

The Fourth Industrial Revolution: Opportunities and Challenges for SMEs in Bangladesh

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AR

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VR

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4IR

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The Fourth Industrial Revolution: Opportunities and Challenges for SMEs in Bangladesh

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About FES

Friedrich-Ebert-Stiftung (FES) was established in 1925 and is the oldest political foundation in Germany. It is named after Germany's first democratically elected president, Friedrich Ebert (1871-1925). Its mission is based on the values of social democracy: liberty, justice & solidarity. The Friedrich-Ebert-Stiftung (FES) Bangladesh office was opened in 2013. In Bangladesh, FES promotes socially and ecologically sustainable economic policies, participation and international cooperation. We do so through research, training, discussions, and exchanging knowledge with our partners. We approach the potentials and challenges of developments in Bangladesh at national, regional and international levels. We do this to link debates worldwide and create opportunities for stimulating exchanges on multiple levels to foster regional and global alliances.

For details, please visit: bangladesh.fes.de/

About SME Foundation

The Small & Medium Enterprise Foundation, widely known as the SME Foundation, was established by the government of Bangladesh through the Ministry of Industries as an apex institution for SME development in the country. The major activities of the SME Foundation are the implementation of SME Policy Strategies adopted by the government, policy advocacy and research to design the intervention plan for the growth of SMEs, facilitating financial support for SMEs, providing skill development and capacity building supports, facilitating adaptation with appropriate technologies and access to ICT, providing business support services and market linkage for SMEs, Women entrepreneurship development, SME Cluster development, etc.

For details, please visit: smef.gov.bd

Preface

The Fourth Industrial Revolution (4IR) fundamentally transforms industries and economies worldwide, presenting opportunities and challenges for Small and Medium Enterprises (SMEs) and employment. This study paper offers a qualitative exploration of the impact of 4IR on the SME sector in Bangladesh, highlighting the associated opportunities and challenges. The study was conducted in partnership with Friedrich-Ebert-Stiftung (FES) Bangladesh and the SME Foundation.

The study's groundwork is built on an exhaustive review of secondary data sources such as newspaper articles, magazines, journals, government reports, and insights from national and international organisations. These findings were synthesised into a coherent and comprehensive questionnaire. Subsequently, the study extensively engages in Key Informant Interviews and Focus Group Discussions with stakeholders, including SME owners, association representatives, and government officials.

The study reveals that while most participants are superficially aware of the 4IR, they view it positively as a blessing for the SME sector. Although the adoption of 4IR technologies is still in the preliminary stages, SMEs anticipate numerous benefits, including enhanced customer experiences, reduced production times, improved product quality, and data-driven decision-making. Regarding employment, most participants believe that adopting 4IR technologies in the SME sector of Bangladesh will create new job opportunities and enhance overall productivity. Participants expressed concern about challenges during the transition period of adopting 4IR in the SME sector. These challenges include a lack of technical knowledge, financial constraints, inadequate training opportunities, safety and security concerns, infrastructure limitations, and difficulties in accessing essential information. These challenges collectively impact the SME sector as it navigates the complexities of transitioning to 4IR. Several key recommendations emerge to harness the full potential of 4IR for the benefit of SMEs in Bangladesh. These include conducting a comprehensive analysis of the current SME landscape, establishing a collaborative platform for SMEs to share information, organising high-quality training and workshops, facilitating shared resource utilisation, attracting foreign clients, promoting local innovation, launching nationwide awareness campaigns, ensuring effective policy implementation, and fostering collaboration among government entities, associations, and academia.

The results of this preliminary study indicate a need for further, more comprehensive research and large-scale sectoral data collection to inform policy-level changes. Participants' concerns regarding adequate training and workshops related to the 4IR indicate the necessity of capacity building in this sector. The challenges in adopting ICT suggest that creating a shared resource platform is crucial to support them. Addressing these concerns through national policy and providing necessary financial and resource facilities can mitigate these challenges.

By strategically addressing these challenges and implementing the recommended strategies, Bangladesh can effectively position itself to embrace the transformative benefits of 4IR, simultaneously improving its SME sector and fostering positive employment outcomes.

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Study Context and Rational

A Small and Medium Enterprise (SME) is a business entity that falls within a specific size range based on factors such as the number of employees, annual revenue, or total assets. The exact criteria defining an SME can vary by country and industry [1]. In Bangladesh, enterprises are classified into Small and Medium Enterprises (SMEs) based on size and assets by the Ministry of Industries. In the manufacturing sector, small enterprises encompass assets valued from BDT 75 lakh to 15 crores or 26 to 120 workers. In contrast, medium enterprises possess assets valued from BDT 15 crore to 50 crores (excluding land and factory building) and employ 121 to 300 workers. In the service sector, small enterprises have 16 to 50 employees and assets worth BDT 10 lakh to 2 crores, whereas medium enterprises employ 51 to 120 individuals and hold assets worth BDT 2 crore to 30 crores.

SMEs play a crucial and significant role in the economic development of Bangladesh [2] and are often described as the backbone of the Bangladeshi economy [3]. These enterprises typically have a limited number of employees, resources and assets. Still, they are the economy's main drivers for various reasons, such as creating jobs, increasing production, reducing poverty, etc. Moreover, SMEs span various industries, from startups to traditional family-owned businesses. According to the SME Foundation There are 7.8 million SMEs (including Cottage and Micro enterprises) in Bangladesh, which employ more than 21 million people and contribute to around 25% of the country's GDP [50]. Most of these are cottage and micro enterprises, as they employ significantly less than the 26 employees constituting the threshold to qualify as 'small enterprises. Thus, the notion of SME in this paper will include micro and cottage enterprises.

Given their significant economic role, it is necessary to consider how SMEs in Bangladesh can adapt to and benefit from the rapid technological changes brought about by the Fourth Industrial Revolution (4IR), also known as Industry 4.0. The 4IR refers to the rapid technological transformation of industries, societal patterns, processes and practices with the latest innovative technology. Every industrial revolution has marked a significant shift in how society operates. In the 18th century, the invention of the steam engine led to the First Industrial Revolution by enabling mechanised production for the first time and resulting in a significant shift toward urbanisation. During the Second Industrial Revolution, also known as the Technological Revolution, the widespread use of electricity and other scientific advancements led to the era of mass production. The Third Industrial Revolution, also known as the Digital Revolution, started in the late 20th century and brought about the rise of computers, digital technologies, and the internet, resulting in the growing automation in manufacturing. Building on the foundation of three industrial revolutions, the fourth industrial revolution focuses on integrating physical, digital, and biological systems.

4IR has changed the way we live, the way we think and the way we work. It has radically transformed and disrupted almost every business sector, including SMEs. It influences how SMEs operate, innovate, and compete in today's rapidly evolving business requirements. The ongoing transformative phase is fueled by rapid technological advancements in areas like Artificial intelligence (AI),

4IR has changed the way we live, the way we think and the way we work. It has radically transformed and disrupted almost every business sector, including SMEs. It influences how SMEs operate, innovate, and compete in today's rapidly evolving business requirements. The ongoing transformative phase is fueled by rapid technological advancements in areas like Artificial intelligence (AI), automation, 3D printing, the Internet of Things (IoT), Cloud Computing, Blockchain, autonomous robots, Virtual Reality (VR), Augmented Reality (AR), biotechnology, etc. In the current situation, businesses need to meet Industry 4.0 requirements of delivering high-quality products at competitive prices in due time by adopting these advanced technologies.

¹ National Industry Policy of Bangladesh 2022

² <http://smedata.smef.gov.bd/index.php/report/summaryTable>

While 4IR offers promising opportunities to the SMEs in Bangladesh to enhance their competitiveness through digitalisation, automation and innovative business models, it also brings some inherent challenges in adoption, such as a lack of skilled workforce, insufficient infrastructure due to limited access to finance and technology, etc. Adopting 4IR technologies can free up human resources, leaving the opportunity to employ these resources in other creative and strategic tasks.

Recent research about the fourth industrial revolution focuses on new and advanced technologies and how SMEs can adapt and utilise these technologies [4]. The literature has focused on understanding how SMEs can adapt and utilise these technologies to remain competitive in today's rapidly changing environment. Some studies have identified the challenges SMEs face in adopting and implementing 4IR technologies [4, 5, 8], whereas others highlight the opportunities presented by 4IR [4, 6, 7]. As SMEs are regarded as the backbone of the Bangladeshi economy, SMEs must perform up to the standard in Bangladesh's current economic situation. Thus, it becomes essential to study the challenges of adopting 4IR technologies in the SME sector and embrace the opportunities offered by 4IR to ensure their contribution to the national economy of Bangladesh.

In this context, this paper aims to evaluate how 4IR will impact the SME sector and employment in Bangladesh in terms of opportunities and challenges. To fulfil this objective, the following research questions are addressed:

- RQ1. What is the meaning of 4IR in the context of SME?**
- RQ2. What technologies are driving 4IR in the SME sector?**
- RQ3. What opportunities are 4IR creating for the SMEs in Bangladesh?**
- RQ4. What challenges are the SMEs in Bangladesh facing due to 4IR?**

The first two questions aim to establish a foundational understanding of 4IR by asking about its meaning and the technologies that can drive Bangladesh's SME sector. RQ3 and RQ4 will help identify areas of the SME sector where policy interventions can be made to maximise the benefits of 4IR while mitigating its adverse effects.

Literature Review

The emergence of the Fourth Industrial Revolution (4IR) has opened a new arena of research in Bangladesh, particularly when considering its impact on the country's Small and Medium Enterprises (SMEs). In recent years, researchers have increasingly focused on understanding how 4IR technologies can address local challenges and create economic growth and social development opportunities in developing countries [4-8].

The literature discussed in this section has been chosen for several reasons. Firstly, these studies explain how 4IR technologies are being adopted and integrated into SMEs in developing countries. These studies also explore SMEs' unique challenges in developing countries, such as limited access to technology, lack of skilled workforce, and financial constraints. Finally, these studies highlight the broader implications of 4IR for economic and social development, emphasising the role of technology in driving innovation, improving productivity, and enhancing the quality of life. Additionally, a few studies have been reviewed to understand the current status and policies related to ICT adoption in the context of SMEs in Bangladesh.

Alqam et al. [4] investigated the influence of the Fourth Industrial Revolution (4IR) on Small and Medium Enterprises (SMEs), particularly within the context of Oman. In this exploratory research, the authors collected primary data from top and middle management staff experts from several SMEs through focus group discussions. The study also relied on previous literature related to 4IR and SME as secondary data sources. The study's results suggest that all organisations must develop an IT strategy to adopt 4IR concepts and technologies. The study pointed out some benefits that can enhance the competitive advantages of SMEs, such as revenue, profitability, etc., by reducing the production time and meeting customer demand properly. However, the current technology infrastructure is one of the most important challenges for SMEs in adopting 4IR, according to the study.

Serumaga-Zake et al. [5] identified the challenges SMEs face due to the business processes changed by 4IR. The study focused on only the manufacturing SMEs of South Africa. This study presents a comprehensive literature review focusing on small and medium enterprises (SMEs) and their significance in developing economies. It explores SMEs' unique needs and challenges compared to larger, well-established organisations. The study also examines how SMEs can leverage new technologies despite their limited resources.

Adelowotan et al. [6] explored how SMEs can survive in the era of disruptive technologies of 4IR. The study examined the opportunities offered by the advanced technologies of 4IR in the context of SMEs in South Africa. The study methodology involves analysing the 2018/2019 South Africa's Small and Medium Enterprises (SMEs) landscape survey results. This analysis aims to uncover the significant roles played by SMEs in the South African economy, pinpoint the challenges they face, and suggest how they can address these challenges through the adoption of 4IR technologies. Despite concerns about job loss and inequality due to 4IR technologies, the study's findings suggest that with clear government policies and business community engagement, entrepreneurs can benefit from new supply chains and markets. Additionally, technological advancements will lead to increased productivity. Consequently, growing labour demand, creating more new jobs than those displaced by automation.

A systematic literature review was carried out by Adegbite et al. [7] to investigate the extent of understanding concerning the adoption of 4IR technologies among SMEs, along with the benefits offered by these technologies to the SME sector in low-income nations, particularly in Africa. This study explores the potential roles of SMEs in the 4IR and its impact on sectoral growth and transformation in Africa by reviewing 29 relevant studies. The study's findings suggest that fully transitioning SMEs into Industry 4.0 could lead to job creation, new business models, and internationalisation of SME products. Moreover, African regional cooperation and development may be essential to facilitate SMEs' involvement in 4IR technologies.

Vuong et al. [8] conducted an empirical study to identify the impact of 4IR on Vietnamese enterprises, focusing on its effects on manufacturing, management, and operations. This study analysed previous studies as secondary data and identified that 4IR adoption could create many challenges for Vietnamese enterprises, impacting

manufacturing, management, and operations. The study identifies Vietnamese enterprises benefit from 4IR opportunities, such as new technologies and a digital economy. However, they face challenges like skill limitations, outdated technology, and intense competition. The study also suggested enterprises should increase their investments and adopt innovative strategies to use 4IR technologies properly.

Antoniuk et al. [49] conducted a study focusing on Ukraine's policy recommendations to improve the SME sector in the era of 4IR. For this purpose, the authors reviewed statistical reports of institutions such as private companies, international organisations, NGOs, and other existing studies on SMEs' innovative development. The study's findings suggest that one of the major obstacles to SMEs' growth is the ineffective support provided by the government. The authors surveyed local high-tech SMEs to address this issue and offer guidance to Ukrainian policymakers. They identified key areas for improvement by using a SWOT analysis. Ultimately, a set of recommendations was developed to improve the SME environment in Ukraine, considering the challenges posed by 4IR.

In the context of Bangladesh, Friedrich-Ebert-Stiftung (FES), Bangladesh, and SME Foundation Bangladesh jointly conducted a study focusing on ICT adoption in the SME sector [50]. The study's results suggested that despite being a significant part of the economy and creating millions of jobs, SMEs in Bangladesh have been slow in adopting ICT. The study uses primary and secondary research methods, including interviews and focus group discussions, to assess ICT adoption in various SME sectors. The manufacturing sector, particularly the plastic industry, uses ICT tools more frequently than other industries. Some SMEs use essential software like MS Office (MS Word, MS Excel) and e-commerce sites for various business processes. On the other hand, the service sector has better ICT adoption, with logistics companies using vehicle tracking systems and the health industry using Enterprise Resource Planning (ERP) software. The study identifies factors and challenges affecting ICT adoption, such as a lack of basic ICT knowledge among entrepreneurs, unskilled labour, and a lack of trust in local ICT service providers.

In another [51], FES and SME Foundation Bangladesh collaboratively provided a policy brief on developing the Technical and Vocational Education and Training (TVET) system to prepare skilled ICT manpower in Bangladesh. For this purpose, the German TVET system is studied as a role model to learn from this. This suggests that replicating the entire German model in Bangladesh may not be feasible due to differences in industrial maturity and limited financial resources in Bangladesh. Instead, the study recommends a gradual adoption of key aspects from the German model, which includes implementing apprenticeship programs, compensating trainees, providing free training in institutions, increasing government funding for educational institutions, and involving industry experts, chambers of commerce, and company representatives in curriculum design, examinations, and certification processes.

To the best of the researcher's knowledge, no study from these directly investigates the impact of 4IR on the SME sector in Bangladesh. This kind of study is necessary, specifically for a developing country like Bangladesh, to identify and address the challenges and opportunities promised by 4IR.

Background: the Industrial Revolutions

Revolution means abrupt and drastic change [9]. The term "industrial revolution" refers to a profound change in economic systems and social structures caused by the introduction of new technologies and novel ways of perceiving the world. These radical changes are divided into four categories, namely the first, second, third and fourth industrial revolutions, as shown in Figure 1. The first industrial revolution was marked by the growth of railroads and the invention of the steam engine. The second industrial revolution was driven by electricity and the assembly line development. The development of semiconductors, personal computers, and the Internet triggered the third industrial revolution. These technologies also paved the way for the fourth industrial revolution, distinguished by much broader, deeper, and more complex and systemic applications of the preceding inventions and the emergence of new technologies such as artificial intelligence and the Internet of Things [10].

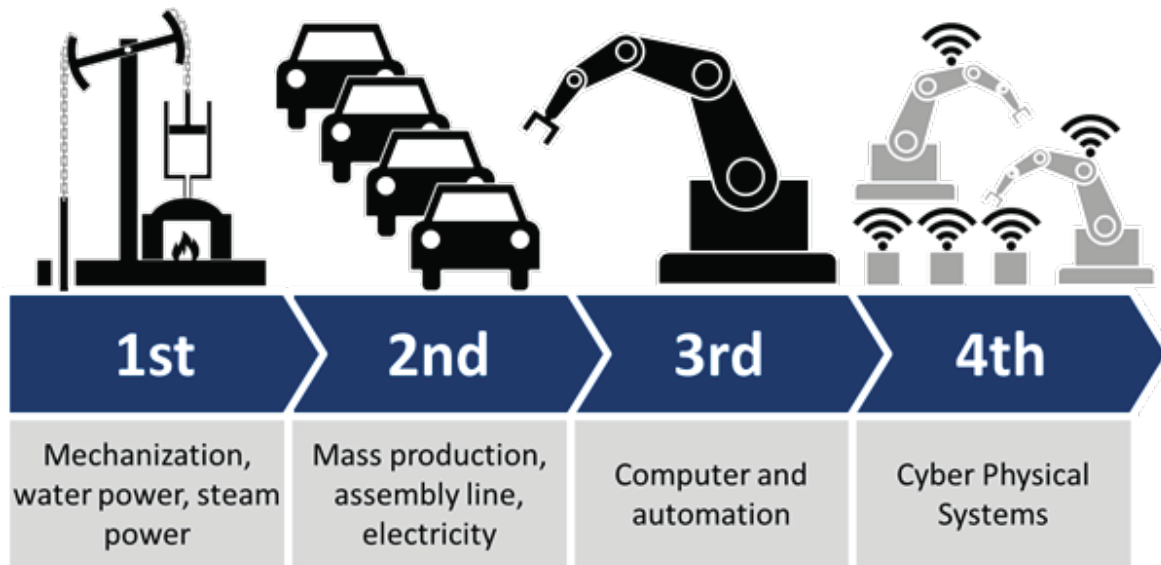


Figure 1: The four industrial revolutions (by Christoph Roser at AllAboutLean.com)

First Industrial Revolution

It began in the late 18th century, around 1760 to 1840 [9]. Several factors, including the development of new machinery, advancements in agriculture, and the growth of trade and commerce, led to the First Industrial Revolution. The steam engine was a notable innovation which powered industries and transportation. This revolution transformed an agrarian and handicraft economy into an industrial economy [11], leading to urbanisation. In 1500, only 7% of the English population resided in cities, whereas it became 50% in 1850 [12]. Although it brought about significant advancements and economic growth, it also brought challenges like social inequality and labour exploitation, particularly women and children receiving much lower wages than men. [13].13

Second Industrial Revolution

The Second Industrial Revolution, also known as the technological revolution, occurring from the mid-1800s to the early 1900s, marked a significant technological advancement with the introduction of electricity, the telephone, and the internal combustion engine [14]. These innovations revolutionised communication, transportation, and daily life, while manufacturing techniques like the assembly line facilitated mass production of goods, leading to improved accessibility and affordability [15]. Despite technological progress, the era was also characterised by harsh working conditions like long hours, low earnings [16], dangerous environments in factories and mines, and increased unemployment due to the replacement of jobs by machines [14].

Third Industrial Revolution

The Third Industrial Revolution, often called the digital revolution, began in the second part of the 20th century and continues to the present day. The emergence of digital technologies, such as the widespread use of computers, the birth of the internet, and the advent of automation, characterises this revolution. The rapid expansion of the Internet has facilitated unprecedented levels of worldwide communication and information exchange, with over 4.95 billion people as of 2022 [17]. E-commerce has transformed how goods and services are bought and sold and thus led to new economic models and opportunities.

Although these technologies increase productivity and efficiency, they also raise concerns about the possible loss of jobs due to automation, especially in sectors such as garments and furniture. Another critical problem is the digital divide brought on by unequal access to technology and the internet, exacerbating disparities in educational and employment opportunities [19]. Additionally, the rapid pace of technological change has posed regulatory and ethical challenges about the misuse of personal data and concerns about privacy.

Fourth Industrial Revolution

The Fourth Industrial Revolution (4IR) concept was introduced in 2016 by Klaus Schwab, the founder of the World Economic Forum [9]. According to Zvika Krieger, the World Economic Forum's head of technology policy and partnerships, the Fourth Industrial Revolution differs from the Third for two reasons: (1) the distance between the digital, physical, and biological worlds is decreasing, and (2) technology is evolving faster than ever [20]. For example, it took 75 years for 100 million people to access the telephone, whereas the gaming app "Pokemon Go" intrigued many users in less than one month in 2016.

4IR is characterised by the rapid integration of technologies such as artificial intelligence, advanced robotics, the Internet of things, 3D printing, quantum computing and other technologies [9], which are discussed below:

- Artificial Intelligence (AI) and Machine Learning (ML): AI refers to the simulation of human-like intelligence processes by computers and machines [21]. ML is a subset of AI that focuses on developing algorithms and techniques that enable computers to learn from and make predictions or decisions based on data. These technologies are used in predictive analytics, natural language processing, and autonomous systems and are revolutionising industries ranging from healthcare diagnostics to financial trading [22], [23]. For example, speech and text recognition are already used to communicate with patients and take clinical notes [24].
- Internet of Things (IoT): IoT refers to the network of interconnected devices embedded with sensors, software, and network connectivity, enabling them to collect and share data by communicating with each other. These devices range from everyday household items like smart thermostats and wearables to industrial machinery and infrastructure systems... It has numerous applications, including intelligent transportation, smart health care, smart home, etc. [25]. In business, IoT devices monitor parameters like temperature, humidity, air quality, energy, and machine performance, enabling real-time analysis to optimise operations and improve decision-making. Thus, IoT makes our world smarter and more connected by converting ordinary objects to smart objects with the ability to communicate and collaborate.
- Advanced robotics and collaboration: Robots enable humans to avoid monotonous, risky, or challenging tasks. Robots are now being deployed in manufacturing, healthcare, and agriculture. For instance, some hospitals are already using robot assistants [26]. Collaborative robots, also known as cobots, assist humans in dangerous or labour-intensive tasks, such as lifting or delivering large or hazardous commodities, while being supervised by humans [27].
- 3D printing: This process uses computer-aided design data to create a physical object through additive manufacturing [28]. It has many applications, including the automotive, biomedical, healthcare, and construction industries. It is used in healthcare products such as hearing aids, artificial ears, rehabilitation aids, artificial joints, and personalised dental implants [29].

- Virtual and Augmented Reality (VR/AR): VR creates a fully immersive digital environment that simulates the user's physical presence in a computer-generated world [30]. AR enhances the real-world environment by overlaying virtual computer-generated elements [31]. VR and AR have already been applied to various fields, such as military, manufacturing, medical, gaming, advertising, and entertainment [32].
- Quantum Computing: This cutting-edge technology harnesses the principles of quantum mechanics to perform computations in a fundamentally different way from traditional computers [33]. It can potentially revolutionise cryptography, optimisation, material science, drug discovery, etc. For instance, global shipping companies use quantum computers to optimise shipping routes, reducing fuel consumption and environmental impact [34].
- Biotechnology and Genetic Engineering: Modern biotechnology developed with genetic engineering and the sequencing of the human genome in 2001 [35]. In recent years, significant progress has been achieved in lowering the cost, increasing the ease of genetic sequencing, and more in activating or editing genes. A genome may now be sequenced in hours and for less than a thousand dollars [9]. With increased processing power, scientists no longer rely on trial and error; instead, they investigate how specific genetic mutations produce certain features and diseases.

Impact of 4IR on Employment

The Fourth can you portrait this healing “Impact a bit differently” Industrial Revolution (4IR) has brought about significant changes in the employment landscape, particularly in the context of SMEs. While 4IR technologies, such as automation, artificial intelligence, and the Internet of Things, have the potential to streamline operations and enhance productivity in SMEs, they also pose challenges to traditional employment patterns.

The current and next decade are expected to face significant challenges for employment worldwide. The World Economic Forum [52] forecasts that half of all employees worldwide will require reskilling by 2025. Along with many other countries, Bangladesh will also encounter significant challenges for future employment due to 4IR with automation.

According to the World Economic Forum [45], 75 million jobs will be displaced. At the same time, the report estimates that a possible 133 million new jobs will be created. A study by a2i project [53] suggests that 47% of employment in Bangladesh could be at risk by 2041. These also include several sectors of SMEs. Based on the collaborative research effort between the Government's a2i initiative and the International Labour Organization (ILO) [46], it is projected that by 2041, the Tourism and hospitality sector will witness a decline of 20% (6 lakh), the Leather Industry will experience a reduction of 35% (1 lakh), Agricultural Products will see a decrease of 40% (6 lakh), the Furniture Sector will encounter a decline of 55% (13.8 lakh), and the Garments Sector will be affected the most with a decline of 60% (27 lakh) due to automation. However, on the bright side, while the automation of 4IR could lead to the loss of 5.5 million jobs, the same technological revolution can also generate 10 million new jobs [52].

The Center for Policy Dialogue (CPD) [47] conducted a study in the Readymade Garment sector, revealing a 16% reduction in officer-level female workers. Female workers often lack the same knowledge about operating machines as their male counterparts, contributing to fewer women in managerial positions. Additionally, social, psychological, and cultural obstacles limit women's participation in skill development activities and contribute to such skill gaps, hindering their promotion opportunities. Women also face difficulties advancing to higher-paid, secure jobs due to domestic duties and inflexible work conditions.

The period between 2005 and 2012 saw a 4.01% increase in employment growth, while from 2012 to 2016, this growth rate decreased to 3.3%. According to the Policy Research Institute of Bangladesh (PRI) [48], there were 545 employed workers in 1990 for every million dollars in exports, but in 2016, this dwindled to 142 because of automation. It can worsen income inequality in society as high-skill, high-wage jobs grow while low-skill jobs decline. Inequality can increase among people, as not all sectors or workers may equally benefit from

technological advancements. Moreover, regions with solid technological infrastructure and innovation ecosystems may thrive while others lag, leading to geographic inequality. Continuous learning, upskilling, and adaptability will be crucial for employment as technological advancements rapidly change job requirements.

The 4IR is closely linked to the changes in employment discussed above. While automation and technological advancements due to 4IR can reduce the need for specific jobs, they also create new opportunities in emerging industries and roles. The overall impact on employment varies across different regions, sectors, and skill levels and is influenced by globalisation, demographic changes, and government policy. Balancing potential job losses with job creation and ensuring that workers have the necessary skills to transition into new roles are crucial challenges in the Fourth Industrial Revolution era.

In Bangladesh, approximately 30 percent of the workforce is engaged SMEs across various sectors, including Ready-Made Garments (RMG), Agriculture, Leather Industry, Furniture etc. Therefore, the impact of the 4IR on employment, as indicated by the statistics discussed earlier, is likely to be most significant in the SME sector.

To summarise, 4IR can lead to the displacement of certain low-skilled jobs within SMEs that can be replaced with automation, which may result in short-term job losses. However, 4IR will also create opportunities for SMEs to adapt to new roles in tech-related fields by upskilling their workforce. Additionally, the digital transformation by 4IR can open doors to global markets, potentially leading to job growth in areas such as e-commerce, digital marketing, and online customer support. Therefore, the impact of 4IR on employment in the SME sector is a complex interplay of challenges and opportunities, ultimately depending on the ability of SMEs to adapt and harness the full potential of these technologies.

Study Frame Work

This paper aims to analyse the impact of 4IR on SMEs study frame work, instead of methodology and employment in Bangladesh. For this purpose, a qualitative paper has been performed. It denotes the paper on the nature of phenomena in a non-numerical format, such as text, audio, or video [36], [37]. It helps to gather an in-depth understanding of a problem or generate new ideas for further research. This paper used a combination of primary and secondary data sources to ensure a thorough investigation. Primary data were collected from Key Informant Interviews and Focus Group Discussions to overcome the weaknesses of each single method [38]. Secondary data were collected from published reports, journals and websites. The collected data were examined using thematic analysis [39]. The overview of the methodology is shown in Figure 2.

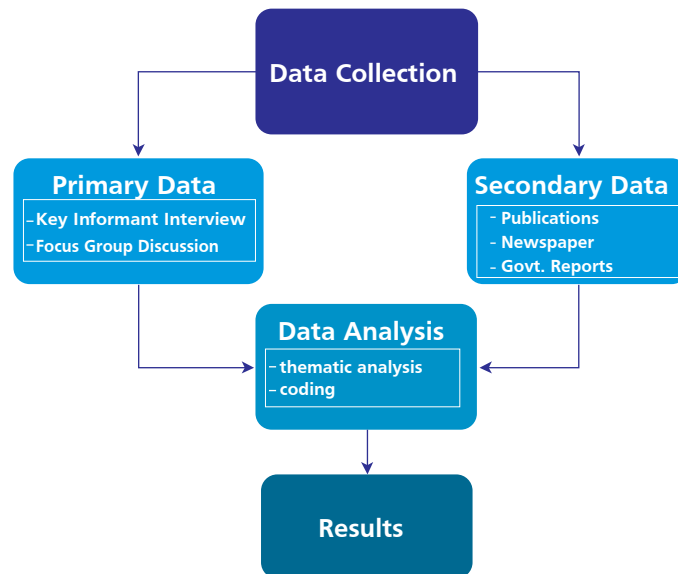


Figure 2: Overview of the study framework

Secondary Data Collection

Newspaper and magazine articles, journal and conference articles, government reports, and reports from other national and international organisations were reviewed to identify the existing benefits, challenges, and policies related to 4IR. Next, incorporating these factors, a questionnaire was prepared.

Primary Data Collection

For collecting primary data, both Key Informant Interviews and Focus Group Discussions were performed to complement each method [6]. In this phase, the following steps were executed:

- i. Designing sample: To collect data, major stakeholders of the SME industry were identified using prior literature. According to [40], SME owners, association representatives, and relevant representatives from national policymakers and government bodies were found to be the primary stakeholders.

SME Foundation provided the researchers with a list of SMEs based on the eleven booster sectors identified by the Ministry of Industries, Government of Bangladesh [41].

- 1) Electronics and Electrical
- 2) Software-development
- 3) Light engineering and metal-working
- 4) Agro-processing/ agro-business/plantation agriculture/ specialist farming/ tissue-culture
- 5) Leather-making and leather goods

- 6) Knitwear and ready-made garments
- 7) Plastics and other synthetics
- 8) Healthcare & diagnostics
- 9) Educational services
- 10) Pharmaceuticals/cosmetics/toiletries
- 11) Fashion-rich personal effects, wear and consumption goods

Next, the participants were randomly chosen from this list.

- ii. **Conducting Key Informant Interview:** Based on the questionnaire prepared in step 1, Key Informant Interviews were performed. Most of the interviews were conducted over the phone and recorded. The researchers also took notes during the interviews, which were later cross-checked with the recordings for accuracy. Based on the participants' responses, an updated questionnaire was prepared, which was used for Focus Group Discussion.
- iii. **Conducting Focus Group Discussion:** The Focus Group Discussion involved top management staff from various SME sectors randomly chosen from the SME Foundation list. The primary researcher conducted the session, which lasted around two and a half hours.

Data Analysis

After collecting data from primary and secondary sources, they were analysed using thematic analysis [7]. Initially, two researchers independently coded the transcripts of the Key Informant Interview and Focus Group Discussion [42]. They then discussed their results until they reached a consensus. Based on the analysis, opportunities and challenges of 4IR for SMEs were identified, and corresponding policy recommendations were made.

Result Analysis

In this paper, 16 individuals participated in the KII and FGD. Among them, 12 were SME owners, two were association representatives, and two were representatives from national policymakers and government bodies,

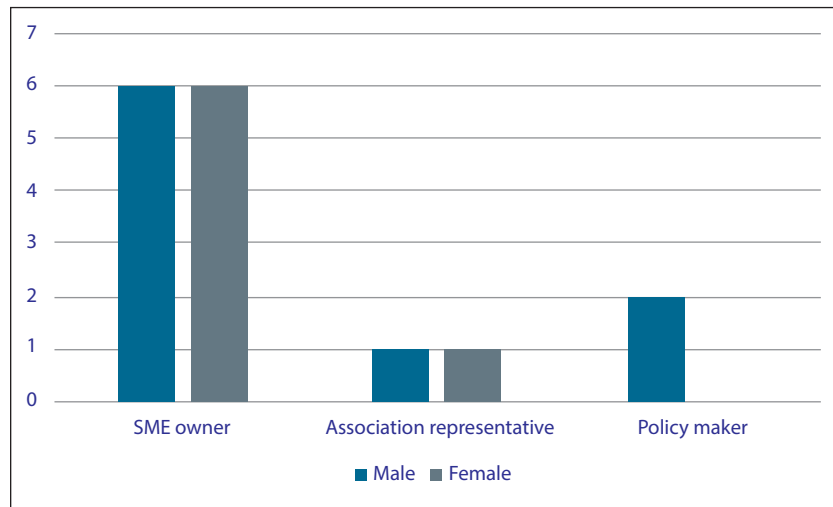


Figure 3: Details of the Participants

The study found that most respondents have a surface-level awareness of 4IR without a detailed understanding. Despite this, they consider 4IR to be a blessing. Although they have not yet fully embraced its potential, they are hopeful that it will provide them with several benefits:

- **Enhancing customer experience:** 4IR will better meet customer requirements and facilitate mass customisation of products. It will enable businesses to offer a more personalised, efficient, and quality-driven customer experience through advanced technologies. **Reducing production time and increasing profitability:** 4IR-related tools and technologies will automate workflows, minimising manual interventions. Thus, it will allow business entities to use their resources more effectively to reduce production time and increase profitability.
- **Improving product quality:** 4IR is anticipated to improve product quality through modern machinery and advanced tools for real-time product monitoring. These improvements will minimise defects and errors, resulting in high-quality products.
- **Data-driven insights:** 4IR will help SMEs collect and analyse data regarding market trends, customer preferences and operational performance. These data-driven insights will enable SMEs to make informed decisions, leading to strategic business improvements.

In the employment sector, participants believe that 4IR will bring significant changes that two main aspects can summarise:

- **Creating new job opportunities and business:** 4IR is characterised by rapidly advancing and integrating cutting-edge technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), blockchain, and 3D printing. These technologies enable the creation of innovative products, services, and business models that were previously unimaginable. According to a study by a2i [54], new occupations are expected to emerge in the prominent sectors of SMEs, such as RMG and Textile, Furniture, Agro-food Processing, Leather and Tourism. For example, sectors like RMG and Textile manufacturing and furniture in Bangladesh, where low-skilled labour is predominant, are expected to face significant job losses due to automation. This will create new job opportunities with a greater demand for skilled and

semi-skilled workers. Bangladesh can win in these sectors if adequate measures are taken to upgrade skills and embrace new technologies. This finding aligns with the World Economic Forum's predictions, suggesting around 133 million new jobs will be created due to technological advancement [43].

- **Increasing worker productivity:** 4IR has the potential to significantly enhance worker productivity through the adoption of advanced technologies, automation, and the optimisation of work processes. 4IR technologies, such as robotics and advanced automation systems, can take over repetitive tasks, enabling employees to focus on more value-added activities that require creativity and critical thinking, thus increasing overall productivity.

Respondents believe that employees will not lose their jobs due to 4IR; their roles may transform. Owners predominantly receive positive feedback from the employees regarding 4IR, noting their interest in learning new skills to enhance their salary or other benefits. While adaptation may require time among workers, owners acknowledge their responsibility to prepare their workers.

Despite the overall positive statement towards 4IR, only one of the SME owners currently utilises 4IR-related tools and technologies such as ChatGPT and Copilot- in their organisation. This disparity is attributed to several challenges:

- **Lack of knowledge:** Many SME owners lack knowledge of existing 4IR tools and technologies and how to integrate them into their companies/businesses. For example, one SME owner had trouble marketing her products due to her ignorance of available tools. Besides, some SME owners have a misconception that such 4IR-related tools and technologies are only necessary for large organisations.
- **Financial issues:** 4IR-related tools and technologies are often expensive, posing financial challenges for SMEs. While one of the policymakers mentions the availability of loans, SME owners express frustration over their difficulty accessing them.
- **Lack of proper training:** Some SME owners cite a lack of training opportunities or workshops related to 4IR as a barrier. Others pointed out that though the government is organising skill development training, those are perceived as inadequate due to substandard trainers' knowledge and budget constraints.
- **Safety and security-related issues:** SME owners are also concerned about the safety and security implications of adopting 4IR technologies. For example, one owner fears plagiarism, which hinders the adoption of modern technology.
- **Infrastructure limitations:** Many participants highlight insufficient infrastructure, particularly internet availability and speed, as a barrier to effectively utilising 4IR technologies.
- **Information accessibility:** A dedicated platform for SMEs to exchange information is lacking, hindering their ability to access assistance or guidance. Despite their interest, employees do not know whom to contact for help. Furthermore, although workers are interested in learning modern tools and technologies, they struggle to find suitable resources.

Several steps have already been initiated to address these challenges the SMEs face, such as establishing one-stop digital service centres [44]. However, respondents suggest additional measures for further improvement. The following steps can be taken in adapting to the 4IR:

- **Thorough analysis of current situation:** Before moving towards 4IR adoption, it is essential to comprehensively analysis the current situation of SMEs. The study should identify sectors that require special attention.

- **Creation of a platform for SMEs:** A platform can be created where SMEs can share information, report their problems, and get suggestions, which can be beneficial. This platform could facilitate finding suitable markets for their products and obtaining guidance on promoting their products or strategies.
- **Organising training and workshops:** Comprehensive training and workshops are crucial to preparing the SMEs for utilising 4IR. These sessions should provide theoretical and hands-on experience with 4IR-related tools and technologies. Therefore, quality training and workshops need to be organised, and arrangements should be made for follow-ups to verify their implications.
- **Provision for sharing tools:** Modern machinery and tools can sometimes be expensive. The platform created for SMEs could facilitate collaborative arrangements for tool sharing, such as grouping similar SMEs, enabling them to share resources and tools and reduce costs.
- **Attracting foreign clients:** The government and industry associations should undertake steps to help SMEs attract foreign clients and local clients, thereby expanding market technologies.
- **Development of indigenous tools and technologies:** Bangladesh should invest in creating its own tools and technologies to reduce dependence on imported machinery and maintain lower costs.
- **Raising nationwide awareness:** Since 4IR will impact everyone—SME owners, workers, clients, and associations—a nationwide awareness campaign is needed. This campaign should highlight the benefits of 4IR adoption and provide strategies for overcoming associated challenges.

Based on the results from this preliminary study, a further detailed study and large-scale data collection is needed. Participants expressed concern about adequate training and workshops on 4IR, indicating that capacity building in this sector is necessary to support them. Many participants expressed their inability to adopt ICT in the SME sector without cooperation from the policy level; a shared resource platform can play an essential role in this case. The national policy needs to provide this support regarding finance or resource needs.

The government should create policies, ensure they are effectively implemented, and monitor their implementation. Moreover, the policy must continue even when there are changes in administration.

Finally, the government, associations and academicians must collaborate to ensure that 4IR benefits SMEs.

Conclusion

The study investigates the opportunities and challenges Final Insights presented by the Fourth Industrial Revolution (4IR) for small and medium-sized enterprises (SMEs). Through the interviews and discussions with SME owners, association representatives, and policymakers, the research reveals that while most respondents have a basic 4IR, they lack a detailed understanding of its implications for SMEs. The potential benefits of 4IR include enhancing customer experience, reducing production time, improving product quality, and enabling data-driven decision-making. Additionally, the study paper promises to create new job opportunities and boost worker productivity.

Despite these advantages, the study identifies several barriers that could prevent SMEs from fully embracing and utilising 4IR technologies. These challenges include a lack of knowledge, financial constraints, inadequate training, safety and security concerns, inadequate infrastructure, and a lack of information-sharing platforms. To overcome these challenges, the study recommends various measures, such as analysing SMEs' current situation, creating a platform for information sharing, organising training sessions and workshops, and fostering domestic technology development.

Finally, the successful integration of 4IR technologies into SME operations necessitates a collaborative effort involving government bodies, industry associations, academia, and Civil Society Organisations (CSOs). This also underscores the importance of raising nationwide awareness about the implications of 4IR, ensuring effective policy implementation, and maintaining continuous policy monitoring and adjustment.

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Quantum Computing

AR

Genetic Engineering

Digitalisation

Biotechnology

VR

IoT

Machine Learning

Robots

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