduce imports. Mobile phone imports fell by 22% in fiscal 2022, while exports increased by 56%. This reduction in imports boosts the domestic economy and creates employment opportunities in the manufacturing sector. Additionally, the increase in mobile phone production demonstrates Digital India's success in fostering local entrepreneurship and technological advancement.

7.2 Digital MSME

The Indian government launched the program to increase information and communication technology use in MSMEs, which the Ministry of Micro, Small, and Medium-sized Enterprises controlled. The program's initiatives included encouraging MSMEs to use ICT tools to connect with the market and improve their management activities *via* various digital software, promoting digital literacy and e-marketing *via* various awareness campaigns, and improving information processing capacity and adopting automated ITC methods to reduce costs, improve overall business efficiency, and ensure proper employee training in MSMEs. They promoted the use of cloud software and the Internet [35].

7.3 Startup India

The Indian Ministry of Industrial Policy and Promotion launched a program in 2016 to encourage new business ventures and make India more economically independent. Economic dependency is made possible by funding from

the Indian government. The solution also offers a mobile-friendly web interface for dealing with government regulators and a tax exemption for up to 3 years. The Indian government has also launched programs to encourage the new wave of digitization in the economy, including e-governance, digital payments, online registration, employment sites, and an expansion of e-commerce [68]. These programs seek to improve company operations transparency, lessen corruption, and expedite bureaucratic procedures. Additionally, the growth of e-commerce offers chances for small firms to access a more extensive clientele and engage in global competition. The combined effects of these initiatives help India achieve its objectives of promoting economic growth and digital empowerment [69].

8 Impact of government initiatives

Numerous government efforts aimed at encouraging the adoption of digital technology have had a considerable impact on the digitization of SMEs in India [19]. Digital India program transformed India into a digitally empowered society and knowledge economy [13,70]. Loans and financial support have been made available by the Pradhan Mantri Mudra Yojana to SMEs so they can acquire digital technology. The Indian government has put in place a number of policies, initiatives, and incentives to assist SMEs in undergoing a digital transformation because it recognizes the critical role SMEs play in the nation's economic growth [71]. To further encourage SMEs to embrace digital solutions like cloud computing, e-commerce platforms, and ERP systems, the government has also implemented rebates and subsidies [19,70,72]. The digitalization of SMEs in India has been positively impacted by these initiatives. According to a survey, many SMEs have been able to increase their competitiveness, productivity, and efficiency using digital technology, which has boosted their growth and profitability. SMEs have been able to reach new markets, grow their customer base, and improve their sales and distribution procedures by utilizing e-commerce platforms [72].

Nonetheless, there have been certain difficulties with India's SMEs' digitalization, as depicted in Figure 9. Numerous small and medium-sized enterprises still encounter obstacles such as lack of finance, cybersecurity, poor infrastructure, low technical skills, and connectivity problems, which might impede their capacity to fully adopt digital technology [73]. To help SMEs overcome these challenges and expedite their digital transition, the government has developed initiatives like the Startup India program, which offers money, coaching, and infrastructural support. In addition, the government has partnered with private sector organizations and industry

groups to provide training and capacity-building programs that assist SMEs in gaining the abilities and know-how required to use digital tools and platforms efficiently [72]. The findings of Capterra's survey on digitization in SMEs are shown in Figure 8. Three hundred top SME leaders were interviewed with 36% of respondents thinking that cybersecurity is a barrier; it seemed to be the biggest obstacle. While 65% of the respondents said they had received government funding, 50% of them agreed that they had upgraded their digital tools. SME owners have found it easier to make connections and promote the use of digital tools because of the acceptance of market linkage (e-commerce, social media). A study by Endurance International Group indicates that 50% of micro and small businesses use video conferencing tools like WhatsApp to conduct daily business operations, while a CRISIL report states that 53% of SMEs in India have embraced digital sales platforms.

9 Discussion and future recommendations

India must be technologically advanced to be competitive globally and build new types of firms. India has one of the world's fastest-growing economies and tremendous potential. SMEs constitute India's backbone and have a substantial economic influence. This will only be achievable if the impediments are removed in the first place. Education should take precedence during the digital shift. Unskilled workers must receive the necessary education and training. It is essential to educate medium-sized firms on the advantages of digitization. They must first understand the importance of the Internet, e-commerce, and comparable tools and the effects of not implementing new technology and business tactics. Therefore, education, training, and awareness are the cornerstones of a successful digital SME. The

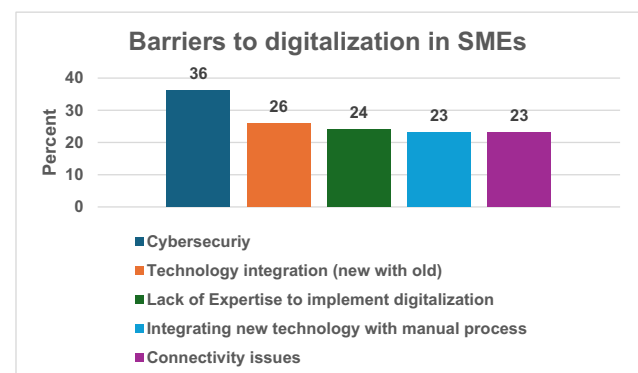


Figure 9: Survey on barriers to digitalization in SMEs by Capterra [73].

government should promote investments in those companies to enable SMEs to benefit from the digital infrastructure. To motivate SMEs to adopt digitalization, incentives should be provided to the adopters. Encouraging an innovative atmosphere within SMEs can be done by recognizing and applauding successful digital changes through leadership training initiatives and awards. Increasing government investment in infrastructure and exploring offline or low-bandwidth digital solutions for areas with limited access is essential in bridging the digital gap. Metrics can help measure the impact of digital projects and share success stories, making it easier to demonstrate returns on investment and promote wider usage.

SMEs can provide tailored and proactive assistance when integrated with customer support systems. Blockchain and IoT offer SMEs valuable opportunities for development and creativity, making them worth exploring. Identifying bottlenecks, improving resource allocation, and boosting operational efficiency are achievable through analysis. IoT sensors can monitor machinery status and predict potential problems in advance, enabling preventive maintenance to decrease repair expenses and downtime. Because blockchain technology is safe and immutable, SMEs can track the movement of goods and materials along the supply chain. This increases transparency and improves traceability while reducing the likelihood of fraud and counterfeit items. Facilitating safe and efficient communication between SMEs and their suppliers or partners helps expedite processes such as order management, payment transactions, and information sharing. It can increase SMEs' access to financing by facilitating transparent and safe financial transactions. Smart contracts built on blockchain technology can reduce time-consuming paperwork and automate payments [15,46]. Integrating new digitalised technologies into the existing IT infrastructure can pose difficulties that require significant preparation and expertise SMEs can address these challenges by starting with targeted implementation in customer engagement or inventory management gradually expanding based on the outcomes. SMEs stand to gain from the support, knowledge, and cost-efficient options available through service providers and industry specialists [74]. By tackling challenges, strategically implementing these technologies, and prioritizing long-term goals, SMEs could lead innovation and productivity and stay ahead in the digital era.

10 Managerial implication of the work

Encouraging SMEs to undergo digital transformation is crucial for India to become a leading global technology

hub. SMEs, the government, and the public sector must work together to undergo this digital transition. Improving infrastructure, upskilling workers, and creating jobs are crucial for SMEs to take advantage of government incentives and overcome resource limits. By combining blockchain and the Internet of Things, SMEs may drastically improve their operational efficiency and cost-effectiveness. The IoT monitors stock and machinery health, allowing for preventative maintenance and reduced downtime. Secure communication between SMEs and suppliers is made possible by blockchain technology, which streamlines payment processing, order management, and information exchange. The upfront costs and technical skill requirements are outweighed by the long-term benefits of these technologies, which include increased output, improved customer relations, and access to new markets. By enlisting the help of service providers and industry specialists, SMEs can test these solutions out in specific areas and expand their operations based on the results. A robust economy, less reliant on large corporations and more receptive to new ideas, might emerge from this approach.

11 Conclusion

The transition from analogue to digital operations has been made more accessible for SMEs due to several government programs. Collaboration among the government, public sector, and SMBs is crucial for the success of digitalization. It is vital to raise awareness among individuals to support the growth of SMEs. With technology advancing rapidly, SMBs need to adjust to stay competitive constantly. India has become a leading technological hub globally thanks to the achievements of its SMEs.

Moreover, enhancing the country's infrastructure, increasing the workforce's expertise, and boosting job opportunities are all crucial aspects to consider. SMEs can thrive and grow successfully by utilizing government incentives, receiving proper training, and having access to essential infrastructure. By implementing these measures, SMEs stand a better chance of overcoming challenges like limited resources and financial constraints. Promoting the growth of SMEs can lead to a more inclusive and robust economy that is not solely dependent on large corporations and is more receptive to innovation and entrepreneurial endeavours.

SMEs can leverage blockchain and IoT technologies to improve operational efficiency and reduce costs. IoT allows SMEs to track equipment performance, inventory levels, and manufacturing processes, enabling proactive maintenance and reduced downtime. Blockchain's secure nature allows SMEs to monitor material flow across the supply

chain, reducing fraud and fake goods. It streamlines processes like order management, payment transactions, and information sharing, allowing SMEs and suppliers to collaborate securely [75]. Blockchain-based smart contracts can automate payments and minimize paperwork. Blockchain and IoT data can provide SMEs with a comprehensive understanding of their clients and business processes, enhancing corporate strategy and making data-driven decisions. Integrating these technologies opens new avenues for innovation and the creation of new goods and services using secure transactions and real-time data. However, adoption may be hampered by high initial costs and technical skills requirements. SMEs can start by deploying IoT and blockchain solutions in specific domains, such as inventory management or customer engagement, and expand based on results. Service providers and industry experts can help SMEs access resources, know-how, and affordable solutions. Despite initial costs, the long-term benefits of increased productivity, improved customer relations, and access to new markets may outweigh the initial costs.

Funding information: Authors state no funding involved.

Author contributions: All authors have accepted responsibility for the entire content of this manuscript and consented to its submission to the journal, reviewed all the results, and approved the final version of the manuscript. VP: conceptualization, methodology, formal analysis, investigation, resources, writing of original draft, and editing, and correspondence. AK: formal analysis, investigation, supervision, review, and editing. SG: investigation, supervision, and review.

Conflict of interest: Authors state no conflict of interest.

Data availability statement: The data collected and analysed during the current study are available from the corresponding author upon reasonable request.

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