

Unlocking Potentials and Challenges of the Fourth Industrial Revolution in Bangladesh: A Case on Bogura District

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Abstract

The Fourth Industrial Revolution (4IR) is nowadays a blueprint for technology-driven change in all spheres of life. Bangladesh, yet to be graduated as a developing nation by 2024, envisions an industry with utmost emphasis on skill development, digital literacy, and entrepreneurial promotion. As a part of the global agenda, the study found that there had been a paucity of empirical evidence to address contextualized research on 4IR in the context of Bangladesh. So, the study investigates the potential and challenges of the 4IR in Bangladesh, especially in the Bogura district. The study followed a mixed-method research design, with data collected through an in-depth interview survey and semi-structured questionnaires from 20 top managerial officials of 10 renowned industries in Bogura. Results show that most industries have no concrete idea about the fourth industrial revolution, but they have some superficial ideas or knowledge from newspapers, media, and government little bit. It is also observed that due to the global wave of 4IR, some industries are moving more towards the implementation of 4IR by excluding the first, second, and third phase of the industrial revolution. Respondents opined that most industries do not have the ability to cope with the 4IR, but even if they are able to cover it, it will be very difficult for them to sustain its results in the future. Historically, the industry sector of Bogura was a prominent one but the problem is that it has lost that importance in the present time. Having been a prosperous geographical settlement in the northern corner of Bangladesh, the industry sector had lack of technological orientation, government initiatives, and limited policy intervention. So, the study recommends synchronously

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mapping the 4IR plan in the Bogura district by the government with the engagement of state, non-state civil society, and market actors. The study has practical implications by presenting plausible guidance for policymakers, government, the Bogura DC office, and relevant business entities for overcoming the challenges of 4IR in the Bogura district.

Key Words: Fourth Industrial Revolution, Potentials, Challenges, Bogura, Bangladesh

Introduction

The term “Fourth industrial revolution” (FIR) is an evolutionary process towards a novel scheme that interconnects the global population with advanced digital technologies and refers to this current era going through autonomous technological transformation (Ross and Maynard, 2020). The German government first adopted the concept coined by the chief of the World Economic Forum, Klaus Schwab, in 2011 under the high-tech plan to accelerate computerization to procure socio-economic advancement. The 21st century has evolved into a digital society where the government not only mobilized one-stop services through Information and Communication Technology (ICT) (i.e. e-notification, e-payment, e-signature) at the urban and rural levels of the country (Islam & Rahman, 2020; Islam & Rahman, 2022; Rahman et al., 2022) but also accelerated the economy through advanced technology and bringing international collaboration via digital platforms. The advent of FIR has innovated the newest technologies to flourish the socio-economic agenda of the 21st century by improving the fluidity of modernization (Nyagadza et al., 2022). To meet the stipulation of the 21st century, FIR significantly provides innovative solutions for structural transformation, reinventing labor and manufacturing modernization to adapt to sustainability (Ndung'u & Singe, 2020).

Bangladesh is gradually bearing up the stream of Industry 4.0 as the country is well situated with booming manpower and imminent manufacturing skills. The integration of 4IR technologies can secure water, food, and energy resources, which have substantial power to reduce poverty through immense production utilizing limited resources. The advent of 4IR in Bangladesh unlocked modern-age prospects in prominent industries like ready-made garments, agro-farm, leather, and textile through the use of digital machinery of manufacturing automation. Industries are spending on IoT devices, robotics, automated machines, sensors, blockchain, and advanced software to process industrial management and production (David et al., 2022). As a developing country in the 21st century, Bangladesh needs to unleash technical skills among enterprises to adopt 4IR technologies, as it will increase production by 30-40% (Ahmed et al., 2022).

Bogura is often distinguished as both the prospective industrial hub and gate way to of North Bengal, where merging 4IR technologies with the existing agriculture and light engineering industries can show its path to

compete in both the national and global market more maturely (Zaman & Islam, 2022; Wadud, 2018).

The district is nationally specialized for its rapidly growing sectors, including agriculture, construction, transportation, and food industries, and here, the intersection of 4IR has the potential to lead to innovation and sustainability (Khan et al., 2023). As the nerve of North Bengal, Bogura has a locational advantage in seizing progressive status. Although late, the most prominent example of automation technology can be given through the massive number of foundry industries in Bogura (Alam et al., 2017; Khan & Ahmed, 2023).

Bogura has a past glory as a commercial region which can be revived and sustained through the integration of automation technologies. The current status of manufacturing automation within the local industries and its link with the entrenched transportation network in Bogura has the potential to drive it a key industrial zone of Bangladesh (Al Mamun et al., 2020).

Despite the global emphasis on the Fourth Industrial Revolution (4IR) and its adaptation into respective industries, Bangladesh is performing as a sorry case till date regarding its contextual implications, not even at research. More significantly, the potential and challenges of 4IR in the light engineering sector remain largely unexplored. The existing studies have primarily focused on overviewing 4IR, but the real-time responses as well as the practical challenges faced by those industries in adopting 4IR technologies untouched. Moreover, Bogura, which had a leading role at industrial sector in national level, is now experiencing a sharp decline because of the absence of technological orientation, government support as well as strategic policies.

Thereby, this paper highlights the significance of the industrial zone of Bogura district along with its potentials and challenges towards the integration of fourth industrial revolution emphasizing the sustainability of innovation. The study has three following objectives which include: describing the existing status of the industry sector in Bangladesh with a special focus on Bogura District, identifying the potential of the fourth industrial revolution in the Bogura District of Bangladesh, and exploring challenges faced by the industry of the Bogura District to implement the fourth industrial revolution.

Scope of the Study

Bogura is often called as the gateway of northern region in Bangladesh. The region is mostly characterized by its agricultural economy, poverty and the availability of surplus low-cost labor. However, there are no significant establishments that have been made for serving the heavy industries except the light engineering one (Wadud, 2018). Although the light engineering industry is fueling the growth of the region in many ways, they face a

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number of challenges collectively. From the over prioritization of imports to the continuous lack of quality raw materials, adaptation of modern technologies, and limited government support- industries in this region are passing by tough times definitely (Majumder, 2020). Research works indicate that the ultimate organizational effectiveness and collective utilization of potential depends on the operational performance of respective industries (David et al., 2022).

Thereby, this paper attempts to build a description of the performance of industries at Bogura in reference to their potential in respect of their technical orientations. This paper draws both research, academic, and government attention regarding the prospects of unlocking the potentials and challenges of incorporating the 4th industrial revolution technologies in Bangladesh with a special reference to the Bogura District where the engineering industry may turn into an asset indeed. With the geographical advantage, abundance of land supply, natural resources production opportunities with other growth potentials- Bogura may turn into the breeding case of growing industries, improving profits and sustainability surely if the induction of 4th Industrial revolution into the operational procedure can be made sufficiently. Additionally, this paper mentions the absolute need of a dedicated economic zone in Bogura region and governmental support- reviewing the existing policies for increasing export opportunity thoroughly.

Literature Review

Industrial Revolution

The industrial revolution alludes to the evolution of the modern economy through the conversion from handicraft to the machine-based system to make products (Ross and Maynard, 2020). The fundamental features of industrial revolution involved with the integration of technology in the global socio-economy and in inventing the factory system and new power sources to increase production (Yuan et al., 2022). In 1760, the first industrial revolution began in Britain focusing on steam power and textile industry, which enabled the usage of coal, cotton, iron, sewing machines, and steam engines. This revolution was mostly confined in Britain as a country restricted to exporting its machinery and techniques. Later on, the limitations of first revolution led to the second industrial revolution initiated in the 1870s through introducing industries based on electricity, chemical, and steel. The third one emerged in the twentieth century which is characterized by digitalization through internet, computer and nuclear power along with the usage of automobiles and motor vehicles (Vries, 2015).

The industrial revolution led to an innate change in human history which marked the sustained process of modern economic growth. Britain was considered the model nation of the industrial revolution to others with a wide colonial empire that brought the concept of revolution based on production. The propulsion force of the industrial revolution was included

on utilizing different sources of fuel to generate energy specifically on coal at first. Eventually, the revolution heaved living standards and provided global solutions to address economic problems (Fremdling, 2014).

Historians ascertained the key characteristics of the industrial revolution followed by the phases of revolutions. The industrial revolution metamorphosed the nature of labor and made fundamental changes in the socioeconomic status worldwide with the invention of machinery and large-scale industry. It is delegated to the technological revolution which globally transformed the governance and international trade system. The first industrial revolution induced energy sources of innovation, the second one fetched large-scale power generation through electric machinery and the third revolution inaugurated digitalization paving the way for socio-economic networking. Lastly, the twenty-first century brought a new wave of the fourth industrial revolution focusing on developing artificial intelligence, genetic engineering, and robotics (Moll, 2021).

Fourth Industrial Revolution

The term Fourth Industrial Revolution (4IR), publicized by Klaus Schwab, shapes the near future with the active integration of artificial intelligence and minimizing the barriers between technology and the market. The concept of 4IR brought rapid change in social patterns through technological automation and massive interconnection. The entire system of governance and business is going to face historical transformation due to the dramatic shift of manual labor (Xu et al., 2018).

The wave of the fourth industrial revolution emerged in a consequential manner with uniqueness. It is based on the third phase of revolution which extended virtual technical services along with the integration of artificial intelligence, nanotechnology, cloud computing, 3D printing, quantum computing, automated machines, and biotechnology. The potential implication of 4IR will foster the advancement of science as well as mitigate the socioeconomic challenges globally (Marivate et al., 2021).

4IR is focused on ameliorating the capacity of machines and working to transform society with hyper-intelligence. Cloud computing augments software capacity and big data technology scans extensive data which enables the extraction of critical information. The rapid progression of artificial intelligence enacted automation of mass production and 3D printing technology has the potency to print multiple materials without using plastics. These 4IR technologies have an enormous impact on global economic growth as productivity has already tumid vastly since its implication (Chung, 2021).

Potentials of 4IR in Bangladesh

Polas et al. (2022) investigated Bangladesh based small and medium enterprises (SMEs) and the use of technological tools of Fourth Industrial

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Revolution Metaverse Era including artificial intelligence, block-chain technology and risk-taking behavior. The research was conducted based on the primary data sources where data were collected from 150 SMEs of Dhaka city in Bangladesh. The study has found that the associated top managers and owners have sufficient knowledge regarding artificial intelligence and block-chain technology. Additionally, the study found that artificial intelligence has positive impact in adopting block-chain technology. It also admitted that the artificial intelligence, block-chain technology and risk-taking behavior became helpful in boosting the competitiveness of SMEs.

Adhikari (2020) explored the scenario of fourth industrial revolution in the South Asia region. The study argued that in spite of being a home of quarter of humanity, it contributed merely 4% of the global gross domestic product. The study has been conducted on the countries of south Asia excluding Bhutan, Afghanistan and the Maldives. After observing the access of internet use in the South Asian countries, the study has found that the internet costs in most of the areas is unaffordable and a single gigabyte of mobile internet costs more than the monthly income. In addition to this, the study has recognized few elements regarding cognitive readiness competencies of leaders in order to reach to the fourth industrial revolution. The recognized elements could be communication, adaptability, intuition, sense making, mental cognition and attentional control.

Khan et al. (2021) observed the tourism and hospitality sector and the application of technological innovation in Bangladesh. In addition, the study found out evidence for supporting the fact that the technological revolution has taken the tourism sector of Bangladesh into a new dimension. The study has been performed based on the available secondary sources of data from peer reviewed journal, conference papers and journal articles. After analyzing data, the study highlighted that rapid technological advancement has proved to be a boon for moving the industry forward. Moreover, in approach of production, distribution and consumption, several technological tools and applications of innovation were being used such as artificial intelligence, virtual reality, block chain, user generated contents including social media, robotics, sensor technology and so on. The overall results of the research supported the potentials of technological revolution in advancing the tourism and hospitality industry in Bangladesh.

Challenges of 4IR in Bangladesh

Islam et al. (2023) investigated the 4th industrial revolution and the potential barrier for the companies situated in Bangladesh regarding joining to the global race. Furthermore, the study has explored the overall challenges which are faced by the emerging economies across the globe. The authors of the study used empirical data collected through interviewing Ready-Made Garments (RMG) and Small & Medium Enterprises (SME) owners,

employees from senior level and industry consultants. The study found lack of leadership in the industries, inadequate industry research and gap in information for prioritizing the adoption of fourth industrial revolution. In addition, the study addressed numerous barriers in facilitating the adoption of fourth industrial revolution in Bangladesh such as poor infrastructure, lack of government support, cheap labor, lack of skilled workforce and organizational capacities. Lastly, the authors recommended proper addressing of the barriers on a timely manner would help in adoption of fourth industrial revolution.

Rahman & Taher (2022) studied the capabilities of different industries and universities in embracing the fourth industrial revolution (4IR) for constructing sustainable business. The study was conducted using both primary and secondary sources where the primary data was collected through convenience and purposive sampling. After analyzing the data, the study found that there existed a gap of the industries and universities for incorporating the fourth industrial revolution components in Bangladesh. The study also provided some syntheses for the policy makers of the government and the associated stakeholders. Nevertheless, the authors have suggested creating awareness among the stakeholders for the proper application of fourth industrial revolution based digital technologies in business.

Soh & Connolly (2021) discussed the fourth industrial revolution and its impact on business and human rights with the perspective of profit and risks. The study has found mixed results with the combination of both positive and negative impact in economic and social consequences. There existed a traditional linkage between the economic competition and bodily integrity which has devitalized new ways of profitability for future digital ecosystem. Furthermore, the study has highlighted the transition of business activities for coping with the next generation of human rights and predicted that the future business activities transition would be hollow, discerning and disseminated.

Research Gap

The industrial revolution is the leading cause behind the digitalized global era which is playing a propulsive role to govern the global trade system. The emergence of the industrial revolution in Bangladesh has a long history based on agricultural production and trade. Most of the previous studies discussed the economic performance, prospects, and preparedness building conceptual links of 4th Industrial Revolution in the context of Bangladesh. Hence, there exists a clear research gap in providing any empirical evidence regarding the potentials and challenges in context of Bangladesh. Furthermore, no study has properly alluded to any strategic plan assembling government organizations, policy makers, business entities, startups, civil society, political actors and general people for overcoming the challenge of 4th Industrial Revolution. Considering the gap of the previous studies, this

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paper emphasizes on the empirical evidence for addressing the contextualized research on 4IR in the context of Bangladesh. Further, it investigates the potentials and challenges of the fourth industrial revolution in Bangladesh concentrating on the case of the Bogura district. Notwithstanding, the study attempts to provide numerous plausible guidance for policymakers, government, the Bogura DC office, and relevant business entities regarding overcoming the challenges of 4IR condensing in Bogura district.

Methodology of the Study

The study was conducted on the distinguished industrial hub of North Bengal, Bogura. Economically, the city plays a crucial role in agriculture and light engineering. In addition, the city is concentrated on numerous rapidly growing sectors such as agriculture, construction, transportation, and food industries. To consider the current status and future potential to drive it a key industrial zone of Bangladesh, the study collected data from five types of industries, including- light engineering, medicine and chemical, agro-processing, manufacturing industry, and food processing industry.

Research Method, Data Collection Method, and Data Collection Instrument

The study followed mixed methods, including both the qualitative and quantitative approaches (Creswell, 2011). The qualitative approach emphasizes words (Bryman, 2004; Creswell, 2011) which is more important in this study to identify the potential and challenges of the fourth industrial revolution in the Bogura District of Bangladesh. Sometimes, it is required to measure certain events and phenomena quantitatively to understand the social world (Creswell, 2002). The study measured challenges faced by the industry of the Bogura District to implement the fourth industrial revolution. However, the study selected face-to-face, in-depth interviews under a survey method, including a semi-structured questionnaire. During the in-depth interview, there were several closed-ended questions and a 3-point Likert Scale to analyze the data quantitatively.

Sampling and Respondents

The study was taken in Bogura district due to geographical importance and historical heritage on industry sector. The study followed non-probability sampling including cluster and purposive sampling. Based on cluster sampling, the study selected five types of industries: light engineering, medicine & chemical, Agro-processing, manufacturing industry, and food processing. It further purposively selected ten renowned and nationally contributing industries in the Bogura district who fulfilled 1IR, 2IR, 3IR or

any single stage of industrial revolution. During data collection, 20 top managerial personnel were taken for in-depth interview survey.

Data Analysis Technique

The study used exploratory and thematic techniques for analyzing data. Based on different themes, the result section is divided into various sections and sub-sections. Excel software was used to generate data, and later, the data was presented in multivariate tables.

Research Ethics

The study followed adequate research ethics by the requirements. The study has obtained written permission from the industries before taking data. The written permission explained to the respondents that the collected data would be used for academic purposes and would be used only for current research. Again, verbal consent was obtained from the enumerators before conducting the in-depth interview.

Table1: List of Selected Participants

Nature of Industry	Name of the Industry	Number of Interviewee
Light Engineering	M/S Kamal Metal Works & Padma Welding Limited	02
	M/S Al-Madina Metal Works & Al-Madina Engineering	02
Medicine & Chemical	One Pharma LTD.	02
	Cipla Ltd	02
Agro-Processing	Bogura Bhandar Jute and Twine Industry (Jute Mill)	02
	Hasan Jute Mills Limited	02
Manufacturing Industry	AB Ceramics Industry-Azad Group	02
	BCL Ceramics Industry LTD - BCL Group	02
Food Processing	M/S Seema Flour Mills	02
	Rahul Flour Mills - Rahul Group Factory	02
Total		20

Findings

Table 2 presents the socio-demographic information of the study respondents, including level of education, marital status, employment status, and years of experience in the industry. The most common educational attainment was graduate, postgraduate and above (n=90%) followed by higher secondary and secondary. A significant proportion of respondents were married (n=19), and the most common (65%) employment status was Managerial ones where they had working experience from 01 year up to 35

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years, respectively. These findings serve as a baseline for assessing the study population and thereby informing the interpretation of the research findings.

Table 2: Socio-demographic Information of the Respondents

	Variety	Frequency (n)	Percentage (%)
Level of Education	graduate, postgraduate and above	18	90%
	Higher Secondary	1	5%
	Secondary	1	5%
Marital Status	Married	19	95%
	Unmarried	1	5%
Employment status	Owners	5	25%
	Managerial	13	65%
	Mid-Level	2	10%
Years of Experience	01-05 Years	7	35%
	06-10 Years	5	25%
	11-15 Years	4	20%
	16-20 Years	1	5%
	21-25 Years	1	5%
	26-30 Years	0	0%
	31-35 Years	2	10%

****Source:** Survey Interview

Business Orientation of the Industry

The study covered 10 industries of the Bogura region. Most of the industries of Bogura district are import-oriented except the jute and light engineering industries. The Bhandar Jute & Twine industries and Hasan Jute Mills Limited export their jute products to India. Some light engineering factories are there, but they keep their product distribution within the national boundary.

Respondent “XY” of Industry “YZ” added that-

“The market of Bogura is mostly driven by imported products as there is a tendency of “Made_in_Mania” and “Brand Value” among the consumers” (Survey Interview, 20 December 2022).

Few imported products especially enjoy competitive advantage in the market like the- Vaccine or other prescribed pharmaceutical products. But mostly they do not get any privileges due to their high prices. However, in terms of machinery, the industries import only the frame and produce spare parts locally, assemble and sell, keeping a price balance. Contemporary

other industries like Jute and ceramics serve the locals with comparatively lower prices indeed. There is seen a controversy among the respondents on the consumers preference over plastic than the jute products.

A respondent “XZ” of Industry “ZX” asserted that-

“Though the foreign industries ensure more quality, finishing, packaging, safety standard & diversity, the high price is keeping them away from attaining popular demands. Here, the locally produced products may grab the last few markets too, if they can promise quality” (Survey Interview, 19 December 2022)

Table 3: Company credentials

	Low	Medium	High
Product Demand	10%	40%	50%
Supply Capacity	0%	55%	45%
Skilled Workforce	0%	45%	55%

****Source:** Survey Interview

Half of the interviewed local industries agreed that they have High (50%) product demand in the market. Where only 10% supported poor demand indeed. In terms of supply capacity- more than half (55%) industries responded that they have moderate supply capacity to meet the market effectively whereas, rest 45% responded that they have such capacity but in full extent. Among the assessed industries, 55% responded that they have skilled workforce to perform their work. Rest of 45% of industries marked moderate skilled personnel too, but they are not oriented with 4IR and its modernized equipment.

Business Orientation about Industrial Revolution

However, in terms of technical orientation, most of the contemporary industries in this region are still performing with either technologies from 2nd IR or 3rd IR till date except few pharmaceutical and raw manufacturing ones where a development can be tracked in terms of advanced technical orientation [See table 4]. With the abundance of land properties and cheap surplus labor supply, these industries hold comparatively higher potential and profit prospects than that of other regions (Wadud, 2018). Results show that most of the industries either skipped the 1st industrial revolution or missed the another. In other terms, most of the cases depict that these industries are following the 3rd era techniques where these require capacity improvement and productivity enhancement.

Table 4: Current Stage of the Industrial Revolution in the selected industries of Bogura district

Nature of the Industry	Industry Name	Stages of Industrial Revolution			
		1st	2nd	3rd	4th

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Light Engineering	M/S Kamal Metal Works Padma Welding Limited	Yes	Yes	-	-
	M/S Al-Madina Metal Works Al-Madina Engineering	Yes	Yes	-	-
Medicine & Chemical	One Pharma LTD.	Yes	Yes	Yes	Yes
	Cipla Ltd	-	Yes	Yes	-
Agro-Processing	Bogra Bhandar Jute and Twine Industry	-	Yes	-	-
	Hasan Jute Mills Limited	-	Yes	-	-
Manufacturing Industry	AB Ceramics Industry- Azad Group	-	Yes	Yes	-
	BCL Ceramics Industry LTD BCL Group	-	Yes	Yes	-
Food Processing	M/S Seema Flour Mills	-	Yes	--	-
	Rahul Flour Mills- Rahul Group Factory	Yes	Yes	Yes	-

****Source: Field observation*¹

Table 5 illustrates the range of knowledge on IR technologies coined from 20 top managerial officials of 10 renowned industries of Bogura in 2022. The respondents had more knowledge of 2nd IR technologies than 1st & 3rd IR technologies. The industries have taken more initiatives on 2nd & 3rd IR technologies than 1st one. Low government support has been traced in the study as well. However, Government support has increased over the time from (30%>50%>70%). The achievement performance in the 1st IR era was merely 50% which was doubled in the 2nd IR. The contemporary 3rd IR is on the move indeed- (55%) has been achieved so far.

Table5: Existing status of the industries (Study area: Bogura District).

Parameters	Knowledge	Initiatives	Government Support	Achievement
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¹ [“Yes” means, Presence of IR Performing parameters and “-” means, Not identified parameter either skipped or missed]

	Yes	No	Yes	No	Yes	No	Yes	No
1 st IR	80%	20%	50%	50%	30%	70%	50%	50%
2 nd IR	100%	0%	100%	0%	50%	50%	100%	0%
3 rd IR	95%	5%	90%	10%	60%	40%	55%	45%

****Source:** Survey Interview.

Knowledge

The table illustrates the amount of knowledge on IR technologies coined from 20 top managerial officials of 10 renowned industries of Bogura in 2022. Overall officials have more knowledge of 2nd IR technologies than 1st & 3rd IR technologies. In terms of percentage, 100% (20 officials out of 20) of the officials have knowledge over 2nd IR technologies.

Similarly, the officials (95%) have higher knowledge on 3rd IR technologies than 1st IR technologies (80%). From the graph it is observed that the knowledge levels of the officials on 1st, 2nd & 3rd technologies are good enough.

Initiatives

The table illustrates the amount of initiative taken by 10 renowned industries of Bogura by 2022 informed by 20 top managerial officials of those Industries. Overall industries have taken more initiatives on 2nd & 3rd IR technologies than 1st technologies in the given period. Compared to 1st & 3rd IR technologies all of the industries (100%) have taken the greatest number of initiatives on 2nd IR technologies. In addition, initiatives taken on 3rd IR technologies also have a significant position (90% of the industries). On contrary only 50% of industries have taken initiatives on 1st IR technologies.

Government Support

The table illustrates the amount of government support over 10 renowned industries of Bogura informed by 20 top managerial officials of those industries. Overall chart shows that the industries have received low support from government. But with the installation of upgrading technological attachment the government support increases but in a small portion. The significant differences of government support on the industries: 30% of the industries got support under 1st IR technologies, similarly 50% under 2nd technologies & 60% under 3rd IR technologies.

Achievement

The table illustrates the amount of achievement of 1st, 2nd & 3rd IR technologies by 10 renowned industries of Bogura informed by 20 top managerial officials of those industries. The Chart overall shows the industries of Bogura have 100% achievement on 2nd IR technologies' installation but lack behind of 1st (50%) & 3rd (55%) IR technologies.

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Collectively the table 5 explores the existing status of the industries Bogura District and finds that- majority of the industries has made significant performance in 2nd IR technologies, but they need more support and initiatives to fully leverage the potential 3rd IR technologies where they are now struggling. Specifically, although officials have not yet got any solid understanding of 3IR practices indeed. Rest dimensions depict that the 2nd and 3rd IR technologies bound majority industries lack in overall government support which slightly increases with the adoption of newer technologies.

Table6:Existing status of Government Support.

	Low	Medium	High
Subsidy	60%	15%	25%
Technical Assistance	25%	65%	10%
Communications	0%	40%	60%

****Source:** Survey Interview

Table 6 presents the performance rates of government support for promoting the industries of Bogura. High percentile (60%) of the respondents marked the low subsidy whereas, another (65%) pointed moderate technical assistance is available in the context only. However, even in such backdrop- the government still managed to keep a high (60%) percentile of communication indeed.

Potentials of the Fourth Industrial Revolution

Perception about 4IR

The successful implementation of 4IR is compactly associated with the cognition of the potential of 4IR. The familiarization of the concept 4IR before adaptation is indispensable therefore the perceptions of the respondents are as following-

Table 7: Respondent's cognition of 4IR.

	Yes	No	Maybe
Status of Conversance with 4IR	35%	35%	30%

****Source:** Survey Interview.

The above table elucidates the respondents' state of cognizance regarding 4IR. About 35% of the respondents have expressed that they are familiar with 4IR; however, nearly 35% of the respondents have no idea about the concept of 4IR. Similarly, around 30% of the respondents are not clear about 4IR. The result indicates that the state of familiarization with 4IR is not satisfactory.

Perception about 4IR Regarding Product Demand and Competitiveness: Over the years Bangladesh has achieved significant

industrial growth to leapfrog straight away into using more commencing technologies and disregard many of the early growing pains of adopting 4IR. Nevertheless, there are plenty of opportunities for flourishing in the market through increasing demand and competitiveness. The study witnessed-

“4IR technologies will make products more efficient, effective & affordable therefore, the product's demand will be increased & our market will be sustained.”(Survey Interview, 18 December 2022)

The adoption of 4IR can increase the production of more products with better quality by addressing the errors and minimizing them. Moreover, 4IR will enhance affordability through cost-effective production, hence increasing the demand for products in the market. The study testified through one of the respondents - *“If we tag & ensure that the products we make are produced using by latest technology which is environment friendly, then we will have a good position in market”* and most of the respondents agreed with the fact.

As Bangladesh attempts to upgrade the level of automation, the fundamental problems are lack of knowledge among the existing industries about 4IR and resistance for adopting modern technologies. A respondent manifested that-

“Maybe, but as far we know the latest technologies that we have found of this industry are mostly semi-automated & they are enough to meet the market.”(Survey Interview, 19 December 2022)

Numerous bewilderments exist regarding the potential of 4IR where few of the industries think the existing technologies and 3rd IR are adequate for the productions. Therefore, few of the industries think that 4IR may increase production nonetheless may not have any influence on the demand.

4IR and Industrial Growth

The Fourth Industrial Revolution represents a fundamental change in the way of living, working and relating to one another. Bangladesh is gearing up for 4IR with a growing manufacturing base, manpower and entrepreneurial class. The cognition associated to the potentials of opening up new markets, promotion of locally produced products and growth rate towards achieving SDG in Bangladesh have been shown a significant result which are as following-

Table8:Potentials of 4IR and Industrial Growth.

	Yes	No	No Comment
4IR may open up new markets affecting the socioeconomics.	70%	20%	10%
4IR may promote the market acceptance of locally produced products	75%	20%	5%
4IR can enhance the growth rate towards the	70%	20%	10%

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achievement of SDG in Bangladesh			
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****Source:** *Survey Interview.*

The above data illustrates the prospects of the 4IR and the industrial growth pertaining the opportunities of new market affecting the socio-economic development, growth of the products that are produced locally and the overall enhancement of the growth rate. In terms of opening up new markets affecting socioeconomics, nearly 70% of the respondents contemplated that 4IR has the potential, and through adopting it, numerous markets may open up along with socio-economic prosperity. In addition, around 20% of the respondents thought 4IR may not bring any scope for new markets affecting socioeconomics.

In Bangladesh, a growing manufacturing base for different industries such as light engineering, food processing, agro-processing, medicine, and chemicals has been constructed for an extended period. Nonetheless, the promotion of these locally manufactured products is a long way to be accepted throughout the market due to the assertion of technological advancement. Among all the respondents, a proportion of about 75% assumed that 4IR can promote the market acceptance of the locally produced products whereas around 20% of the respondents thought 4IR may not have any influence in promoting the locally manufactured products in the national and global market.

Bangladesh is a developing country on its way to achieving the SDG goals within 2030, and sustainable advancement in industry and technology are two prerequisites. Nearly 70% of the respondents agreed that 4IR could enhance the growth rate toward achieving the SDG in Bangladesh; conversely, about 20% of the respondents assumed 4IR might not have any influence on the growth rate toward achieving the SDG.

Thereafter, a small number of respondents did not have any idea about 4IR's potential or its influence on industrial growth.

Challenges of 4IR

Bangladesh is putting its best efforts against the concern of revolutionizing the industrial sector through modern technological orientation and induction. 4IR leads the motion. However, this transformative process towards 4IR bears some challenges that are creating a negative impact on it. Literature predicted that the five core areas of discussion must be brought under rigorous consideration, and relevant policies must be established as well. These core challenges are briefly discussed below-

Barriers of knowledge and orientation: the prospects of 4ir have been facing absolute barriers by the contextual education sector and its performances. The study report shows that 75% of respondents marked the knowledge and 4ir orientation gap is making the way of 4ir adaptation in the country tougher.

Poor infrastructural development: the performance of infrastructural development in the country will surely have a cruel impact on the 4IR adaptation. The infrastructure must be updated and equipped before the 4IR induction to attain all its prospects precisely. The study finds - 45% of respondents observed that poor industrial support might be the challenge of 4IR ahead in their respective industry.

Up-skilling and reskilling challenges: the study also observed the context of industries from Bogura district and marked a trend of perception indeed. With the availability of unskilled labor and no training facilities around, 55% (highly agreed) & 45% (moderately agreed) respondents marked that the concern of up-skilling the newbies, unskilled with reskilling the trained under technical upgrade orientation program is going to hold the topmost challenge towards 4IR adaptation and exercise.

Lack of Industry based research and development: In terms of deciding over the context- whether Industry based research and development is crucial for 4IR adaptation or not. The respondents were observed as grouped into two. A major (45%) portion of respondents rated the R&D as comparatively less challenging than that of other aspects. In the same, another (35%) decided that- the context is the highly challenging one.

Lack of Government Support: The trend of governmental support in the context of Bogura in terms of technical or administrative support, a high portion (70%) recorded their responses as- the contemporary government support is not effective at all. Another (20%) of the respondents also put their consent supporting the poor government support experiences.

On the contrary, acceptance and installation cost are considered to be the most significant factors, challenging the procession of 4IR into the industry. One of the respondents, Mr. “XY” from the “XYZ” industry stated that-

“We have Infrastructural problem with no absolute market demand, leading to the new technology acceptance related complexities like- expensive installation, lack of skilled workforce and chances of unemployment for the conventional workers. The whole environment is simply not cost effective for the context and cost-efficient for the process indeed. We already have gas and electricity supply shortage related complexities. How can we dream Big?” (KII - 7, November 22, 2022).

Respondent “YZ” responded that,

“Concerning the financial viability, we are yet to be prepared for the 4IR adaptation process. In fact, if we can work with the semi-automatic or, manual machine in a full-fledged manner, why should we go for advanced, complex to handle, expensive to install and maintenance machines indeed?” (KII - 8, November 23, 2022).

Moreover, another respondent “ZX” tracked the plethora and stated-

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“We in this, Bogura region have both possibilities and challenges ahead of the 4IR adaptation. The adaptation process will follow dualism too. It could be effective but now, it will not be the efficient one. We are still lagging behind the 3IR technologies. There is not a single CNC² operator in Bogura till date. Instead of full automation, we may go for semi-automation indeed.”(KII - 11, November 24, 2022).

Discussion

The fundamental objective of this study is to evaluate the existing industrial structure of Bangladesh based on the Bogura district along with finding out the potentials and challenges of the industries of Bogura to effectuate the fourth industrial revolution (4IR). The study found that the maximum industries of Bogura have a shallow idea of the 4IR stream and many of the industries are incapable to stand the global stream due to the lack of resources and industrial orientation. It is impracticable to implement 4IR without familiarizing the concept among people and the study found that the majority of people are not entirely acquainted with the concept. Though Bangladesh has a major obstacle to adapting 4IR technologies the country has made notable progress to achieve industrial growth by employing automated machines. The study found that most of the industries in Bogura are semi-automated and the respondents believe that 4IR technologies will increase the efficiency and affordability of production. Research works of Ane & Yasmin (2019) also claim kind of similar perception that the mills and farms are already adapting advanced technology to stimulate rapid production which has increased the capacity of existing sectors in Bangladesh. The study also found that the respondents assume that adopting 4IR will pave the way for Bangladesh to achieve SDG goals and the local industries will secure sustainability. Bhuiyan et al. (2020) in their respective research work also discussed similarly as the economy of Bangladesh will thrive, and the country will achieve global standards with the contribution of 4IR.

Most of the industries of Bogura are import oriented regarding machinery except for the Jute industries which are primarily focused on export. According to the respondents, 55% of the industries have an average supply capacity to handle the market demand, and 45% have a full capacity, which is quite satisfactory. The study observed that the industries of Bogura have adopted 2IR technologies fully but only 55% of the industries could install 3IR technologies which is a huge downside to carrying through 4IR. From the government level, there is a lack of initiative to promote 4IR technologies in Bogura as only 10% of the local industries are receiving necessary technological assistance from the government.

² CNC: Computer Numerical Control machines are automated machines, which are operated by computers executing pre-programmed sequences of controlled commands. Completely the opposite of “old-school” manual devices.

Core barriers towards 4IR in Bangladesh evolve around the lack of orientation, poor infrastructure, an unpracticed workforce, the inertia of government, and scarcity of industry-based research. As per the respondents, the industries of Bogura are dealing with weak infrastructure and the installation of modern technology may lead to complexity as the district is struggling with the shortage of electricity and gas. As industries can properly function with manual or semi-automated machines, some of the respondents believe that there is no necessity for expensive 4IR technologies to be installed. A similar concept was explored in the work of Shabur & Hridoy (2021) which states that the industry owners are not interested to invest in 4IR technologies as they can support cheap labor and there is also a lack of initiative from the government to make supportive policies along with the hesitance to provide an adequate resource to hold the 4IR stream. The study explored that Bogura has both challenges and opportunities for 4IR transformation and attempted to provide relevant guidance to overcome the challenges of 4IR prevalent in the district. Partnership development with the investors, technical up-skilling programs, campaign programs to familiarize the 4IR concept, and the government's willingness to create scope for industries to adopt 4IR technologies have the potential to overcome the major difficulties to embrace 4IR.

Conclusion and Policy Implications

The study has the concern for revelation of the potentials and challenges of the Fourth Industrial Revolution concentrating in the context of Bangladesh. Based on the in-depth interview survey, the study found that most of the existing industries have no concrete idea about 4IR nonetheless they have numerous superficial ideas from different newspaper, articles and media advertisements. In most cases, it has been observed that the industries are leapfrogging the first, second and third phase of the industrial revolution. In addition to this, some industries assumed that adoption of 4IR may not be sustainable due to lack of resources as well as capacities. Despite the limitations, the study has investigated several potential areas in the study areas such as the geographical settlement, growing manufacturing base and existence of entrepreneurial class.

So, the findings of the study confirmed that proactive policies are decisive to put out the existing drawbacks in industries. Therefore, the findings of the study confirmed that without strengthening the institutional capabilities involving policymakers, government, the Bogura DC office, and relevant business entities, the mapping the 4IR plan in the Bogura district will not be possible. Hereafter, the research acclaimed the following suggestions for acquiring a better ambiance for industry.

- The study found the knowledge gap and lack of skills among the industry workforce regarding the phases of industrial revolutions. The findings have direct implications in identifying the core problems of the industries and providing strategic guidelines for gradually

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upgrading the industries in consistency among skills, demand & supply.

- The findings also have great implications in research & convincing the authorities as per the existing SDG goal -09 which is 'Industry, Innovation and Infrastructure'.
- The findings also have policy implications for working on innovation investment on Bogura which focuses on collaborative & partnership development and finding investors & create credibility.
- The Ministry of Education, Education board and associated local government offices need to emphasis on technical education. In addition to this, the industries need to up-skilling training programs for newly recruited workforce as well as the existing personnel.
- Different concerned community campaigns can be arranged for acknowledging the new entrepreneurs and industrialists regarding the scopes and prospects concentrating 4IR.
- The Ministry of Commerce, different non-profit organizations and associations need to promote locally produced diversified products. Furthermore, in order to promote these products in the national and global market, the government needs to provide special subsidies.

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