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Abstract

The world is going through the phase of fourth industrial revolution (4IR). It is changing the nature of work and services in various sectors. Technology is also playing an important role in Bangladesh's development. However, technology disrupts the labour market in terms of displacing workers. A number of sectors are already experiencing this phenomenon. The information technology (IT) services industry has embraced artificial intelligence (AI) more than any other sectors. Over the last few years, Bangladesh has seen tremendous growth and prosperity in IT services industry. This paper examined the 4IR's penetration and impact on the workforce in the IT services sector in Bangladesh. The study discusses some of the challenges that Bangladesh's IT sector faces at present. Emerging automation is deemed as a threat to its human counterpart, especially to the older workers in the IT sector of Bangladesh. Employees are afraid of moving out of their comfort zones and learning about upcoming technologies that would boost their cross-skills. Moreover, employers often do not spend time and resources on re-skilling the employees. Hence, a number of coordinated efforts from the employers, the employees and the government are essential to address the challenges and disruptions posed to the prospects of the IT services sector.

Artificial Intelligence and Its Impact on Information Technology (IT) Service Sector in Bangladesh

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Acronyms

4IR	Fourth Industrial Revolution
ADM	Application Development Maintenance
AI	Artificial Intelligence
BDT	Bangladeshi Taka
BPO	Business Process Outsourcing
CAGR	Compound Annual Growth Rate
CSE	Computer Science Engineering
EGM	Expert Group Meeting
GDP	Gross Domestic Product
GoB	Government of Bangladesh
ICT	Information and Communications Technology
IoT	Internet-of-Things
ISP	Internet Service Provider
IT	Information Technology
IT-es	IT-Enabled Services
ITU	International Telecommunication Union
ML	Machine Learning
NGO	Non-Government Organisation
ODC	Offshore Development Centre
RPA	Robotic Process Automation
UK	United Kingdom
USA	United States of America
USD	United States Dollar
UNDP	United Nations Development Programme
WDI	World Development Indicator

1. Introduction and Objectives

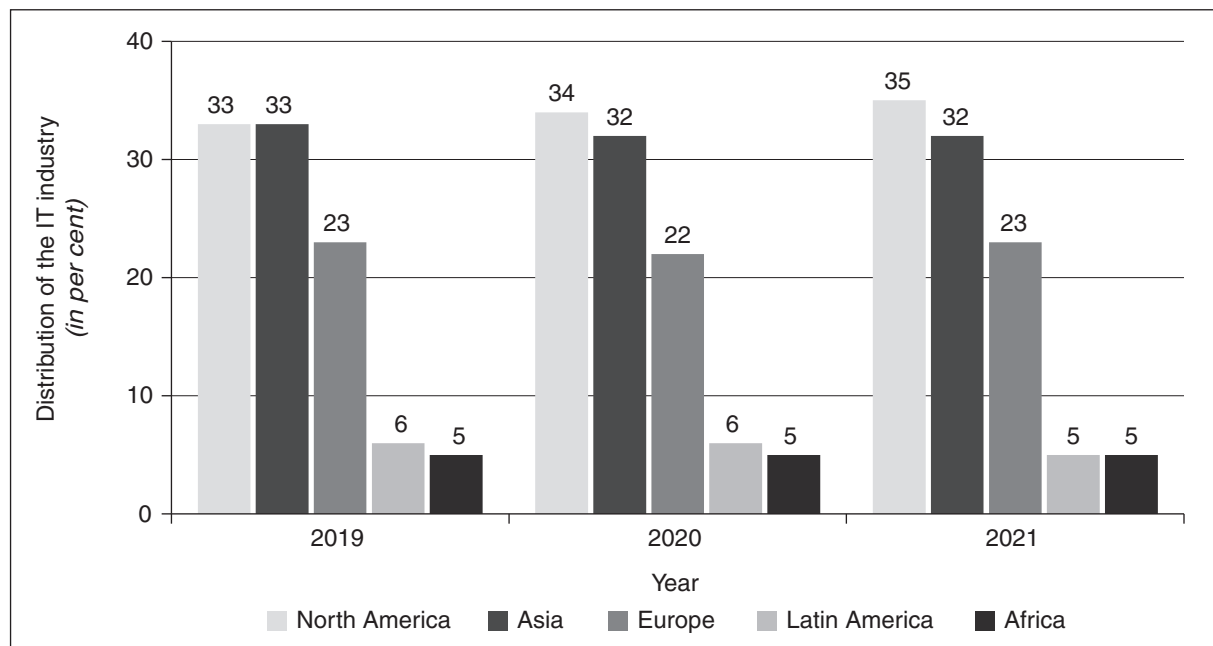
The world is going through the phase of the Fourth Industrial Revolution (4IR). It is changing the nature of work and services in various sectors. Technology is also playing a key role in Bangladesh’s development. However, technology disrupts the labour market in terms of displacing workers. A number of sectors are already experiencing this phenomenon. Albeit the information technology (IT) services sector has made tremendous strides and optimised working style globally, the industry has not been immune to challenges. Among the growing challenges are economic uncertainty, data privacy and security concerns, skill mismatches, legislative implications, market fragmentation, retention strategies for labour force, turnover, escalating remuneration, and technological infrastructure, to name a few.

By 2021, the worldwide IT business will be worth around USD 5 trillion. Asia, at 32 per cent (Figure 1), is also anticipated to make a sizeable contribution to the global IT industry (Statista, 2021a). Looking ahead, the global sector is forecasted to continue growing at a 5 per cent compound annual growth rate (CAGR) till 2024 (Statista, 2021a).

Over the years, the IT services sector has witnessed significant digitalisation. The IT service sector has embraced 4IR more than any other sector. Enterprises in the sector focus on deploying advanced technologies such as artificial intelligence (AI), blockchain, cloud computing, robotic process automation (RPA), big data, conversational services, and machine learning (ML)—the outcomes of the 4IR—to enhance productivity and improve customer experience (Schwab, 2017). The shift from traditional analytics to new-age technology-based solutions enables companies to implement intelligent solutions and enhance service delivery (Xu, David & Kim, 2018).

Currently, due to its remarkable potential, automation is widely used in myriads of sectors including telecommunications, banking, pharmaceuticals, and readymade garments (RMG). The IT industry is expanding at a fast pace with time, and the 4IR is penetrating the sector. Stakeholders at the regional and national level are getting more involved in this industry, with service offerings generally ranging from transactional IT-Application Development Maintenance (ADM) and IT help desk to niche services such as big data analytics, the Internet-of-things (IoT), 3D image

Figure 1: Global Distribution of the IT Industry by Region from 2019 to 2021



Source: Statista, 2021a.

processing, and the other components evolved from the 4IR (Jain & Gupta, 2017).

This report aims to analyse the penetration and consequent implications of the 4IR for the IT service sector in Bangladesh. To be more precise, the objectives of this paper are: (i) to understand the 4IR technologies' entry into Bangladesh's IT services industry; (ii) to analyse the implications of 4IR for employment, particularly in the IT services sector in Bangladesh; (iii) to review the existing policies and initiatives taken by the government to address the needs of IT services sector; and (iv) to suggest measures for preparing the workforce for employment in the IT services sector.

The present study uses both qualitative and quantitative data to fulfil the objectives. Data have been collected from both secondary and primary sources. Reports, journals and databases published by national and international organisations were used for secondary information analysis. This includes International Telecommunication Union (ITU) database to collect and analyse the use of and access to technology in Bangladesh. World Development Indicator (WDI) and Human Development Reports of United Nations Development Programme (UNDP) were also used. For the primary data collection, an expert group meeting (EGM) was organised in order to gather necessary information from the experts. The discussion was attended by national experts, private sector representatives, and academics. Subsequently, a detailed analysis has been executed using EGM outputs and existing data.

2. Conceptual Issues

The 4IR that has been shaping since the late 20th century builds upon the third revolution and digital innovation (Raihan, 2019). The speed and magnitude of the 4IR cannot be underestimated, as it now encompasses computer-generated 3D printing which can construct solid objects by layering successive materials (Xu et al., 2018). In comparison to the previous revolutions, the spectrum of the 4IR is multifold, and the impacts are widespread covering nearly every industry

across all countries (Xu et al., 2018). And their range and depth presage the revolution of entire supply chain, administrative and institutional mechanisms (Schwab, 2016).

The 4IR is a notion that defines everything in the IT services sector (Sun, 2018). The following table (Table 1) illustrates a summary of various components of 4IR along with their implications for IT services sector. Not only 4IR has altered traditional computing methods, but it has also penetrated other industries, substantially transforming them (Kim, 2018). As the world has become more digitised and all sectors are significantly developing, IT businesses need to keep pace with the growing process by introducing and increasing innovation (World Economic Forum, 2016).

What actually differentiates 4IR technologies is the inventive way in which hardware, software and connectivity are reconfigured and combined to accomplish ever-higher goals: the collection and analysis of huge amount of data, the continuous interaction of AI, and the blurring of the physical and virtual components of output (Philbeck & Davis, 2018). The 4IR technologies are being adopted across a range of sectors, including manufacturing, aerospace and defence (Lavopa & Delera, 2021).

The IT services sector comprises businesses which provide IT consultation or information processing services to other businesses (Miller, 2019); and the IT-enabled services (IT-es) industry is a component of the IT service sector (UNCTAD, 2015). The IT-es industry encompasses all operations that leverage the opportunities of IT to increase an organisation's productivity; it is often referred to as web-enabled services or remote services (Khan, 2021; Center for Project Management and Information System, 2019). The emphasis of this IT services industry is on IT goods and services, with a lesser importance placed on IT-es. However, IT-es play a significant role in achieving the objective of re-skilling the labour force. As a result, IT-es are crucial for achieving the national aspiration of increasing the share of IT sectors in gross domestic product (GDP).

Table 1: Summary Table—Components of 4IR and their Implications for IT Services Sector

Technologies: Definitions	Implications for IT Services Sector
<p><i>“Artificial Intelligence (AI) is the computer emulation of human intelligence processes. Machine intelligence is often referred to as artificial intelligence or intelligence displayed by machines” (Pillai & Sivathanu, 2020).</i></p>	<ul style="list-style-type: none"> • Industry 4.0 is projected to be enabled by AI solutions, along with other enablers like industrial IoT devices and platforms. • People anticipate their relationships with digital assistants to go beyond simple convenience to important duties like teacher or adviser. • ML, virtual personal assistants, decision support systems, automated data analysers, and others are seen as having a strong influence on organisations in the future.
<p><i>“Big data is a massive collection of structured or unstructured data, and its analysis reveals insights that result in enhanced judgments and smart business actions, thereby capitalizing on big data.” (Hurwitz, Nugent, Halper & Kaufman, 2013).</i></p>	<ul style="list-style-type: none"> • Data manipulation from smartphones and linked items is enabling new service options and lowering IT costs. • Intuitive consumer intent detection is made possible by big data, a technology that spans technology, apps and processes.
<p><i>“The Internet of Things (IoT) is the notion of linking any device with an on/off switch to the Internet so that users may interact with and monitor and manage these items remotely.” (Brown, 2016).</i></p>	<ul style="list-style-type: none"> • Combined with automation, IoT has the ability to scale the economy, but at the cost of reduced labour, which can lead to higher national unemployment. • Although it will open up new job opportunities, the country’s existing graduate and professional market may not be ready to adapt to the new business environment and skills required for new roles.
<p><i>“Cloud computing is an emerging model for offering on-demand cloud infrastructure in which consumers can avoid the initial complexity and costs of having their own equipment by paying only for what they need.” (Lin, Fu, Zhu & Dasmalchi, 2009).</i></p>	<ul style="list-style-type: none"> • The most significant benefit of cloud services for IT services industry is cost reduction. • IT services systems must evolve to meet changing demands. On-premise infrastructure expansion requires significant costs, forcing organisations to utilise inefficient technologies. Cloud services offer dynamic scalability. • Cloud services help IT services firms combine and acquire. Unlike traditional systems, they allow for simple application integration.
<p><i>“Robotic Process Automation (RPA) is a pre-set software instance that utilizes business rules and established activity choreography to automate the execution of a wide range of processes, operations, payments, and responsibilities in one or more unconnected software applications” (Motiani & Kulkarni, 2018).</i></p>	<ul style="list-style-type: none"> • RPA is slowly infiltrating industries to undertake outsourced labour. This method ensures cost, competence, and way in all business operations and industrial industries. • It creates high value while conserving money and speeding up the time to value.
<p><i>“Blockchain technology has served as the foundation for a new sort of internet to emerge, Due to the fact that it allows digital information to be distributed but not replicated” (Ferdous, Sultana, Reza & Ahmed, n.d.).</i></p>	<ul style="list-style-type: none"> • Information about related assets can be transmitted to or from the new owner in order to facilitate possible actions. • Increases commercial transparency to reduce delays in commerce. • Internal systems that are fragmented are centralised, allowing greater interconnectivity.

Source: Compiled from Hurwitz, Nugent, Halper & Kaufman (2013); Brown (2016); Lin, Fu, Zhu, & Dasmalchi (2009); Motiani & Kulkarni (2018); Ferdous, Sultana, Reza, & Ahmed (n.d.); Pillai & Sivathanu (2020).

3. Overview: IT Services Sector in Bangladesh

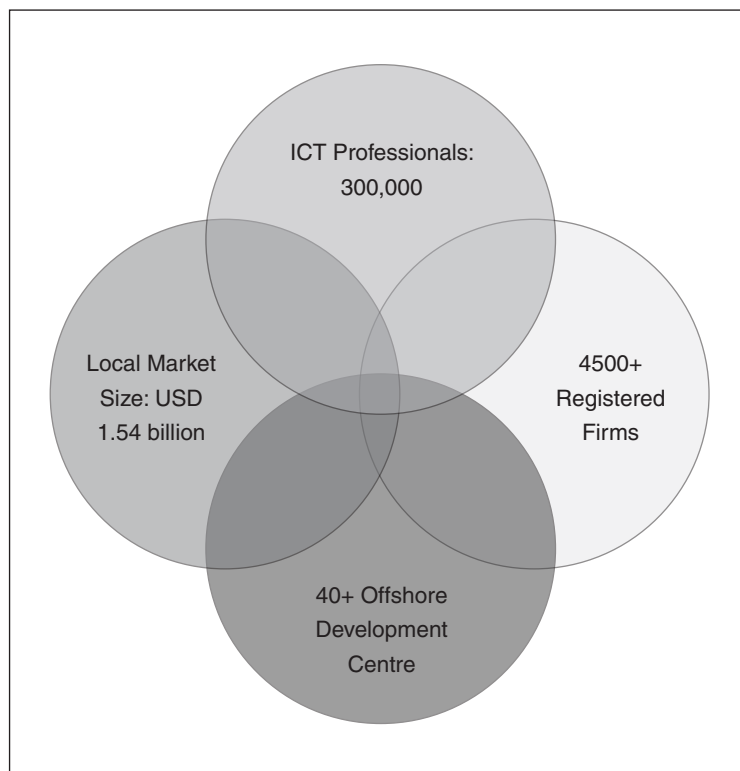
Bangladesh has recognised IT as a ‘prospective sector’ as it addresses the potential for a number of development strands—effective advancement, creation of new jobs, development and improvement of the industry, and high overflow impacts in different areas including administration (BASIS, 2021). The IT sector in Bangladesh can be categorised into software, internet service provider (ISP), telecommunications, call centres, and hardware sectors. Excluding telecommunications and hardware, the market size of the IT sector is now about USD 1.54 billion in Bangladesh (Figure 2), of which export earning is worth about USD 1 billion (BASIS, 2021).

While specific figures determining Bangladesh’s IT service industry revenue earnings are difficult to access, the amount of USD 1–2 billion is less than 1 per cent of GDP and significantly less than USD 30.6 billion in RMG exports FY2017–18 (ADB, 2019).

Though relatively small in size, the IT sector in Bangladesh is observing an increasing number of exports. From a minimal amount of USD 700 million in FY2015–16 (Figure 3), the sector increased its exports to USD 800 million in FY2016–17. However, between FY2016–17 and FY2018–19, the growth rate in exports in this sector has remained flat for some time.

As the demand for local IT-es has grown, Bangladeshi software enterprises have expanded their footprint in the global market. Bangladesh has had tremendous growth in terms of information and communications technology (ICT) export in recent years, indicating a rapidly rising trend in ICT export.

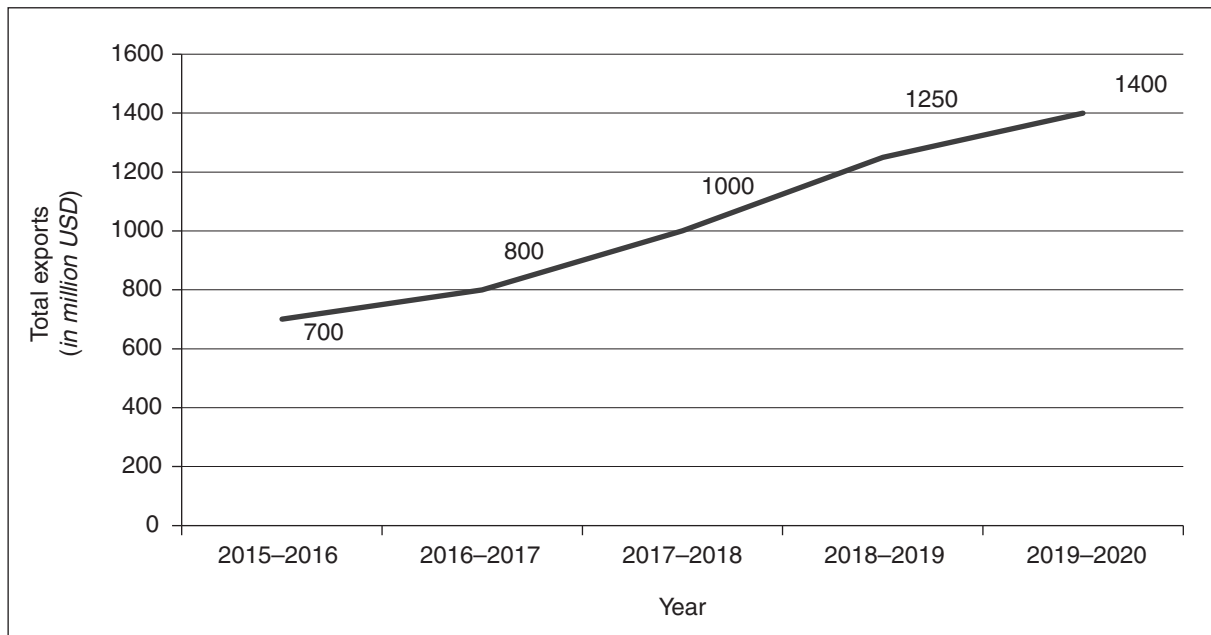
Figure 2: Bangladesh's IT Sector in 2021—A Snapshot



Source: BASIS, 2021.

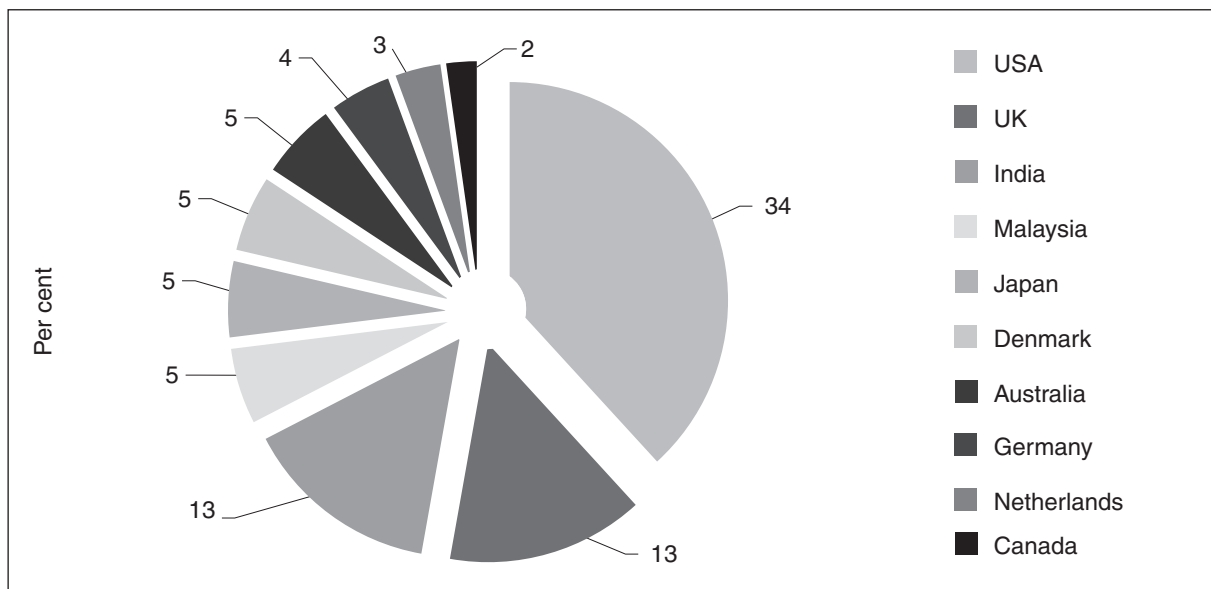
According to BASIS (2021), local software enterprises are rapidly expanding, with annual export revenues roughly amounting to USD 1.3 billion from IT services, with local businesses contributing to the 75 per cent of the total while foreign firms contributing to the 25 per cent. The United States of America (USA) is one of the major export destinations with 34 per cent of the total export (Figure 4). In addition, Bangladesh’s IT sector is currently expanding its reach to other areas including the United Kingdom (UK), Denmark, and the African countries.

Figure 3: Bangladesh IT Sector Export Trend over Last Five Years



Source: BASIS, 2021.

Figure 4: Major Bangladesh IT Sector Export Destination 2020



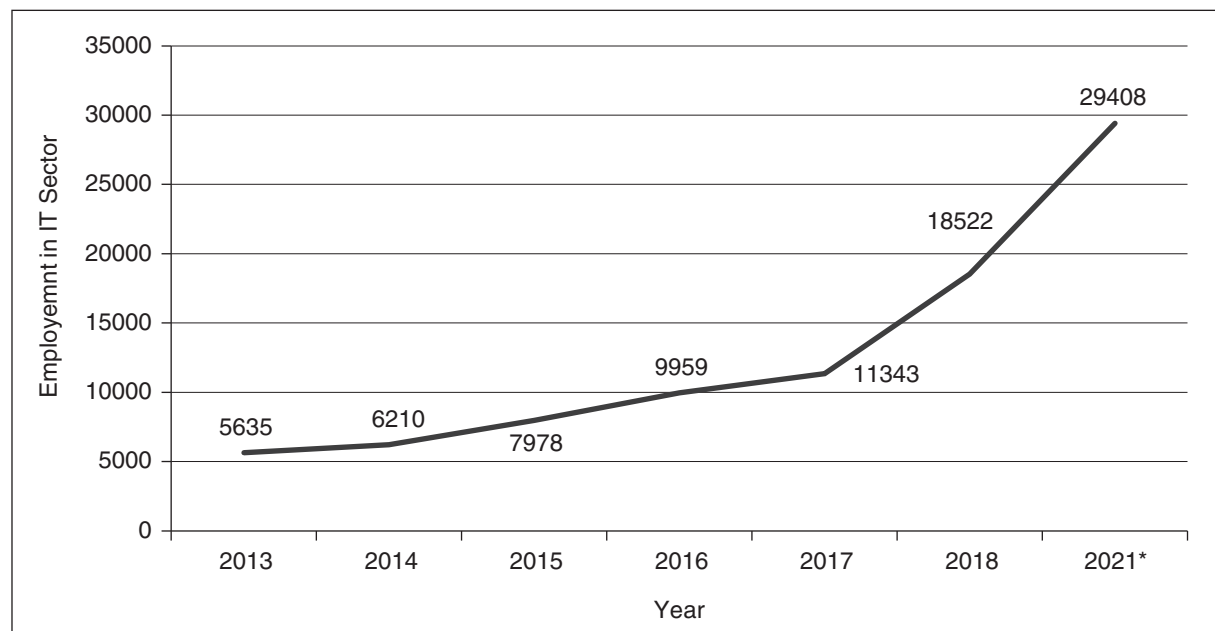
Source: BASIS, 2021.

4. Workforce in IT Services Sector of Bangladesh

At present, more than 4500 software and IT organisations are enlisted in Bangladesh. These organisations utilise more than 3,00,000 onshore

or domestic IT experts (BASIS, 2021). Over 40 companies, among the exporters, are established through joint venture with an overseas company or as an offshore development centre (ODC) by 100 per cent foreign capital (BASIS, 2021).

Figure 5: Trend of Employment in the IT Services Sector 2019 in Bangladesh



Source: PMIS, 2019.

Note: *Shows predicted value.

The sector currently employs about 0.22 million IT professionals (Figure 5), of which 35,000 belong to software industries, 30,000 belong to freelance software service, and 50,000 belong to IT jobs in different non-government organisations (NGOs) and other sectors (Hossain, 2018). According to a survey, the number of employees in the IT services industry has consistently increased throughout the years. Employment forecasts for 2021 are significantly higher than recent steady improvement (PMIS, 2019).

According to the current employment distribution of IT professionals based on job classification, most IT experts in a typical programming firm are either developers or computer programmers—about 60 per cent (Hossain, 2018). The majority of call centres and re-evaluating firms use Business Process Outsourcing (BPO) administrators or professionals, with just around 15 per cent of their employees working with board courses and other specialised areas of expertise (Khan & Pradhan, 2018).

Bangladesh now accredits academic qualifications in ICT disciplines at over 100 institutions, including

universities, colleges, and institutes. Bangladesh presently produces over 10,000 IT graduates each year from more than 95 universities and 200 polytechnic or technical colleges (Hossain, 2018). Additionally, there are approximately 300 training/education programmes that provide IT technologies and techniques, hence contributing to the development of human resources for Bangladesh's IT services businesses. Bangladesh has 73 institutions, according to the Ministry of Education (MoE, 2019), and more than 60 universities provide IT related courses. Each year, these universities, colleges and institutes produce more than 6,000 graduates with degrees in IT related subjects. Around 2,500 of them are computer science or software engineering majors.

Despite the increasing numbers of IT graduates as well as employees, the IT industry seems to fall behind in terms of gender equality in the business. Based on the gender-aware analyses of current representatives in different sub-sectors of ICT, except call centres, the proportion of female employees in most occupational classes is less than 20 per cent (Rahman & Islam, 2013; Hossain, 2018). According to a survey, women

participated in Computer Science and Engineering (CSE) programmes at a rate of around 21.5 per cent between 2013 and 2018, whereas female graduates secured jobs at a rate of 58.6 per cent, the growth being 23.6 per cent lower than male graduates (ADB, 2019).

5. Opportunities and Challenges Due to the Emergence of 4IR in IT Services Sector

5.1 Opportunities

To reap the long-term benefits of 4IR, Bangladesh must focus on the labour force, particularly on the younger group. Bangladesh's demographics can provide a consistent supply of resources at extremely cheap prices (KMPG, 2012). In 2020, Bangladesh's labour force participation rate was reported to be 55.7 per cent (ILO, 2020). In 2019, around 67.61 per cent of Bangladesh's entire population was between the ages of 14 and 64 (Statista, 2021b). This group of individuals can acquire skills and knowledge in IT by: (i) getting enrolled in universities, colleges, institutions, and training centre that offer IT courses, and (ii) through various on-the-job trainings at their workplace.

Furthermore, the ICT sector employs barely 0.3 per cent of Bangladesh's labour force (BBS, 2018). At a juncture when the country's IT services industry is rapidly expanding, it is expected that the country's economy would expand accordingly with the help of its labour force.

The majority of Bangladesh's educated population can read and speak English fluently. For some ICT sub-sectors, such as call centres and e-commerce,

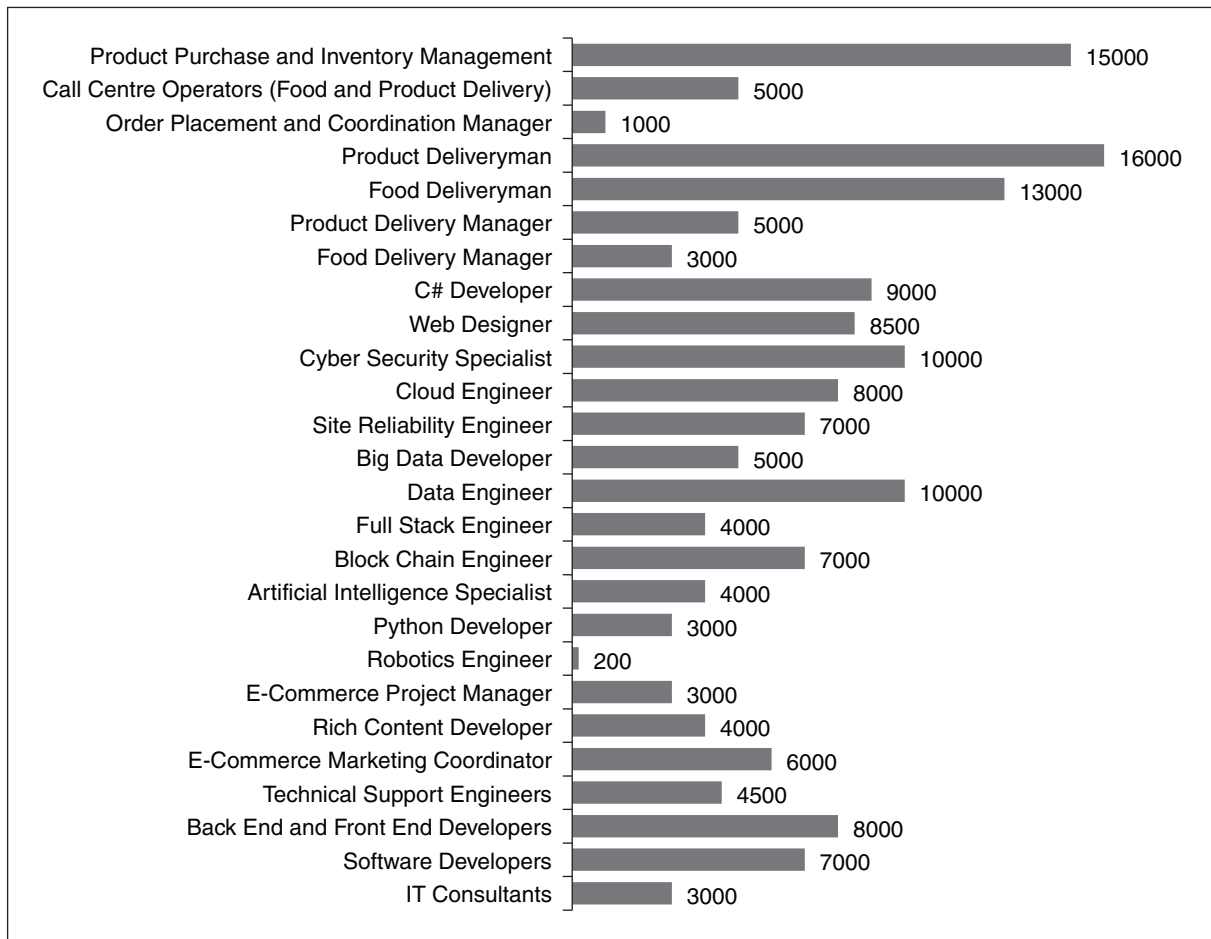
highly experienced computer programmers and ICT graduates are not required, and the level of their proficiency in English and computer-related knowledge is adequate for relevant occupations (Raihan, Lemma, Khondker & Ferdous, 2017). Bangladesh currently has more English-speaking residents than its Latin American and East European competitors, with more than 7 million (KMPG, 2012). And this skill is further helpful and instrumental in the preparedness for 4IR interventions.

Due to the increasing demand for IT services, firms in Bangladesh are recruiting additional IT consultants, software developers, backend developers, front end developers, and technical support engineers. It has been estimated that another 10,000 new jobs in the IT and tech companies across Bangladesh would be created by the end of 2020 (Figure 6) as firms have been investing in moving towards digitalisation of many services in response to the work-from-home arrangements (a2i, 2020).

However, the automation of manufacturing industries will open horizons for jobs with new dimensions requiring cognitive abilities, technical skills, complex problem solving, resource management skills, content, process, and social skills (Bhuiyan et al., 2020).

Around 10,000 ICT-related graduates are produced each year (Hossain, 2018), which exceeds the industry demand of roughly 5,000 graduates per year. Nonetheless, the IT services business has struggled to locate quality graduates (Mamun-Ur-Rashid & Rahman, 2017). Capacity development of IT universities and institutes in order to produce more qualified IT graduates might be one strategy for further strengthening this service sector.

Figure 6: Jobs to Be Created by the End of Year 2020



Source: a2i, 2020.

5.2 Challenges

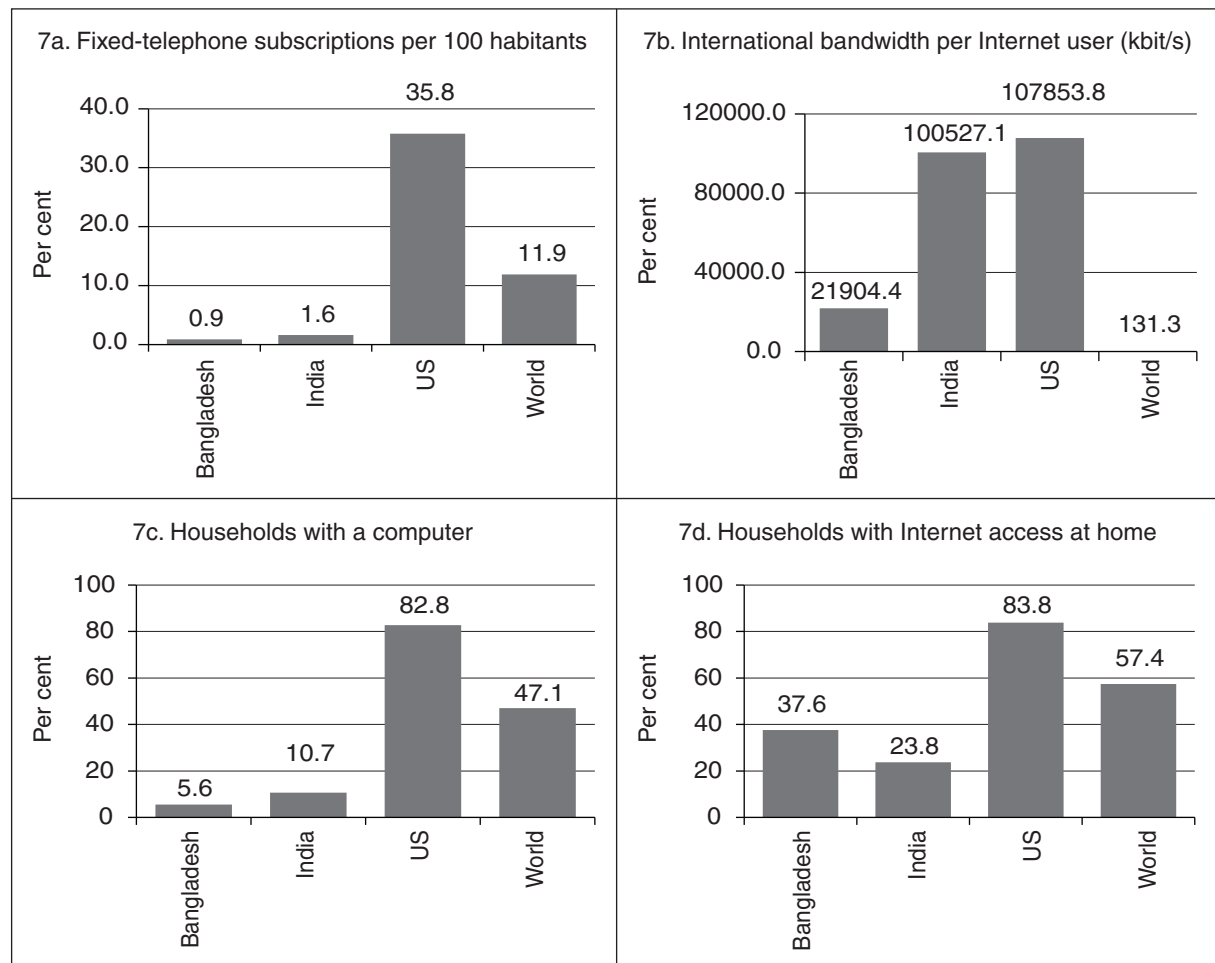
Throughout the third industrial revolution, humans were inextricably linked to machine intelligence in order to automate (Kim, 2018). On the other hand, the 4IR calls for a scenario where computers and machines will converse freely using various technologies such as cloud computing, AI, and ML. In view of this, the 4IR's most important concerns are the changing role of humans and the possibility of job losses. The public are afraid that machines will progressively be able to substitute humans, particularly in unique and specialised industries, making human jobs obsolete.

Industrial revolution 4.0 or 4IR may result in an unparalleled wave of technological, organisational,

and interpersonal breakthroughs, posing a question to individuals' and institutions' adaptive capabilities in the face of risks to individual consciousness, societal cohesion, and financial prosperity (Schwab, 2017). Bangladesh still lags behind in terms of several indicators essential for the 4IR, especially in terms of infrastructure, access to technology and skills. When compared to a developing and developed country, Bangladesh ICT development indicators seem to lag behind in a number of respects.

ITU (2021) found that Bangladesh has 0.9 fixed telephone subscriptions per 100 habitants in 2019, whereas India has 1.6 in 2018 and the USA has 35.8 fixed telephone subscriptions (Figure 7a) per 100 habitants in 2017. The data also shows that,

Figure 7: Access to Technology



Source: Compiled from ITU (2020) and ITU (2021).

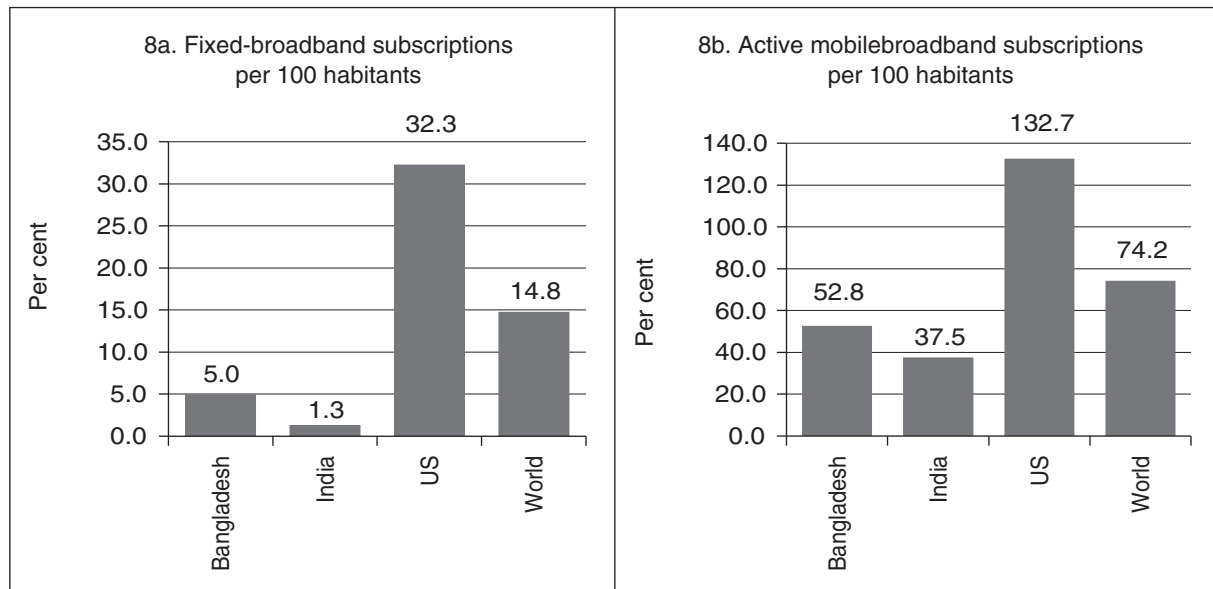
Note: 2019 data for Bangladesh and World and 2017 and 2018 data for USA and India, respectively.

in Bangladesh, only 5.6 per cent (Figure 7c) of the households own a computer in 2019. On the other hand, 10.7 per cent of the households in India in 2018 and 82.8 per cent of the households in the USA in 2017 own a computer. However, 37.6 per cent of the households in Bangladesh have internet access at home in 2019 which is higher than that in India where only 23.8 per cent of the households (Figure 7d) have internet access at home in 2018. Despite having higher proportion of households with internet access, the international bandwidth per internet user in Bangladesh is only 21904.4 kbit/s in 2019 which is very low compared to India—100527.1 kbit/s in 2018 (Figure 7b).

The use of technology in Bangladesh is comparatively higher than that in India. Bangladesh had five fixed broadband subscriptions per (Figure 8a) 100 habitants in 2019 whereas, India had only 1.3 per 100 habitants in 2018. Similarly, Bangladesh had 52.8 active mobile broadband subscriptions per 100 inhabitants in 2019, whereas India had only 37.5 per 100 inhabitants in 2018 (Figure 8b).

Bangladesh is at a neck-on-neck position with India in terms of technological skills. Figures 9a, 9b and 9c show that, the mean years of schooling of Bangladesh are pretty close to India, that is, 6.2 years in Bangladesh and 6.5 years in India in 2019

Figure 8: Use of Technology



Source: Compilation of ITU (2020) and ITU (2021).

Note: 2019 data for Bangladesh and World and 2017 and 2018 data for the USA and India, respectively.

and 2018 respectively. Similarly, Bangladesh's percentage of gross secondary enrolment is close to India's—72.6 per cent in Bangladesh for 2019 and 74.4 per cent in India for 2018. Moreover, there is 24 per cent tertiary, gross enrollment in Bangladesh in 2019, which is a tad slower than in India. Compared to a developed country such as the USA, Bangladesh has to cover a considerable gap and has to go a long way to adapt 4IR completely. As human roles are being replaced by new technological innovations such as AI, RPA and the IoT, and different jobs are becoming redundant or obsolete due to the emergence of automation, qualification requirements for new jobs will become more stringent, and new skills and experience will be obligated (Schwab, 2017). Because of this, on-the-job training is necessary for both newly hired staff and existing staff. However, studies show that 25 per cent of the employees receive the training from company's own training institutes (Hossain, 2018). So, it is obvious that upskilling and re-skilling are more or less absent in the industry.

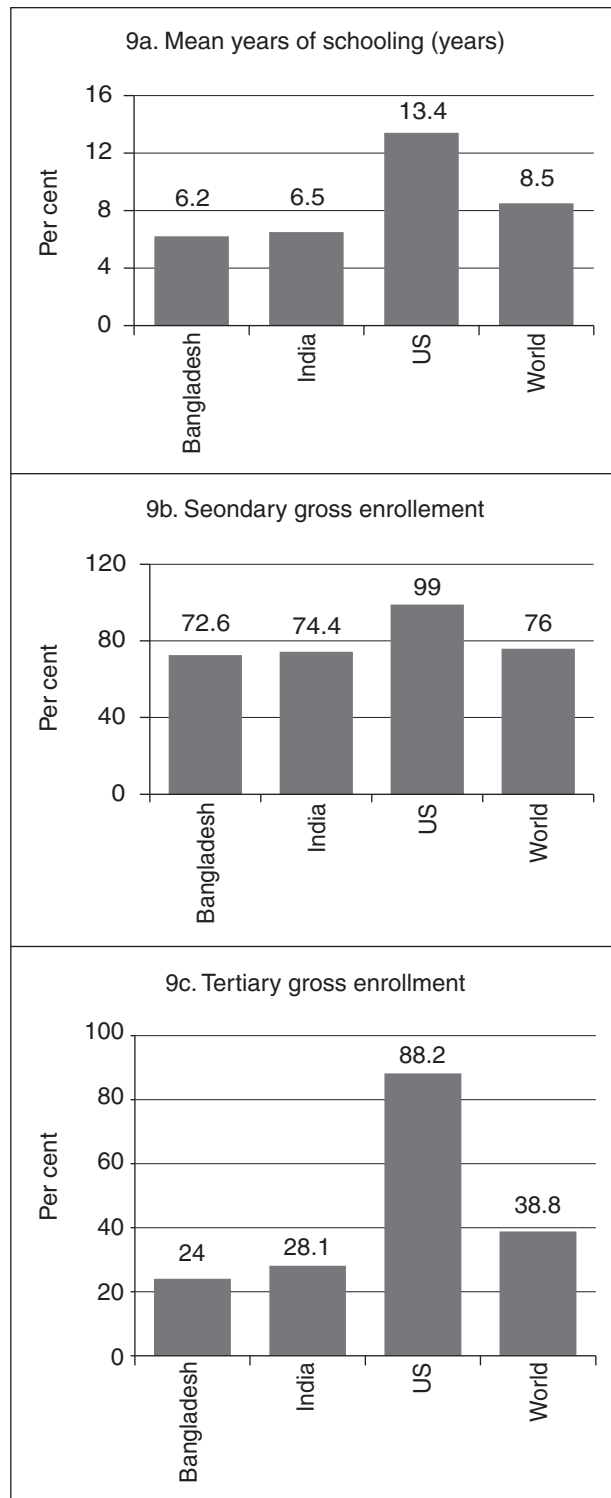
Despite the fact that new possibilities for high-skill categories may be opened up, as argued by Drucker (2014), it is not yet known how many additional jobs will be needed to keep up with the labour

demand. According to an EGM expert, despite the fact that Bangladesh has a cost advantage in ICT and it produces approximately 10,000 IT graduates each year, labour skills are not at the requisite level for the most cases. Along with a dearth scarcity of critical skills, increased mobility of IT experts and tardiness are key impediments to corporate expansion in this sector (Shinkai & Hossain, 2011).

Outmoded curricula, insufficient training infrastructure and instructors, and lack of appropriate institutions are all major contributors to poor labour skills (Chanda & Raihan, 2016). Universities' curricula are disconnected from market demands. The experts mentioned that there is a lack of cooperation between colleges and professionals, which results in a mismatch between the graduates' skills and the employers' demand. Moreover, they highlighted that the teaching method in Bangladesh is incapable of producing experts who can meet market need, and IT graduates frequently find themselves unfitting for jobs in the ICT sector.

Given that 4IR requires huge resources to execute smart infrastructure and economy, intelligent business model adaptability, economic

Figure 9: Technological Skills



Source: Compiled from UNDP, 2021; and World Bank, 2021.

Note: 2019 data for Bangladesh and World and 2017 and 2018 data for the USA and India, respectively.

advantages, and competitiveness, the financial industry has not prioritised high-tech sectors for investment, and financial allotment is essential (Bhuiyan et al., 2020).

In the digital sector, women are underrepresented (ITU, 2019). Approximately 100 million individuals globally are working in ICT services, that provide decently well-remunerated jobs for women. Nonetheless, the proportion of females in ICT employment remains relatively low, especially in developing countries (UNCTAD, 2017). A survey underlines the digital sector's disparities, with lower than a quarter of ICT personnel being women (Plan International, 2018). As women often do lack the knowledge on the technical side, they will face difficulties in the era of 4IR (Moktadir et al., 2018). So, it can be anticipated that this revolution will also increase gender discrimination in our country.

Automation will increase gender discrimination, but there is no effective gender-sensitive policy in our country to upskill women workforce (Rumi et al., 2020). Bangladesh underutilises its female workforce greatly (Farole et al., 2017), which is unquestionably a wasted opportunity.

6. Policies and Legislations for the IT Sector in Bangladesh

The Government of Bangladesh (GoB) has formulated a number of policies to foster infrastructure developments in ICT. 'Digital Bangladesh' is a state-sponsored vision that seeks to encourage various significant ICT projects aimed at creating an open and poverty-free society. Digital Bangladesh is a major element of the government's Vision 2021 and 2041 strategies (Table 2).

Several strategies and policies are prepared to enrich the IT services industry. In addition to this, the objectives of National IT policy 2018 is to integrate eight strategic objectives, including digital government, digital security, social equity and universal access to education, research and innovation, skills development, job creation,

Table 2: Digital Bangladesh Vision

Digital Bangladesh	<i>“Bring socioeconomic changes through ICT and digital revolution across the country”</i>
Vision 2021 (First Perspective Plan)	<i>“The goal is to achieve digital Bangladesh—to use digital tools to alleviate poverty and reduce corruption: to bring every home under the digital network; and to digitalize government services”</i>
Vision 2041 (Second Perspective Plan)	<i>“It aims to eliminate extreme poverty and reach upper middle-income by 2030 and high-income country around 2041 with zero poverty—transform into knowledge-based economy.”</i>

Source: Aziz, 2020.

and strengthening domestic capacity to cope with emerging technological changes (LICT, 2018). Policies that directly impact the ICT sector in Bangladesh are many to be mentioned which contribute to the ICT Indicator—use of technology. One of them is Broadband Policy 2009 which aims to ensure easy access to the internet through the state-of-the-art IT network and effective service delivery for the realisation of the Digital Bangladesh vision (GoB, 2009).

There are policies which contribute to the ICT indicator—access to technology. To be more precise, National Telecommunications Policy 2018 aims to ensure affordable and universally accessible communication, quality of service and customer protection, development of telecommunication market and services, management of scarce resources, investment, safety and security from cybercrime, efficiency and innovation, employment and entrepreneurship, standardisation of local hardware and software production, and environment friendly networks (GoB, 2018).

There are policies which indirectly impact the IT sector in Bangladesh. For Instance, Industry Policy 2016 aims to ensure sustainable and inclusive industrial growth through generation of productive employment to create new entrepreneurs; mainstreaming women in the industrialisation process; and creation of international market linkage (GoB, 2016). National Cybersecurity Strategy aims to work collaboratively at home and abroad in order to manage all major cyber risks which affect us directly irrespective of their origin and type and, thereby, creating a safe, secure and

resilient national information infrastructure for our economy and society (GoB, 2014).

National Strategy for AI of Bangladesh has six strategic pillars which are: research and development; skilling and reskilling of AI workforce; data and digital infrastructure; ethics, data privacy, security and regulations; funding and accelerating AI start-ups; and industrialisation for AI technologies (GoB, 2019). Similarly, there is National Blockchain Strategy which recognises the need to explore blockchain technology in order to advance its technical capacity, develop resilient infrastructure, increase efficiencies in e-Governance and foster innovations.

7. Conclusions and Recommendations

The 4IR is more rapid, expansive, complex and destructive than its previous revolutions. Mechanisation of manufacturing occurred during the first industrial revolution, followed by mass production and finally automation of production during the 4IR. Without a doubt, the technological developments of the 4IR have the potential to improve human lives more than the preceding three industrial revolutions combined. 4IR will reshape human roles, skills. Connectivity and creativity are vital human traits that will boost research and development, design, and marketing. Humans must adapt to cohabit with modern 4IR technologies. As a result, humans are expected to gain new abilities. They are developing complicated problem-solving, social, and process technologies.

IT service has embraced artificial intelligence (AI) more than any other sectors. In view of the recent growth and potential of IT services industry in Bangladesh, this paper examined the 4IR's penetration and impact on the workforce in the country's IT services sector. However, technology disrupts the labour market in terms of displacing workers. The study has found a number of challenges facing Bangladesh's IT sector. The emerging automation and cutting-edge technology is deemed as a threat to its human counterpart, especially to the older workers in the IT sector of Bangladesh. Moreover, complications persist in the IT services industry in terms of the existing gap between the lack of skillsets among the professionals and the knowledge required to meet the industry's objectives. Even the employers sometimes fail in taking necessary measures for re-skilling and upskilling the employees. Hence, the study comes up with the following recommendations.

- The focus needs to be shifted to the development and augmentation of the coursework and curriculum of engineering and polytechnic institutions aligning with industry's requirements, such as establishing interpersonal skills, instituting core technical skills, and establishing psychological behaviours, to nurture the engineers' quality while preparing them for future industry engagements.
- Professionals must design a methodology that incorporates automation capabilities. Employees should develop their skillsets and acquire new ones in emerging technologies like AI, big data, IoT, RPA, cloud computing and blockchain.
- Organisations need to develop a strategy for educating employees by engaging with companies to build workforce skills

and knowledge and accomplish organisational goals.

- Organisations should establish innovative research and development centres to analyse and comprehend recent developments in global technology trends, forecast the industry's growing technology demands accurately, and assist professionals in upskilling by establishing up-to-date training centres in house within the nation.
- Organisations would require managers with effective management and technical abilities to meet organisations' demand and assist in forecasting the industry's future state and market saturation.
- IT entrepreneurship must be promoted through scholarship programmes and sponsoring relevant training courses to develop IT skills and foster a vibrant IT services industry.

While this sector has grown with the fullest of its potential, an array of innovations as well as economic opportunities is increasing worldwide. Due to the components of the 4IR including automation and AI, the country is experiencing divergent growth in a number of respects. And to keep pace with that growth and potential, coordinated and concerted efforts and smooth policy actions are required to address the challenges in the IT services sector's workforce. Hence, the employers, the employees and the government should act urgently and collectively. Various aspects of 4IR should get necessary reflections in the policy agendas. Enhancing the skillsets of the workforce is also vital in the preparation for the digital age of 4IR. This preparedness will determine how Bangladesh would be able to reap the benefits of 4IR.

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The fourth industrial revolution (4IR) has brought dramatic changes in many sectors including labour and trade, and expediting the delivery of the global goals. It can also play a crucial role in Bangladesh's development. As a part of this industry 4.0, the information technology (IT) service has embraced artificial intelligence (AI) more than any other sectors. An array of innovations and opportunities is increasing nationally as well as worldwide in line with the widespread expansion of the IT/IT-es sector. Over the past few years, Bangladesh has seen tremendous growth and prosperity in IT services industry. In this context, this paper has attempted to examine the 4IR's penetration and impacts on the workforce in the IT services sector in Bangladesh. This study also discusses some of the challenges that Bangladesh IT sector faces at present. Finally, contemplating Bangladesh's preparedness for the digital age of 4IR in terms of access to technology and policy framework, the paper makes a number of recommendations which can enable the country to reap the full benefits of 4IR.



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