

FUTURE SKILLS & EMPLOYMENT

Finding the Emerging Skills and Employment Opportunities based on 4th Industrial Revolution in Bangladesh



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PART-A



Vision
CAREER

Goal

Skill

Future

Education

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Acronyms

AI	: Artificial Intelligence
AR	: Augmented Reality
CAD	: Computer-Aided Design
CAM	: Computer-Aided manufacturing
EU	: European Union
FAO	: Food and Agriculture Organization of the Unitade Nations
GDP	: Gross Domestic Product
GOTS	: Global Organic Textile Standard
GSP	: Generalized Scheme of Preferences
ICT	: Information & Communication Technology
IoT	: Internet of Things
ISC	: Industry Skills Council
IT	: Information Technology
LC	: Letter of Credit
LDC	: Least Developed Country
LEED	: Leadership in Energy and Environmental Design
PLC	: Programmable Logic Controller
RMC	: Ready-Mix Concrete
RPA	: Robotic process automation
SEO	: Search Engine Optimization
VPN	: Virtual Private Network
VR	: Virtual Reality

Bangladesh is entering a profound transformation driven era by the Fourth Industrial Revolution, which is reshaping industries and redefining the skills required for the workforce. This revolution, characterized by groundbreaking advancements in artificial intelligence, robotics, the internet of things (IoT), blockchain, 3D printing, nanotechnology, biotechnology, and quantum computing, presents both opportunities and challenges for the country. While the shift toward technology-driven and automated production threatens jobs traditionally dependent on low-skilled labor, it simultaneously opens doors to innovative employment opportunities requiring advanced and emerging skill sets.

To thrive in this rapidly changing landscape, Bangladesh must adapt swiftly by equipping their workforce with the skills necessary for the new economy. Despite vulnerabilities stemming from a lack of preparedness, Bangladesh holds significant potential to capitalize on the opportunities offered by 4IR. The global adoption of advanced technologies has created a more accessible and competitive environment, enabling developing nations to better prepare their workforce for the demands of emerging industries.

In response to these challenges and opportunities, a2i, in collaboration with ActionAid, conducted a comprehensive study titled “Future Skills & Employment: Finding Emerging Skills and Employment Opportunities based on the 4th Industrial Revolution in Bangladesh.” This research aims to explore evolving skill demands, identify emerging job prospects, and provide actionable insights to help Bangladesh in harnessing the full potential of 4IR. The study examines the current landscape of occupational roles and skill requirements across

16 pivotal sectors, including ICT, Agro-Food, RMG, Furniture, Tourism and Hospitality, Transportation, Light Engineering, Insurance and Banking, Construction, Creative Media, Ceramic, Informal Small and Medium Enterprises, Leather, Pharmaceuticals, Real Estate, and Healthcare Services.

To analyze these industries in the context of 4IR, the study utilized a robust methodology involving in-depth literature reviews and structured consultations with key stakeholders. Data was collected through workshops, focus group discussions, key informant interviews, and industry visits, projecting the transformative effects of automation and the emergence of new occupations over the next 25 years. The findings reveal that a significant portion of the workforce in key industries is at risk of job displacement due to robust automation technology, with transformative impacts expected across all 16 sectors. The study identifies occupational roles highly susceptible to computerization, as well as emerging trades and skills in demand across these industries.

Key future skills such as robotics control, augmented reality, cybersecurity, data analytics, and digital marketing are critical for workforce adaptability. Workers with limited skills face the highest risk of job displacement, highlighting the need for targeted development. The study underscores the importance of sector-specific strategies and internal assessments to balance automation with inclusive growth. It provides actionable recommendations for stakeholders to build a skilled, future-ready workforce and invites collaboration on a holistic strategy for sustainable development in the 4IR era.

Potential Skills of 4IR: A Comprehensive Overview of Key Sectors in Bangladesh

Introduction

Background of Future Skills

The Fourth Industrial Revolution (4IR) marks a transformative era characterized by the convergence of technologies that blur the lines between physical, digital, and biological realms. This revolution introduces unprecedented connectivity, automation, and data-driven decision-making, driven by groundbreaking advancements such as artificial intelligence, robotics, the Internet of Things (IoT), big data analytics, and advanced manufacturing. These innovations have the potential to revolutionize industries, significantly enhancing efficiency, productivity, and innovation. In Bangladesh, embracing 4IR is crucial for fostering economic growth, enhancing competitiveness, and promoting comprehensive development across various sectors. By integrating digital technologies and 4IR principles, industries such as manufacturing, agriculture, healthcare, and services can improve productivity, allowing the nation to leapfrog technologically and achieve greater global integration. Moreover, 4IR promises to create new employment opportunities, nurture skill development, and stimulate entrepreneurship, contributing to inclusive growth and reducing socioeconomically unbalanced situations..

As the 4IR unfolds, it is imprinting itself on Bangladesh, driving significant technological advancements and transforming diverse sectors. The rapid expansion of the ICT sector, centered on software development, IT-enabled services, and digital entrepreneurship, illustrates the country's commitment to leveraging digital technologies for economic advancement. Industries like manufacturing, agriculture, and healthcare are increasingly adopting automation, robotics, and data analytics to enhance their productivity and foster innovation. The government actively promotes digital inclusion and connectivity, striving to bridge the digital divide and equip its population with essential digital skills. The growing startup ecosystem reflects the emergence of technology-driven enterprises across various sectors, signaling a shift toward a more innovative economy. However, challenges remain, such as ensuring digital literacy and addressing infrastructure gaps. Nevertheless, Bangladesh is making remarkable strides to harness the immense potential of 4IR.

a2i, an initiative by the Government of Bangladesh, is conducting in-depth research to prepare the nation and its workforce for the demands of the Fourth Industrial Revolution (4IR). This report, part of that ongoing effort, was developed through a multi-stakeholder consultation process. Workshops were held to explore technological trends in Bangladesh and their effects on businesses and workers across sixteen key sectors, providing insights to align workforce skills with future industry needs.

Overview

The country's economic landscape comprises diverse sectors to its growth and development. The report consists of sixteen most noteworthy sectors that are going to and already using the technology of 4IR. The Agro-food sector focuses on agricultural production and food processing, while the Ceramic sector thrives on manufacturing products for both domestic and international markets. The Construction sector is booming, driven by infrastructure development and urbanization, creating opportunities in real estate and civil engineering. In the Creative Media sector, growth is evident in digital content creation, animation, and gaming. The Healthcare industry is expanding rapidly to meet the needs of a growing population, necessitating skilled professionals and advanced medical technologies.

Moreover, the ICT sector is dynamic, propelling innovation and IT-enabled services. The Informal Small and Medium Enterprise sector plays a pivotal role in generating employment across various industries, while the Banking and Insurance sector provides essential financial services to support economic activities. The Leather sector is renowned for its high-quality products, catering to global and local demand, and the Light Engineering sector contributes to industrial growth through machinery parts and equipment manufacturing. The Pharmaceutical sector is rapidly expanding, producing a wide range of medicines and healthcare products. The Real Estate sector thrives due to urbanization. The RMG and textile sector, one of the largest textile exporters globally, significantly bolsters the economy. The Tourism & Hospitality sectors are also witnessing remarkable growth, catering to both domestic and international tourists. Collectively, these sectors contribute to Bangladesh's economic development and provide significant employment and investment prospects. With a vision to emerge as a digital economy powerhouse, the country recognizes the transformative power of emerging technologies and their profound impact on various sectors.

This report aims to deliver a concise yet comprehensive overview of these significant sectors, highlighting their progress, challenges, and professional development within the context of 4IR. To fully capitalize on the advantages of the revolution, Bangladesh must adopt a comprehensive approach that encompasses both policy and infrastructure development. Central to this strategy is the investment in digital infrastructure, such as high-speed internet connectivity and data centers, which are vital for the effective implementation of 4IR technologies. Additionally, educational reforms are imperative to equip the workforce with the necessary skills and knowledge for the digital era, including promoting STEM education, digital literacy, and vocational training centered around emerging technologies. Moreover, creating an enabling ecosystem for innovation and entrepreneurship is crucial. This involves fostering research and development, providing financial incentives and support to startups, and facilitating collaboration between academia, industry, and government. These measures will drive innovation, accelerate the adoption of 4IR technologies, and pave the way for transformative advancements. Collaboration and partnerships between the public and private sectors both domestically and internationally play a pivotal role in leveraging expertise, accessing resources, and sharing best practices. By working

together, stakeholders can collectively drive the adoption of 4IR technologies and unlock their full potential. Furthermore, developing policy frameworks that address regulatory challenges, data privacy, and cybersecurity is essential to instill trust and ensure a secure digital environment for all. By pursuing this comprehensive strategy, Bangladesh can position itself at the forefront of the 4IR revolution, reaping its benefits and propelling the nation towards a digitally advanced and prosperous future.

Research Methodology

The researcher used a robust methodology to create this report, starting with a thorough desk study that reviewed international journals, strategies from other nations, and relevant online resources. This foundational research included a comprehensive review of existing literature and case studies.

After the desk study, the consultant and a2i team developed a detailed framework for consultative workshops. Using this framework, they organized workshops with key stakeholders from sixteen sectors to ensure an inclusive view of sector-specific needs. Discussions were recorded, transcribed, and analyzed to produce an initial draft. To deepen the findings, the consultants conducted further interviews with subject-matter experts to clarify any issues raised in the workshops.

In collaboration with the a2i team, the consultant identified factories in Bangladesh currently adopting automation, visiting these sites to observe changes firsthand. Industry visits provided firsthand observations of practices, adding depth and relevance to the data. This study engaged over 600 industries, collaborated with more than 20 industry associations and Industry Skills Councils (ISCs), and connected with over 50 training centers, securing a broad perspective on skill development across sectors. This multifaceted approach captured diverse viewpoints and provided a clear understanding of Bangladesh's workforce readiness for the Fourth Industrial Revolution (4IR). At the end of this process, the research findings were presented to and reviewed with a2i representatives, resulting in this comprehensive report that examines the impact of technology across various sectors.

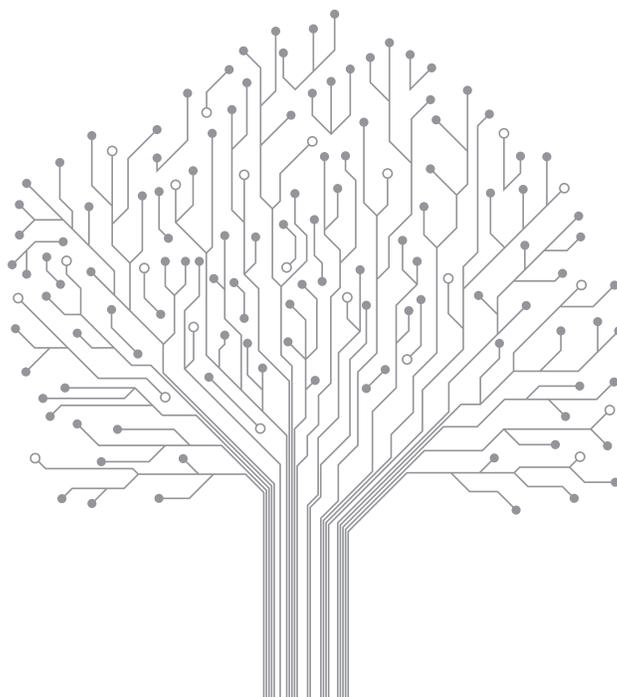
During the workshops, the facilitation team, supported by a2i, used a structured approach to optimize expert contributions. Participants, carefully selected from relevant stakeholder groups, were introduced to 4IR concepts through an audiovisual presentation. Stakeholders then shared their firsthand observations on automation within their industries. For the final stage, participants formed groups to discuss key topics and presented their insights to the larger group. Feedback from these discussions was documented and verified through secondary research and follow-up interviews to ensure clarity and accuracy. These collective efforts culminated in a report that delivers a thorough analysis of how technology will shape Bangladesh's industries in the 4IR era.

Limitations

This comprehensive study, based on expert industry insights, offers important guidelines for future skill development, though additional research is required to confirm its findings. A key achievement of the study was identifying specific areas needing further exploration. However, limited data availability on this topic especially within Bangladesh and other developing countries posed challenges. Unlike prior studies that analyzed only five sectors, this research has successfully expanded the scope to cover sixteen sectors, reflecting significant progress. Despite this, the lack of data made it challenging to verify certain conclusions, necessitating reliance on primary data collected through workshops and key informant interviews. Furthermore, digital literacy and infrastructure limitations could impact the effective implementation of 4IR technologies. The continuously evolving technological landscape also calls for ongoing skill development to prepare the workforce for future demands. Addressing these issues will require sustained investments by both government and industry to enhance digital infrastructure, such as high-speed internet and advanced data centers, which are essential for broader technology adoption and workforce readiness in the coming years.

Provision for Further Research

Further research is necessary to fully understand the evolving skill demands of 4IR in Bangladesh, particularly in sectors like healthcare, ICT, and manufacturing. Future studies could focus on specific skill development within these sectors, assessing the impacts of STEM education, digital literacy initiatives, and vocational training programs. Additionally, a closer look at policy frameworks, cybersecurity, and data privacy issues will be essential to establish a secure, trustful digital environment. Enhancing collaboration between academia, industry, and government would help bridge knowledge gaps and drive sustained innovation.





PART-B

**ICT
SECTOR**

Introduction

In the dynamic landscape of South Asia, Bangladesh is rapidly becoming a leader in Information and Communication Technology (ICT). Over the past few decades, the nation has undergone a remarkable transformation, leveraging technology to propel its economy, society, and governance. This progress is fueled by a focus on innovation, infrastructure development, and investment in human resource development.

Bangladesh's ICT sector has experienced remarkable growth with a series of planned initiatives and policies. Since 2009, there has been a rigorous effort to improve infrastructure, develop a skilled workforce, and promote e-governance. These initiatives have laid the groundwork for a thriving IT-enabled services industry. Bangladesh has emerged as a significant player in the global ICT arena, with its tech sector contributing to the country's economic development.

The ongoing focus on integrating technology across various sectors reflects a broader vision to create a more connected and efficient nation. Efforts to leverage ICT are not just about improving digital connectivity but also about using technology to empower citizens, streamline government services, and stimulate economic innovation. Through continuous investment in technology and innovation, Bangladesh is positioning itself to meet the challenges of the modern world while fostering sustainable development.

Importance of the Sector

The ICT sector has become an increasingly vital sector for Bangladesh's economy and development. As per data from the Bangladesh Bureau of Statistics, the sector's contribution to GDP grew from 1.47% in FY2010–11 to 2.94% in FY2020–21^a. Major subsectors like mobile technology, outsourcing, software services, and IT-enabled services have fueled this growth. ICT exports from Bangladesh have also risen significantly, reaching \$1 billion in FY2020–21, according to the Ministry of Commerce^b.

The Bangladesh Telecommunication Regulatory Commission reports that internet and smartphone penetration exceeded 160 million and 150 million users, respectively, by December 2021^{a,b}. This rising digital access is empowering citizens through platforms for education, healthcare, agriculture, and commerce. ICT-driven initiatives in education have resulted in a 35% increase in digital literacy rates from FY2015–16 to FY2020–21^c. Telemedicine services have expanded, reaching over 10 million consultations in FY2020–21^c. Between FY2017–18 and FY2020–21, agriculture saw a 20% boost in productivity due to digital platforms and IoT applications. Governance improvements through e-government initiatives have streamlined public services, reducing processing times by 40% from FY2016–17 to FY2020–21^{a,b,c}.

a <https://businessinspection.com.bd/industry-wise-gdp-contribution-in-bd/>

b Bangladesh's ICT Sector: A new driver of economic growth (banglatribune.com)

c By 2030, Bangladesh will be the 24th largest economy. Here's how ICT is driving that growth | World Economic Forum (weforum.org)

Impact of the 4IR in the sector

4IR has profoundly impacted the ICT sector, revolutionizing how technology is utilized and transforming various aspects of society. The convergence of digital technologies, such as artificial intelligence (AI), big data, robotics, and the Internet of Things (IoT), has unleashed unique opportunities and challenges for the ICT sector. It has paved the way for advanced automation, intelligent systems, and data-driven decision-making, enhancing productivity, efficiency, and innovation across industries. However, it has also presented new privacy, security, and ethical challenges. It requires a comprehensive approach to ensure the responsible and inclusive adoption of 4IR technologies in the ICT sector.

Occupations at Risk

While adopting 4IR technologies brings numerous benefits to Bangladesh's ICT sector; there are also certain occupational risks associated with using these advanced technologies. Some of the risky occupations within the ICT sector that arise from the implementation of 4IR technologies are enlisted in the following table with approximate projected demand for the year of 2025, 2030 & 2040.

SL No.	Occupation	Human Resource (Thousand)		
		2025	2030	2040
1	Cybersecurity Practitioners (Case Basis)	30	26	16
2	Data Entry and Checkers (Desk Based)	55	46	23
3	Maintenance and Operation Technician	36	26	15
4	Tech Support Specialist	30	26	16
5	Computer Service Provider	77	43	38
6	System Administrator	51	33	28
7	Network Administrators	45	35	22
8	Database Administrators	40	32	18
9	Quality Assurance (QA) Testers	35	28	16
10	IT Support Technicians	50	38	26
11	Technical Writers	22	19	14
12	Help Desk Operators	40	30	20
13	Technical Sales Representatives	37	29	22
14	Telecommunications Technicians	33	27	19
15	Web Developers (Basic Level)	48	36	24
16	Digital Marketers (Entry Level)	42	33	22
17	Data Analysts (Basic Reporting Roles)	38	31	21

By addressing these risks and ensuring the availability of skilled professionals in relevant domains, Bangladesh can harness the transformative potential of 4IR technologies while safeguarding against potential challenges.

Emerging Occupations and Skillsets

The emergence of the 4IR technologies in the ICT sector has given rise to new occupations and skills sets in Bangladesh. As the country embraces the opportunities presented by 4IR, the following are some of the emerging disciplines and their skillsets with the projected demand (aprox) are presented in the following table which are becoming increasingly important in ICT sector.

SL No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
Core Occupation					
1	Artificial Intelligence (AI) Specialist	Able to develop and implement AI algorithms, machine learning models, and natural language processing systems	11	36	51
2	Machine Learning Engineer	Able to build and apply machine learning models to solve business problems and gain insights from data	15	40	80
3	Business Intelligence (BI) Developer	Able to design, develop and implement BI and data warehouse solutions to support business analytics and data-driven decision making	10	30	60
4	Big Data Architect	Able to architect big data systems involving data ingestion, storage, processing and analytics to derive insights at scale	8	25	50
5	Python Expert	Proficient in Python programming skills for data analysis, machine learning, web development, system automation etc	5	15	30
6	Data Scientist	Able to possess the skills to collect, process, and analyze data, uncovering patterns, trends, and correlations	12	39	66
7	Cybersecurity Expert	Able to protect sensitive information and mitigate cyber threats	23	44	79
8	Robotics Engineer	Able to possess expertise in designing, developing, and maintaining robotic systems that enhance productivity and efficiency	26	52	69
9	ROS Developer	Proficient in building robotics applications using Robot Operating System (ROS)	30	60	90
10	IoT Specialist	Able to connect devices, analyze sensor data, and develop IoT applications	12	18	27
11	IoT Developer	Proficient in developing Internet of Things solutions involving connected devices, sensors, cloud platforms and analytics	15	25	40
12	Blockchain Expert	Able to possess the skills to design and develop decentralized applications, smart contracts, and secure digital transactions using blockchain technology	11	35	51

SL No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
13	Augmented Reality (AR) and Virtual Reality (VR) Developers	Able to create immersive experiences, develop AR/VR applications, and integrate these technologies into various sectors	10	25	32
14	Cloud Computing Specialist	Skilled in Cloud computing has become a fundamental aspect of modern ICT infrastructure	12	36	64
15	Cloud Architect	Skilled in designing distributed cloud architectures and systems	8	25	50
16	Cloud Engineer	Skilled in deploying, resizing, monitoring, and maintaining services in the cloud	12	30	60
17	Cloud Software Engineer	Skilled in developing and managing cloud-native applications and services	10	28	55
18	Cloud Data Scientist	Skilled in programming, analytics, data visualization in cloud environments	7	20	40
19	Cloud Automation Engineer	Skilled in automation, integration & optimization of cloud infrastructure and services	5	15	30
20	Cloud Security Analyst	Skilled in securing systems, applications, identity & access controls in cloud computing	15	35	70
21	Cloud Network Engineer	Skilled in cloud networking, traffic management, virtual private networks (VPNs)	10	25	50
22	Cloud Support Engineer	Skilled in monitoring systems, troubleshooting issues, and providing user support in cloud environments	12	27	56
23	Cloud Administrator	Skilled in administering cloud infrastructure, platforms, applications and managing user accounts	12	30	60
24	Software Developer	Skilled in developing software for cloud-based applications	15	40	80
25	Cloud Practitioner	Basic understanding of cloud concepts, models, technologies and terminology	5	15	30
26	Cloud Solution Architect	Skilled in designing holistic cloud solutions based on client requirements	10	30	60
27	Apps Developer	Skilled in developing mobile, desktop or web applications for cloud deployment	10	28	55
28	Website Developer	Skilled in designing, developing and maintaining websites and web applications on cloud infrastructure	8	25	50
29	Ethical Hacker	Skilled in penetration testing, vulnerability assessment and risk analysis of cloud systems and applications	10	24	52

SL No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
30	AI-driven Customer Experience Designer	Able to create personalized shopping experiences using AI, design customer journeys, and optimize user interfaces	9	22	40
31	E-commerce Data Analyst	Able to analyze customer data, sales trends, and market behaviors to support data-driven decisions in e-commerce	7	20	45
32	Digital Payment Solutions Architect	Able to design and manage secure digital payment systems and integrate them with e-commerce platforms.	7	19	38
33	E-commerce Personalization Engineer	Able to develop algorithms and systems for delivering personalized shopping experiences based on user behavior	6	16	34
34	Voice Commerce Developer	Able to create and optimize voice-activated shopping experiences for virtual assistants like Alexa or Google Assistant.	5	15	30
35	Sustainability Compliance Officer	Able to ensure that e-commerce practices are environmentally sustainable and comply with international standards	4	12	25
36	Cross-border E-commerce Consultant	Able to expand e-commerce businesses into international markets by navigating logistics and regulatory compliance	4	11	23
37	Omnichannel Communication Manager	Able to manage and integrate various communication channels (voice, chat, social media, etc.) for a seamless customer experience	6	16	33
38	Voice Analytics Specialist	Able to analyze customer interactions using voice analytics tools to improve service quality and customer satisfaction	5	14	31
39	Remote Workforce Manager	Able to manage remote call center agents, ensuring productivity, compliance, and quality of service	5	13	28
40	AI-Powered Call Routing Specialist	Able to design and manage AI systems that optimize call routing based on customer needs and agent availability	5	14	30
41	Emotional AI Specialist	Able to develop AI systems that detect and respond to customer emotions, improving the quality of customer interactions	6	15	33
42	Virtual Call Center Trainer	Able to provide training to call center agents using VR or AR to simulate customer interactions	4	12	26

SL No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
43	Call Center Automation Engineer	Able to automate repetitive tasks in call centers using robotic process automation (RPA) and AI	6	15	31
44	Customer Engagement Strategist	Able to develop strategies to enhance customer engagement across multiple touchpoints, ensuring cohesive communication	5	13	28

These emerging occupations require diverse skills sets, including proficiency in programming languages, data analysis, machine learning, cybersecurity, and domain expertise. Continuous learning, adaptability, and a strong foundation in ICT fundamentals are crucial for professionals seeking to thrive in Bangladesh’s evolving ICT landscape driven by 4IR technologies.

Recommendations

In today’s rapidly growing technological landscape, the integration of 4IR technologies has become essential for staying competitive and driving progress. As these technologies, such as AI, robotics, and IoT, become more prevalent, they are reshaping the job market by rendering some traditional professions outdated while simultaneously creating the need for upskilling and reskilling in various fields. Additionally, the rise of 4IR has given birth to new professions that are now in high demand, reflecting the shift towards a more digital and automated future. Policymakers and governments are advised to adopt several key measures:

- Implementing 4IR technologies such as AI, robotics, edge computing, cloud computing, blockchain, big data analytics, 5G technology, AR and VR, cybersecurity solutions, and robotics is crucial for the transformative development of the country, as these technologies are readily available in both national and international markets. Therefore, to keep up with it, the existing and upcoming labor forces needs to possess the necessary skills.
- Bangladesh Hi-Tech Park Authority (BHPTA), Department of Information and Communication Technology (DoICT), and Bangladesh Computer Council (BCC) can take an initiative to improvise the training program in the context of 4IR and collaborate with the training institution to offer specialized courses in 4IR-related field to foster a talent pool of tech professionals.
- Bangladesh Association of Software and Information Services (BASIS), Bangladesh Association of Contact Center and Outsourcing (BACCO), Bangladesh Computer Samity, Internet Service Providers Association of Bangladesh (ISPAB), and e-Commerce Association of Bangladesh (e-CAB) can establish 4IR cell and support their member companies.



Agro-Food Sector



Introduction

Agro-food production and processing make up Bangladesh's enormous Agro-food economy. Agro-food encompasses poultry, fisheries (fish processing and dry fish processing), dairy, fruit processing, bread, spices, and crop processing. There are 30,000 enterprises which include 100 majors, 2000 mediums, 5,000 smalls, 8,000 cottages, and 14,900 microenterprises^a. This sector employs 28,54,000 (approx.) people, of whom 15% are seniors, 60% are mid-level, and 25% are juniors^a. The rapid adoption of new technology in every subsector is commendable. Farmers have sought strategies to increase output, reduce waste, and reduce their environmental impact for decades. Agriculture can flourish and be sustainable using modern technologies.

Modern instruments and computerized management systems help farmers track crops, alter planting, and decrease costs. Advanced technology lets farmers calculate the irrigation, fertilizer, and pesticides needed in each farm area. By assessing demand and production forecasts, we can balance Agro-food production and processing with the labor-intensive 4IR sector. Hygienic, safe, standard food goods for export zones require expert personnel. To address skilled worker demand, a skill development plan is needed.

Agro-food ISC expects a skilled workforce for the industry. Promoting food industry skills for decent employment of the poor, women, and others to boost businesses' productivity, quality, and profitability to achieve onset status by 2040. The Agro-food sector's objective is a skilled and hunger-free Bangladesh.

Importance of the Sector

Bangladesh is an agriculture-based country, and it is a good sign that people have started to use tractors for cultivating lands, automatic harvesting machines, and drones for spraying pesticides and paddy field investigation. The statistics for Bangladesh show that only 30% of working employees are skilled in their respective fields. The Agro-food sector plays a vital role in the economic development of Bangladesh. According to the report of FY2022-2023^{b,c}, this sector (including crops, animal husbandry, forests, and fishing) contributes approximately 11% of GDP, a decline from 14.74% in previous years (Quarterly Labor Force Survey 2015-16), and employs about 36.86% of the labor force, down from 41% previously reported. At present, the increase in population, income, urbanization, and the excellent prospects of exports have combined to make the sector expand its scope, diversify its products, increase its value-added products, and finally make it a significant source of employment.

Bangladesh government is following to maintain the SDG target. Eliminating poverty (SDG 1); Zero hunger (SDG 2); Excellent education (SDG 4); Decent jobs and economic growth (SDG 8); Industrial innovation and infrastructure (SDG 9); Responsible consumption and production (SDG 12); and climate action (SDG 13) connects to agriculture and food are directly related with the agro-food sector. Food are directly related with the agro-food sector. For faster achievement, our agricultural sector needs further improvement. The 4IR can play a great role. A hunger-free Bangladesh is possible with the 4IR in Agro-food. That is why, agriculture and food production are

a <https://policylinkglobal.org/newsroom/shaping-bangladeshs-path-to-improved-food-safety>

b <https://www.trade.gov/country-commercial-guides/bangladesh-agriculture-sectors>

c <https://www.thedailystar.net/recovering-covid-reinventing-our-future/blueprint-brighter-tomorrow/news/role-agriculture-bangladeshs-economic-growth-2960736>

developing day by day with the use of new technologies. Scientists are researching and creating new technologies for the agro-sector. Bangladesh's Agro-food processing industry accounts for 8% of manufacturing production contributing 1.7% of GDP with a high workforce.

Impact of the 4IR in the sector

There is a sense of urgency as Bangladesh prepares for the 4IR. The nation has set an ambitious target to leave the Least Developed Country (LDC) category in 2026, move into the upper-middle income category in 2031, and become a high-income country in 2040 ^{d,e}. This means that Bangladesh will see the effects of 4IR on agriculture more than any other area of the economy. Technology advancement is needed in traditional agriculture, especially crop production, where smallholders predominate.

Agriculture and Industry in 4IR are intertwined. It uses modern technologies and data to boost productivity and efficiency in farming. Agro-food is adopting current 4IR applications. In The World Government Summit (2018), Oliver Wyman's research titled 'Agriculture 4.0: The Future of Farming Technology' found that population increase, resource scarcity, climate change, and food waste will affect agriculture in the future. The term 'Agriculture 4.0' is used to describe the anticipated changes by new technologies, notably the application of AI to facilitate greater robotic integration and make wiser planning decisions. Crop cultivation and harvesting, weeding, milking animals, and pesticide distribution through drones might all be done by intelligent robots. Other agricultural-specific technologies include vertical farming, and new gene-editing tools to create crops with improved yields and disease resistance ^f.

Over 70% of Bangladesh's suitable land is used for cultivating crops, and nearly 50% of the country's population works mainly in agriculture. Consequently, there is a lot of room for technical advancement in agriculture. It is also possible to assert the technologies, especially for several important crops like rice, jute, wheat, tea, legumes, oil seeds, vegetables, and fruits. However, a recent Food and Agriculture Organization (FAO) assessment states that the quoted comma will start from "our" not from "has" It is anticipated that 4IR would increase labor and land production while relieving growers of the strenuous labor required to cultivate and harvest crops ^g.

Occupations at Risk

In the agro-food sector, there are some professions whose demand will be in decreasing mode concerning time (years). It's important to note that many of the occupations that are at risk can be mitigated with proper training (upskilling/reskilling), safety protocols, and adherence to regulations. The daily labor-based workers' demand will be drastically reduced. Some of the risky occupations within the Agro-food sector that arise from the implementation of 4IR technologies are enlisted in the following table with approximate projected demand for the year of 2025, 2030 & 2040.

^d <https://www.thedailystar.net/news/bangladesh/development/news/bangladesh-has-capacity-become-upper-middle-income-country-2031-iccb-3585001>

^e <https://www.thedailystar.net/opinion/open-dialogue/news/graduation-middle-income-status-bangladesh-must-address-institutional-weaknesses-2915236>

^f <https://eias.org/policy-briefs/towards-the-middle-income-status-in-bangladesh/>

^g <https://cgs-bd.com/article/5766/Graduation-to-Middle-Income-Status--Bangladesh-Must-Address-Institutional-Weaknesses>

Sl. No.	Occupation	Human Resource (Thousand)		
		2025	2030	2040
1	Agriculture Field Technician	23	17	10
2	Food Processing Plant Operator	49	30	15
3	Agricultural Chemical Applicator	37	24	10
4	Agricultural Field Worker	30	23	11
5	Food Safety Inspector	26	18	10
6	Basic Data Analysts	35	25	15
7	Manual Precision Agriculture Worker	30	20	11
8	Manual Technicians	25	18	10
9	Basic Farm Management Software Developers	30	20	12

Emerging Occupations and Skillsets

The Agro-food sector needs 4IR technologies, including AR, VR, AI, and IoT. An advanced agro-food processing system generally uses 4IR technologies including PLC programming, power technology, control techniques, automated food packaging, food safety analysis, e-banking, e-communication, data analysis, digital weighting, counting, and coding of product service.

Modern instruments and computerized management systems help farmers in all respects. Advanced technology lets farmers calculate the amount of irrigation, fertilizer, and pesticides needed in each farm area. To understand how Industry 4.0 affects agriculture, let's examine its applications. Industry-specific AI lets robots gather data, assess situations, and deliver real-time insights. AI improves crop quality, identifies plant diseases and pests, and determines herbicide placement and timing. Vertical agriculture is a new concept that uses cutting-edge technologies to harness resources economically and produce more food in a smaller space than row-wise planting crops. The 4IR has brought significant advancements and transformations in various industries, including the agriculture and food sectors. As the country embraces the opportunities presented by 4IR, the following are some of the emerging disciplines and their skillsets with the projected demand (aprox) are presented in the following table which are becoming increasingly important in agro-food sector.

SL No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
Core Occupations					
1	Precision Agriculture Specialist (agriculture)	Help farmers make data-driven irrigation, fertilization, pest management, and crop health decisions	2	15	22
2	AI-powered Farm Management Software Developer	Develop software using AI/ML to optimize farm operations and productivity	5	18	30
3	Agricultural Data Scientist (agriculture)	Analyze big data on soil quality, weather, agricultural yield, and market trends	46	65	89
4	Agricultural Machineries and Robotics Engineer	Operate autonomous vehicles, robotic arms, and other smart machinery to improve farming efficiency and reduce labor costs	43	73	90
5	Food Safety Technologist (Agro-Food)	Use blockchain, IoT sensors, and data analytics to monitor food safety and quality throughout the supply chain	11	22	30
6	Vertical Farming Specialist (Agriculture)	Manage vertical farming systems using hydroponics, LED lighting, and climate control to maximize crop production in limited spaces	14	22	47
7	Agro-Tech Entrepreneur (Agro-Food)	Build innovative farming technologies, farm management software, or platforms that connect farmers with buyers or provide market insights	9	18	25
8	Sustainable Agriculture Consultant	Help farmers adopt sustainable practices and navigate certification	13	20	41
9	Agro-Biotechnologist (Agriculture)	Apply molecular genetics, plant biotechnology, genomic analysis techniques like next-generation sequencing, bioinformatics, and genetic engineering using CRISPR-Cas9 and other gene-editing tools. Leverage technologies like tissue culture, marker-assisted breeding, and machine learning for crop and trait optimization	18	35	50

SL No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
10	Agro-Food Supply Chain Analyst	Increase efficiency, reduce waste, and ensure timely delivery of agricultural products by using data analytics, AI, and logistics optimization	15	22	31
11	AI-assisted Data Analyst	Analyze agricultural data using AI/ML tools	5	15	25
12	Robotics Technicians	Maintain and repair agricultural robots	8	18	30
13	Drone Pilot and Data Acquisition Specialist	Operate drones for crop monitoring, data collection, and analysis	7	15	25

Recommendations

The agro-food sector faces challenges from climate change and automation, traditional farming roles are becoming gradually risky. To stay relevant, workers must upskill and reskill in areas like precision agriculture and biotechnology. Emerging professions driven by 4IR advancements are gaining importance. Policymakers and governments are requested to adopt several key measures:

- The public-private skills service providers need to arrange reskilling programmes (especially on drone operation, AI, Robotics, IoT, and Cloud computing technology) to accommodate the workforce at risk in the context of 4IR.
- Bangladesh Agro-Processors Association (BAPA), Bangladesh Agro-Processors' Association (BAPA), Bangladesh Frozen Foods Exporters Association (BFFEA), Bangladesh Organic Products Manufacturers Association (BOPMA), and Agriculture Industry Skill Council (AISC) can establish a 4IR cell to guide their member industries, foster industry-academia collaboration, and arrange continuous policy dialogue.
- The Agriculture Training Institute (ATI) can include 4IR elements/skills in agricultural diploma programmes.
- The National Agriculture Training Academy can add 4IR elements/skills in short courses to prepare the future workforce.







RMG & Textile Sector



Introduction:

Bangladesh has made remarkable economic and social progress in recent decades in which the Ready Made Garment (RMG) sector has already played an important role. Despite the challenges brought forth by the COVID-19 pandemic, the nation remains resolute in its pursuit of becoming a middle-income country within the next seven years. The backbone of this success lies in the RMG industry, which has propelled Bangladesh to the forefront of global garment exporters. Over the past ten years, the RMG sector has undergone rapid development and modernization, significantly improving the working conditions of around four million employees. However, the pandemic has momentarily hindered the industry's growth, especially with the emergence of global fashion sourcing trends that potentially threaten Bangladesh's supply chain position. Recognizing the critical importance of the RMG sector, the Bangladesh German Chamber of Commerce and Industry collaborated a decade ago, in 2011, to release "Bangladesh's Ready-made Garments Landscape: The Challenge of Growth." For the past four decades, the RMG industry has played a pivotal role in Bangladesh's progress. Aiming to achieve high-income status through industrialization, the growth and potential of the RMG industry will be instrumental in attaining these ambitious goals..

In addition to Bangladesh's economic achievements, the country's RMG sector has earned global acclaim through the widely recognized "Made in Bangladesh" label. The RMG industry has significantly contributed to Bangladesh's economic prosperity, accounting for 84% of export revenues. The journey of garment manufacturing in Bangladesh commenced over 60 years ago in 1960 with the establishment of Reaz Store, later renamed Reaz Garments Ltd. It took until 1973 for the RMG sector in Bangladesh to make its inaugural shipment of clothing overseas.

The growth and expansion of Bangladesh's garments sector can be attributed to several factors, including the EU GSP program, the establishment of Export Processing Zones (EPZs), and the provision of back-to-back Letter of Credit (LC) facilities for manufacturers. These initiatives have enabled small and major manufacturers to thrive in the industry. Notably, Bangladesh boasts nine of the world's top ten green garment manufacturers, as recognized by the Bangladesh Garment Manufacturers and Exporters Association (BGMEA). The country has also received accolades with 135 Leadership in Energy and Environmental Design (LEED) green garment factories certified by the US Green Building Council (USGBC), with an additional 500 factories currently being certified.

Despite its noteworthy sustainability achievements, Bangladesh's garment industry has faced challenges in diversifying its product range. While it houses the highest number of LEED-certified manufacturers worldwide, the sector has predominantly focused on producing low-cost goods, indicating the need for increased investment in diversification. Nevertheless, equipped with a solid foundation and remarkable capabilities, the RMG industry possesses the potential to explore new avenues and expand beyond its current comfort zone.

Importance of the Sector:

RMG industry has emerged as a front runner in growth and foreign exchange profits, surpassing other sectors. It plays a significant role in the national economy by providing ample job opportunities and contributing to social development, thereby alleviating poverty. Despite its undeniable success, this industry faces several formidable barriers to future expansion. This sector has the capacity and potential to help Bangladesh achieve its vision and goals.

Over the past three decades, the RMG sector has substantially contributed to the country's physical infrastructure, establishing 4,222 RMG units. Moreover, it has played a crucial role in developing human capital, with nearly 4 million employees directly engaged in the industry. Women empowerment is also a notable achievement, as approximately 90% of the labor force in the RMG sector comprises females, the highest proportion in Southeast Asia. Regarding key economic factors, RMG accounts for approximately 14.07% of Bangladesh's GDP^a. However, the study identifies several challenges hindering the industry's development. These include issues such as unskilled labor, inadequate infrastructure, energy crisis, high-interest bank loans, high tax rates, complex social compliance requirements, limited market and product diversification, compliance pressure from international agreements, and a lack of integration. To overcome these challenges, both the public and private sectors must collaborate and coordinate their efforts.

Environmental sustainability has emerged as a major concern in today's era of industrialization, and the RMG industry recognizes the significance of addressing this issue. Today's consumers are increasingly concerned about environmentally responsible production processes. To achieve its goals, the RMG industry in Bangladesh must adopt cleaner and enhanced technologies as well as management practices that prioritize a healthier environment. Industry owners have actively sought and implemented eco-friendly manufacturing guidance from globally renowned organizations, taking into account client demands and requirements. Sustainable development goals that are connected with this sector include cleaner water and sanitation, affordable and clean energy, industrial innovation, infrastructure development, climate action, and responsible consumption and production. Environmental sustainability is influenced by factors such as energy usage, water consumption, and proper storage and handling of chemicals. Addressing these aspects, it is crucial for the long-term success and sustainability of Bangladesh's RMG industry.

^a <https://emergingrating.com/wp-content/uploads/2022/11/RMG-Industry-of-Bangladesh-The-Challenges-and-Opportunities.pdf>



Impact of the 4IR in the sector:

The 4IR has brought about a remarkable transformation in Bangladesh's RMG sector, presenting opportunities and challenges. The sector has witnessed a significant boost in productivity and cost-effectiveness by implementing automation and robotics. The utilization of data analytics and AI has greatly optimized production planning and decision-making processes. Moreover, the digitalization of the industry has expanded market reach and connectivity, enabling greater market penetration. However, for inclusive growth, it is essential to prioritize upskilling the workforce and bridging the digital divide. Smaller manufacturers may require assistance in adopting new technologies to prevent a widening technological gap. In conclusion, the 4IR has revolutionized the RMG sector, improving efficiency and decision-making, but addressing workforce adaptation and technological disparities is vital for sustainable development.

Occupations at Risk:

With the introduction of new technologies and the automation of processes, it is to be expected that the labor force would experience unemployment issues. When equipment is introduced into processes, it is more likely to affect unskilled and semi-skilled labor than skilled workers. One big disadvantage of the sector is that a large group of workers is unskilled, and it is these individuals who would suffer the most because of the adoption of 4IR technology. Continuous skill development and knowledge upgrading are essential to ensure Bangladesh's safe and sustainable RMG sector. Bangladesh's RMG sector encompasses various risky occupations and skill sets due to their nature and associated challenges. Some of the risky occupations within this sector that arise from the implementation of 4IR technologies are enlisted in the following table with approximate projected demand for the year of 2025, 2030 & 2040.

SL No.	Occupations	Human Resource (Thousand)		
		2025	2030	2040
1	Garment Factory Worker	85	77	58
2	Cutting and Sewing Technician	63	38	19
3	Maintenance Technician	29	21	12
4	Quality Assurance Inspector	21	6	0
5	Dyeing and Printing Technician	77	53	33
6	Pattern Designer	29	21	13
7	Compliance Officer	40	27	19

Emerging Occupations:

The rapidly evolving nature of the RMG sector in Bangladesh necessitates the emergence of new occupations and skill sets. As the country embraces the opportunities presented by 4IR, the following are some of the emerging disciplines and their skillsets with the projected demand (aprox) are presented in the following table which are becoming increasingly important in RMG sector.

SL No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
Core Occupations					
1.	Additive Manufacturing Technician	Operates and maintains additive manufacturing equipment to produce textile and apparel prototypes and products	15	30	55
2.	Automated Cutting Specialist	Operates computerized cutting machinery with automated optimization of fabric usage	10	25	50
3.	Robotics Engineer	Designs and implements robotic automation solutions for industrial processes like sewing, inspection, packaging etc	8	20	40
4.	AR/VR Designer	Creates and tests virtual/augmented reality experiences for areas like online shopping, digital sampling, wearable simulations	5	15	35
5.	Textile Recycling Technician	Operates advanced waste sorting and material separation machinery to recover fibers from textile waste	12	28	50
6.	Supply Chain Manager	Able to oversee logistics, inventory management, and coordination with suppliers and buyers	19	37	67
7.	Supply chain Technologist	Utilize technologies like blockchain and IoT	15	35	65
8.	Procurement Officer	Responsible for identifying suitable suppliers, negotiating prices, and ensuring timely delivery of raw materials and components	17	37	67

SL No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
9.	Inventory Manager	Manage the company's stock by tracking inventory levels, handling deliveries and shipments, and reducing waste	19	39	69
10.	Practices Specialist	Able to help RMG companies adopt eco-friendly manufacturing processes, comply with sustainability standards, and navigate certifications like LEED and Global Organic Textile Standard	22	44	58
11.	Product Development Specialist	Able to work closely with designers, conduct market research, and identify new trends to develop innovative and competitive garment designs	10	15	23
12.	Automation Technician	Able to operate, maintain, and troubleshoot advanced machinery and robotic systems	9	30	43
13.	Compliance Officer	Able to ensure adherence to national and international regulations, conduct audits, and promote ethical practices within the RMG sector	9	30	43
14.	Quality Assurance Specialist	Able to monitor production processes, conduct inspections, and implement quality control measures	10	23	36
Common Occupations					
15.	Data Analyst	Able to analyze production data, consumer trends, and market insights	9	30	43
16.	Digital Marketer	Able to develop online marketing strategies, manage social media presence, and utilize digital platforms	10	15	29
17.	Computer-aided Manufacturing Operator	Operate computer-aided manufacturing machinery like cutters, sewing machines with automated threading functions, Program patterns and designs for computerized garment manufacturing	11	18	32

To stay competitive and adapt to industry changes, RMG sector professionals in Bangladesh should acquire these emerging skill sets. Continuous learning, vocational training programs, and collaborations between industry and educational institutions can be crucial in developing the required talent pool for the evolving RMG sector.

Recommendations:

The RMG sector is seeing traditional manufacturing jobs at risk due to automation and AI. Upskilling and reskilling in digital design and smart manufacturing are essential for staying competitive. New roles in sustainable fashion and tech-driven production are emerging, fueled by 4IR technologies. Policymakers and governments are suggested to adopt several key measures:

Bangladesh Garment Manufacturers and Exporters Association (BGMEA) and Bangladesh Knitwear Manufacturers and Exporters Association (BKMEA) can

- conduct continual market analysis for emerging jobs and jobs at risk in order to accommodate skilled workers with the transition.
- undertake capacity-building measures for our government and non-government professionals related to this area for smooth execution of 4IR skills and employment initiatives.
- Create a supportive ecosystem for startups working on 4IR solutions for the construction sector.
- collect job demand from their member industries and accommodate skilled manpower according to their needs
- BGMEA and BKMEA can collaborate with the government and private skill service providers to arrange reskilling and upskilling programs to accommodate the workforce at risk of 4IR automation.





Furniture Sector



Introduction:

One of the goods that is essential for our homes and offices is furniture. Apart from being a necessity for daily use, furniture is also used for decoration and reflects the customer's taste for elegance. In Bangladesh, the furniture business has experienced significant growth, adapting to changing preferences and demands of consumers. According to The Business Standard, the furniture industry in Bangladesh generates over 10,000 crores in income annually. The sector has expanded its operations to include exports, creating new opportunities in the country's export trade. The history of the furniture industry in Bangladesh dates back to before independence, with traditional furniture firms. However, it transitioned to mass production in the 1990s to meet rising demand, significantly contributing to the nation's economy. The sector is divided into organized and unorganized categories, with unbranded businesses dominating 65% of the market. Well-known brands like Hatil, Otobi, Navana, Akhtar Furniture, Legacy, Homes Furniture, Partex, and Brothers Furniture mainly fulfill the furniture demand. With over 100 medium-sized and large furniture firms established in the country, various types of furniture are manufactured, including solid wood, processed wood, aluminum, and cane furniture. While the majority (93%) is sold domestically, the furniture industry employs more than 2.5 million people. Recognizing its significance, the Bangladeshi government has designated the furniture industry as a "Thrust Sector" to stimulate economic growth, job creation, and export revenue. Bangladesh's furniture industry is also a priority industry according to the 2015-2018 export policy. The country's furniture is exported to several countries, including the United States, Canada, Australia, the United Kingdom, Middle Eastern nations, Europe, and even India. Although the COVID-19 pandemic has impacted the industry, causing job losses and disruptions, the sector is gradually recovering. The Bangladesh Furniture Export Association (BFEA) and the Bangladesh Furniture Industries Owners Association (BFIOA) are working towards the industry's growth and potential. Despite the challenges, the Bangladeshi furniture industry is expanding significantly, aiming to improve productivity, quality, and profitability.

Importance of the Sector:

The furniture sector plays a significant role in the economy of Bangladesh, highlighting its importance in several aspects. The industry has experienced rapid growth, contributing to the country's GDP and export revenue. Over the past decade, furniture exports from Bangladesh have surged by approximately 267%, reaching \$76.41 million in the fiscal year 2019-2020. This growth can be attributed to the industry's ability to meet the rising demand for furniture both domestically and in international markets, including the corporate sector. Secondly, the furniture sector in Bangladesh provides employment opportunities for many people^{a,b}.

Currently, the industry employs over 2.5 million individuals, making it a significant source of livelihood and a pivotal contributor to reducing unemployment in the country. Moreover, the sector's growth has also created indirect employment opportunities in related industries such as manufacturing, logistics, and retail. Thirdly, the furniture industry in Bangladesh has showcased its potential for innovation and adaptation. With the advent of 4IR technologies, such as digitalization, IoT, and advanced analytics, the sector has enhanced productivity, quality, and customization

a <https://businessinspection.com.bd/bangladesh-furniture-industry-sees-remarkable-growth/>

b <https://www.dhakatribune.com/business/277930/bangladesh-exported-190.36m-worth-of-furniture>

capabilities. Manufacturers can now produce furniture on a large scale while maintaining personalized and customized offerings. This ability to provide individualized products has opened new markets and opportunities for growth. Furthermore, the furniture sector has demonstrated its commitment to sustainability and achieving the SDGs. With a focus on renewable energy sources, the industry aims to reduce its environmental impact and contribute to the seventh SDG of “Affordable and clean energy.” This commitment aligns with global sustainability goals and positions Bangladesh as a responsible and environmentally conscious player in the worldwide furniture market.

The furniture sector in Bangladesh holds immense importance in terms of its contribution to the economy, job creation, innovation, and sustainability. Its rapid growth, increasing exports, and ability to adapt to changing market demands highlight its significance in driving economic development and improving the livelihoods of millions of people. With continued investment, skill development, and focus on sustainability, the furniture industry in Bangladesh has the potential to expand its reach further and establish itself as a competitive player on the global stage.

Impact of the 4IR in the sector:

The 4IR has significantly impacted the furniture sector, revolutionizing various aspects of the industry. Advanced technologies such as artificial intelligence, robotics, the IoT, and AR have transformed how furniture is designed, manufactured, and sold. Regarding design, 4IR technologies enable the creation of intricate and innovative furniture designs through CAD software and 3D modeling tools. This allows designers to explore new possibilities and customize products according to customer preferences. Manufacturing, automation, and robotics have improved efficiency and precision, reducing production time and costs. Smart factories with IoT sensors monitor inventory levels, streamline logistics, and enhance supply chain management. Additionally, augmented reality has revolutionized the shopping experience, enabling customers to visualize furniture pieces in their spaces before purchasing. Online platforms and e-commerce have also flourished, providing a convenient and accessible way for customers to browse, compare, and purchase furniture. Overall, the 4IR has transformed the furniture sector by enhancing design capabilities, improving manufacturing processes, and revolutionizing how customers interact with and purchase furniture.

Occupations at Risk:

In the furniture sector in Bangladesh, the adoption of 4IR technologies brings opportunities and potential risks to certain occupations. While the overall impact of 4IR is positive, a few occupations may face potential risks due to automation and technological advancements. It is important to note that while certain occupations may face potential risks, adopting 4IR technologies in the furniture sector also creates new job opportunities. These technologies require a skilled workforce to develop, implement, and maintain them. Therefore, individuals who acquire the necessary skills and knowledge in digital design, data analytics, automation, and IoT integration can position themselves for new and emerging roles in the industry. Additionally, the furniture sector may require software development, cybersecurity, and technology management professionals to ensure the smooth integration and operation of 4IR technologies. Some of the risky occupations within the furniture sector that arise from the implementation of 4IR technologies are enlisted in

the following table with approximate projected demand for the year of 2025, 2030 & 2040.

SL No	Occupation	Human Resource (Thousand)		
		2025	2030	2040
1	Manual Laborer	78	57	30
2	Machine Operator	64	41	24
3	Traditional Craftsman	52	41	23
4	Quality Control Inspector	54	36	20
5	Manual Laborer in Furniture Manufacturing	78	57	30
6	Low-skilled Furniture Designer and Craftsman	52	41	23
7	Traditional Furniture Sales Representative	52	41	23
8	Furniture Quality Control Inspector	54	36	20

Emerging Occupations:

In the furniture sector of Bangladesh, the 4IR has introduced new emerging occupations and skill sets that align with the advancements in technology and automation. These emerging occupations and skill sets are vital in driving innovation, increasing productivity, and ensuring the sector remains competitive in the digital era. As the country embraces the opportunities presented by 4IR, the following are some of the emerging disciplines and their skillsets with the projected demand (aprox) are presented in the following table which are becoming increasingly important in furniture sector.

SL No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
Core Occupations					
1	Customer Experience Manager	Ensures seamless interactions, personalizes service, and provides post-purchase support, fostering customer satisfaction and loyalty	5	7	10
2	Sustainability and Circular Economy Expert	Contributes to developing eco-friendly materials, reduces waste, and implements responsible production processes	2	2	3
3	AI-powered Design and Customization Specialist	Specializes in AI and machine learning for designing and customizing smart furniture	4	5	7

SL No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
4	Furniture Manufacturing Robotics Technician	Mastered robotics, automates processes, programs, and maintains manufacturing robots	4	6	8
5	Smart Furniture Software Developer	Develops embedded systems, integrates IoT, and creates apps for connected furniture	2	3	4
6	Sustainable Materials and Resource Management Specialist	Expertise in sourcing sustainable and eco-friendly materials, optimizing waste, and practicing circular economy strategies	2	2	3
7	Automated Wood Sawing Machine Operator	Operates sustainable treatment chemicals, understands wood behavior, and manages pressure treatment equipment, ensuring compliance with environmental regulations related to wood treatment	7	10	14
8	Wood Treatment Technician	Executes heat treatment cycles, utilizes the DELPHI program, measures moisture content, understands wood species characteristics, and adheres to safety protocols	6	8	10
9	Wood Seasoning Operator	Programs and operates PLC and NC systems, uses Aspire and Geomagic Studio software, manages 3D scanning, and performs CAM programming	6	9	12
10	Design and Fabrication Specialist	Programs PLCs, integrates automation systems, troubleshoots issues, networks systems, applies electrical knowledge, and maintains cybersecurity awareness	5	6	8
11	PLC Automation Specialist	Programs PLCs for automation on the factory floor and integrates control systems.	5	7	10

SL No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
12	Robotic Painting Specialist	Programs robots, applies paint using advanced techniques, troubleshoots material issues, and manages UV drying, servomotors, and stepper motors	4	6	8
13	3D Designer	Designs in 3D using CAD software and models innovative, customizable furniture	47	64	87
14	Data Analyst	Mines data, predicts trends, and provides business intelligence for informed decision-making	37	50	68
15	Automation Technician	Optimizes production processes and minimizes downtime through automation	10	14	19
16	Internet of Things (IoT) Specialist	Develops and implements IoT infrastructure, enabling remote control, automated adjustments, and data-driven insights	11	24	30
17	Supply Chain Manager	Integrates technology into supply chain management, manages inventory systems, tracks in real-time, and analyzes supply chain performance	21	28	39
18	E-commerce and Digital Marketing Specialist	Optimizes online presence, manages digital campaigns, and leverages digital platforms to effectively reach and engage customers	2	3	4

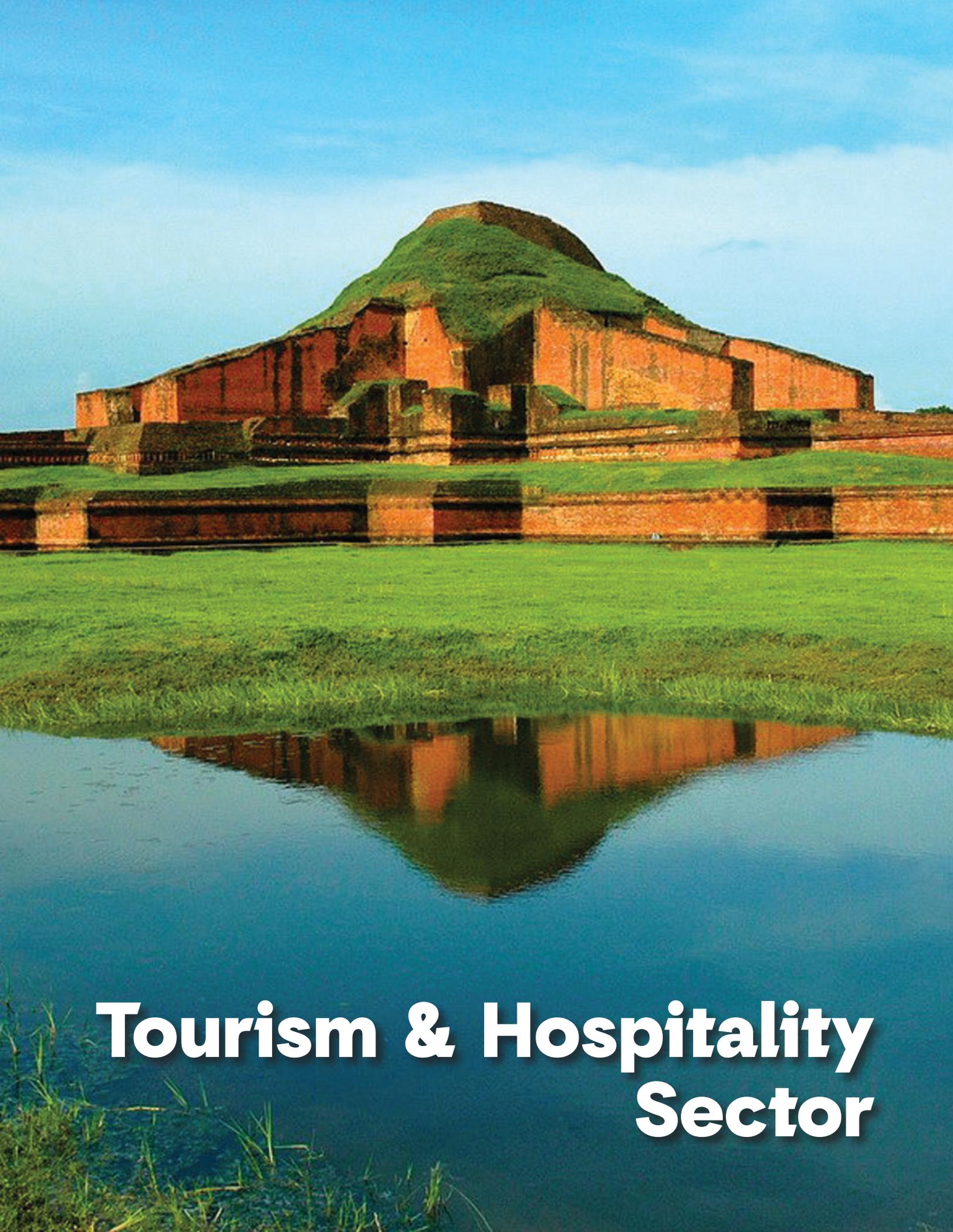
These emerging occupations and skills reflect the changing landscape of the furniture sector in Bangladesh as it embraces 4IR technologies. By developing a skilled workforce in these areas, the industry can harness the full potential of technological advancements, drive innovation, and meet customers' evolving demands in the digital age.

Recommendations

With automation reshaping the furniture industry, manual labor roles are at risk, necessitating upskilling in areas like CNC machining and digital design. Reskilling in sustainable material sourcing and smart manufacturing is key, as 4IR introduces emerging professions in customized, eco-friendly furniture production. Policymakers and governments are requested to adopt several key measures:

- The public-private skills service providers need to arrange reskilling and upskilling programs to accommodate the workforce at risk of 4IR automation.
- Bangladesh Furniture Industries Owners Association (BFIOA) and Bangladesh Furniture Exporters Association (BFEA) can establish a 4IR cell to guide their member industries, foster industry-academia collaboration, and arrange continuous policy dialogue.
- BFEA can conduct market research to identify emerging occupations in the global furniture market.





Tourism & Hospitality Sector



Introduction:

Tourism is a pleasurable experience for visitors and also serves as a significant source of income for numerous destinations and even entire countries. In many instances, the tourism industry has adapted to societal and technological advancements. In the age of digitalization and the Fourth Industrial Revolution, it must embrace advanced technologies. Tourism plays a critical role in destinations' economic, social, and cultural development by contributing to job creation, revenue generation, infrastructure improvement, and the exchange of ideas and knowledge.

On the other hand, hospitality entails offering services and accommodation to guests or tourists. It involves creating a friendly and comfortable atmosphere for visitors, meeting their needs and expectations, and delivering exceptional customer service. The hospitality industry encompasses various sectors such as hotels, resorts, restaurants, travel agencies, tour operators, airlines, cruise lines, and other establishments or services that cater to travelers' requirements. Hospitality is essential to the tourism experience as it shapes guests' overall satisfaction and enjoyment during their stay or visit.

Bangladesh's tourism and hospitality sectors have witnessed significant growth and development in recent years, positioning the country as an emerging tourist destination in South Asia. With its rich cultural heritage, diverse landscapes, and warm hospitality, Bangladesh offers travelers a unique and authentic experience. From the bustling streets of Dhaka to the vibrant riverine landscapes of the Sundarbans to the serene beauty of Cox's Bazar, the world's longest natural sandy beach, there are endless attractions to explore.

The sector has seen substantial investments in infrastructure, including the expansion of airports, the development of luxury hotels and resorts, and the improvement of transportation networks. The government's initiatives to promote tourism and the growing interest from international tourists have further propelled the sector's growth, making Bangladesh an exciting and promising destination for leisure, business, and eco-tourism experiences. Bangladesh Parjatan Corporation (BPC) is working to identify practical and pragmatic solutions to enhance Bangladesh's tourism sector. Even if there are numerous difficulties as a result of globalization, tourism, and hospitality are particularly beneficial for developing nations where people are looking for possibilities.

Importance of the Sector:

The acknowledgment of tourism's significant role in a country's economic, social, and cultural development is now widely accepted. Tourism and hospitality industries contribute to the economy by generating revenue through tourists' expenditures on local accommodations, dining, shopping, attractions, and entertainment venues. Additionally, the government benefits from fees and taxes paid by various industries, particularly those associated with tourism. Tourism plays a crucial role in stimulating economic growth, creating job opportunities, and promoting the export of local products. Many countries rely on tourism as a primary source of foreign exchange earnings. Furthermore, tourism has a positive impact on the society and culture of a country^{a,b,c}.

The tourism and hospitality sectors have been at the forefront of global transformation, according to the United Nations World Tourism Organization (UNWTO). These industries have effectively

a <https://researchhub.wttc.org/product/bangladesh-economic-impact-report>

b <https://www.ijbssr.com/journal/details/tourism-it-s-contribution-on-gdp-and-employment-in-bangladesh-140132917>

c <https://www.unwto.org/tourism-statistics/economic-contribution-SDG>

adapted to demand and trends by leveraging different types of technology to enhance and improve travelers' experiences. The tourism industry pioneered online bookings for flights and hotels, establishing itself as a leading force in the 4IR. Mobile phones have also significantly influenced the sector, particularly in terms of expanding data roaming options. This has opened up opportunities for online travel agents to provide updates, specific information, search tools, comments, and general reviews to assist travelers and make the process more accessible, offering a wider range of choices.

Bangladesh Parjatan Corporation (BPC) the country's former National Tourist Organization (NTO), visioned and intended to discover practical and realistic solutions to expand Bangladesh's tourism business. Regarding employment creation, poverty reduction, raising the national GDP, and the growth and preservation of tourism, the Vision seeks to contribute to the nation's overall development.

Bangladesh's tourism sector's mission is to encourage, promote, and develop tourism as a major socio-economic activity to generate foreign currency and local employment, ultimately spreading the benefits of tourism to both the private and public sectors. At the same time, the vision of Bangladesh's tourism sector is to adopt new technology, train and re-training of human resources, and broaden the scope of employment opportunities.

The Tourism Vision 2030 BPC leverages several key factors for success: ensuring a positive and enduring image, establishing political stability, transforming Bangladesh into a unified destination like renowned countries such as the Maldives, Malaysia, and Singapore, welcoming approximately 1.30 million tourists annually after 2030 with a growing rate, contributing a significant 4-5% to Bangladesh's GDP through the tourism industry, and establishing a robust communication network both internally and externally ^d.

In 2015, world leaders reached a historic agreement at the United Nations, committing to 17 SDGs to create a better future for all. Tourism is essential in achieving sustainable solutions for people, the planet, prosperity, and peace, as outlined by these 17 SDGs and their 169 related targets, which provide a new direction for the global community. Each of the goals can benefit from tourism in various ways. Goal 8 focuses on decent work and economic growth, directly linking to economic progress. Goal 12 emphasizes responsible consumption and production, which significantly impacts the ability of the travel and hospitality sector to produce goods. Additionally, Goal 14 aims to prevent and reduce marine pollution caused by land-based activities, such as nutrient and marine debris pollution by 2030, making it relevant to the tourism and hospitality sector. Failure to develop the tourism industry may hinder the achievement of the SDGs by 2030, highlighting the importance for Bangladesh to prioritize the growth and development of its tourism sector ^{c,d}.

Bangladesh's tourism business is rapidly expanding. In 2014, it brought in 1,25,000 tourists from outside and \$1.5 trillion in export revenue. International visitor arrivals increased by 4.3 percent in 2014. Tourism's contribution to the gross domestic product (GDP) is estimated at 3.02 percent by the Bangladesh Bureau of Statistics (BBS). In local currency, this amounts to Tk 76,690.7 crore. The actual figure is much more if the direct and indirect earnings of the sector is considered. The total contribution of Travel & Tourism to GDP (including wider effects from investment, the supply chain and induced income impacts) was BDT 627.9 bn in 2014 (4.1 % of

GDP). The direct contribution to GDP in 2016 was BDT 421.4 billion, or 2.2% of the overall GDP. That contribution is expected to rise by 6.2% in 2017. According to the World Travel and Tourism Council, direct employment support from travel and tourism is expected to grow by 2.9% per year, reaching 1,785,000 jobs (1.9 percent of total employment) by 2023. About 2,247,000 jobs are anticipated in 2026 and 2,695,000 jobs in 2027. So, this sector will create huge job market for young peoples to whom a skills development plan is very necessary d,e,f. Foreign visitor expenditure (or visitor exports) is a key component of direct contribution in the country. In 2014, visitor exports accounted for 25% of overall exports in Nepal and 23% in Sri Lanka, respectively. Foreign tourist expenditure in Bangladesh accounts for just 1.4% of total exports.

Impact of the 4IR in the sector:

The arrival of the 4IR has significant implications for higher education and training institutes in the tourism industry, signaling a need for a new direction in both business and education. 4IR has become a popular catchphrase worldwide, highlighting the global movement towards digital technologies such as robotics, artificial intelligence, virtual reality, blockchain, and more. However, the effective adoption of these technologies depends on the country's cultural and value systems. The World Economic Forum estimates that by 2030, technology may replace 800 million unskilled workers globally, potentially affecting Bangladesh as well. To address this, a comprehensive plan for reskilling, upskilling, or new skilling is necessary to ensure that individuals can adapt to and remain relevant in the face of these new technologies.

South Asian emerging countries, including Bangladesh, India, Nepal, and Sri Lanka, are also embracing the opportunities presented by 4IR to boost their local industries. Bangladesh, in particular, is experiencing significant growth in various sectors and recognizes that innovations and skills related to 4IR will play a crucial role in achieving its economic goals. However, challenges related to accessibility, cost, and technological adaptation in a rapidly changing global context must be addressed for Bangladesh to fully harness the potential of 4IR.

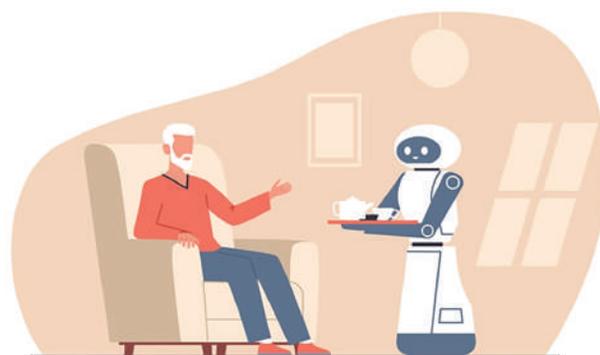
Fortunately, the government of Bangladesh is well aware of the responsibilities and advantages associated with 4IR and is taking steps to leverage innovative co-creation and technologies from Industry 4.0 to transform the perception of tourism and the overall business sector. Tourism has the potential to bring numerous benefits, including job creation, economic growth, and foreign exchange earnings. Bangladesh, with its diverse tourist destinations such as beaches, islands, hills, waterfalls, religious sites, and historical landmarks, can tap into the power of tourism to generate foreign currency and stimulate economic development. Many Asian countries have already demonstrated their natural beauty, climate, culture, and heritage attractiveness, positioning tourism and hospitality as one of their top export product categories.

However, Bangladesh still has room for improvement in leveraging 4IR technologies within its tourism and hospitality sector compared to other countries in the region. Stakeholders and global companies strive to catch up with the advancements and bridge the gap. By recognizing the potential of 4IR and actively embracing its benefits, Bangladesh can enhance its competitiveness in the tourism industry and position itself as a destination of choice for travelers worldwide.

Occupations at Risk:

Using the modified technologies in the tourism and hospitality sectors, three different sections of jobs are in the risk zone. The risky job sections are marketing management, office management, and housekeeping management. Most workers in these risky occupations must be more experienced in augmented technology, artificial intelligence, or computation expertise. Their lack of experience and their backdated mentality (not to keep them advanced) are the main reasons for job losses. Some of the risky occupations within the tourism and hospitality sector that arise from the implementation of 4IR technologies are enlisted in the following table with approximate projected demand for the year of 2025, 2030 & 2040.

SL No.	Occupation	Human Resource (Thousand)		
		2025	2030	2040
1	Marketing Management <ul style="list-style-type: none"> • Sales Executive • Account Officer • Marketing Officer • Communication Executive 	37	32	15
2	Office Management <ul style="list-style-type: none"> • Office Executive • Desk Ticket Seller • Gatekeeper Assistant • Communication Manager • Room Allocation Manager 	26	10	2
3	Housekeeping Management <ul style="list-style-type: none"> • Housekeeping • Laundry & Cleaning Manager • Door Keeper • Linen Room Supervisor 	25	14	10
4	Travel Agent & Tour Guide	20	15	10
5	Front Desk/Check-in Staff	30	25	20
6	Routine Maintenance Staff	35	30	25



Emerging Occupations and Skillsets

The implementation of 4IR in the tourism industry encounters various obstacles, which hinge on the preparedness of the target group in terms of skills, procedures, trust, and interest. These challenges are commonly encountered when introducing new concepts in marketing, but they must be overcome for the new paradigm to succeed. As the 4IR expands, there is a growing demand for technical roles. Occupations such as IT specialists and computational experts are highly sought after. Furthermore, there is a demand for VR and AR technologists, as virtual reality can assist potential visitors in choosing their destinations, while augmented reality can enhance the experience of historical sites. Additionally, 3D printing technology can be utilized to preserve cultural heritage, create souvenirs, or craft unique food items for tourists. The 4IR technology will emerge in some noteworthy occupations to smooth advancement. As the country embraces the opportunities presented by 4IR, the following are some of the emerging disciplines and their skillsets with the projected demand (aprox) are presented in the following table which are becoming increasingly important in tourism sector.

SL No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
Core Occupation					
1	Conversational AI Travel Assistant & Chatbots Developer	Developing natural conversations through machine learning and artificial intelligence to support travelers virtually and in person with queries, recommendations and reservations	5	10	20
2	AI-based Customer Experience Manager	Analyzing customer data and behaviors to create personalized experiences and journeys using artificial intelligence and predictive analytics tools	4	8	15
3	Hospitality Robotics Specialist	Programing and maintaining robotic devices utilized in hospitality facilities for tasks like transporting items, greeting guests, room service delivery and automated food preparation	3	6	12
4	Smart Tourism Coordinator	Leveraging technology to promote and implement sustainable practices in the tourism and hospitality industry	7	12	20
5	Electronic Room Technician/ Electronic Technician	Installs and maintains smart room technologies, including smart TVs, connected devices, and integrated room controls for lighting, temperature, and entertainment	15	25	40

SL No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
6	Kitchen Equipment Operation and Maintenance	Maintains and oversees robotic systems used in restaurant kitchens for tasks such as food preparation, cooking, and dishwashing	12	20	30
7	Hotel Reservation System Manager	Manages and optimizes smart reservation systems, utilizing AI algorithms to predict demand, optimize table turnover, and enhance the overall dining experience	8	13	23
8	Digital Customer Relationship Manager (CRM)	Focusing on improving the overall passenger/customer experience, customer experience managers may use data and technology to streamline processes, reduce wait times, and enhance the overall satisfaction of travelers	6	10	18
9	Destination Specialist	As new destinations gain popularity, specialists who understand and can navigate the unique challenges and opportunities of emerging markets may be in demand	10	17	28
10	Event Manager	Collaborate with stakeholders, vendors, clients, develop event plan, make proposal along with budget, onboard manpower to organize the event & close the event and ensure report	20	30	45
11	Digital Booking Specialist for the OTA	Identify the digital marketing trends, use technologies to capture the market, provide right direction to digital marketer, and ensure quality services in OTA	7	12	20



SL No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
12	Digital Content Creator for Hospitality & Tourism	<p>Develop and implement content marketing strategies to increase brand awareness and engagement with customers, conduct research on topics related to the company's products or services to help identify new trends or opportunities for growth, Manage social media channels and other forms of electronic communication for a company or organization</p> <p>Write and edit blog posts, newsletters, e-books, white papers, case studies, and other content for websites, blogs and other channels, create digital marketing campaigns including banners, text ads, pop-ups, and other forms of interactive content, Develop and maintain a website or blog to post company news and product information</p> <p>Produce videos, podcasts, infographics, slideshows, or other digital media formats to engage customers in new ways, Create and manage digital advertising campaigns in collaboration with other team members to achieve specific goals, such as increasing website traffic or increasing sales of certain products or services</p>	9	15	25
13	Chef	Able to deal with online orders and deal with smart cooking appliances including robot	11	25	48
Common Occupations					
14	Digital Marketing Expert	Able to conduct digital marketing	7	12	23
15	Photography and Videography Expert	Able to develop quality videography & photography	46	65	89

SL No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
16	IT Expert	Able to provide IT-related services like e-commerce, e-office management, blockchain	13	20	41
17	Social Media Coordinator	Able to deal with different social media	10	26	36
18	Cobot Operator	Able to maintain and operate Cobot for tourists in museums, parks, and hotels	1	2	4
19	AI, AR & VR Developer	Able to develop AR & VR with AI	9	18	26
20	Data Analytics	Able to capture information by analyzing data	3	5	7
21	Internet System Security Expert	Developing data security and secured internet	5	7	11
22	Website Developer	Deal with websites and their development	22	30	45
23	3D Printing Expert	Able to develop CAD design, operate 3D printer and its products	14	27	42

Recommendations

Traditional roles in tourism and hospitality are becoming vulnerable as digital platforms and AI transform the industry. Upskilling in customer experience design and reskilling for digital marketing are crucial. New professions in virtual tourism and AI-driven hospitality management are on the rise due to 4IR. In addition to the skills development plan, there are some recommendations for the tourism industry of Bangladesh to be one of the most influential sectors of the GDP growth:

- 4IR-based eco-tourism like the use of drone surveys to monitor natural areas, personalize tourist experiences with AI, use of mixed reality (MR) to combine the real and virtual world, etc. can be introduced to flourish with the wind of revolution in this industry across the nation
- Implement AI-powered chatbots and virtual assistants to handle customer inquiries, bookings, and personalized recommendations.
- Introduce Internet of Things (IoT) devices for efficient resource management, energy conservation, and security in hotels and tourist sites.
- Use AR applications for interactive guided tours and real-time navigation assistance.
- Bangladesh Tourism Corporation, Bangladesh Tourism Board (BTB), Tourism & Hospitality Industry Skills Council, Tour Operators Association of Bangladesh (TOAB), and Association of Travel Agents of Bangladesh (ATAB) can introduce 4IR-based courses based on the market demand.



Transportation Sector



Introduction

Since Bangladesh gained independence in 1971, the transportation industry has expanded at a breakneck pace, and means of transportation on land and waterways have started to mature. Air travel came into existence later. Even though Bangladesh has made significant progress in transportation, the country still has several problems that prevent it from progressing in other areas of its economy and society. Transportation has progressed to largely land-based vehicles, but it still has a way to go before it meets current safety requirements, which puts the lives of ordinary people at risk.

The term “transportation” refers to moving products and people from one location to another and the many modes of conveyance that make this possible. Mobility is made possible by public transportation. Communities must have access to essential services to maintain a better quality of life and living. These services guarantee physical and mental health maintenance, job possibilities, and social and leisure activities.

Most of the people who live in rural areas rely on one of the six modes (Bus, Train, Airlines, CNG, Bicycle, Boat/Ship) of transportation to get about their surroundings. Some modes of transportation may be more readily accessible than others in each town; this varies from place to place.

Importance of the Sector

The movement of people, animals, and things from one location to another is accomplished via various modes of transportation. In more recent times, the advent of industrialization led to an increase in rail and road transport. Subsequent advances in scientific knowledge resulted in the creation of the automobile, aircraft, and even spacecraft. Developing nations will see an improvement in their standards for the construction of transport modes that are both efficient and reliable because of the fourth industrial revolution. Additionally, these nations will invest more in technology transfer, assisting the local manufacturing sector and agriculture.

Bangladesh is rapidly developing its transport networks by constructing highways, flyovers, and roads. Recently, Metrorail has been operating in Dhaka city which has made transportation comfort for many people. Newly developed Cox’s Bazar rail line will accelerate the tourism for visiting sea beach^a. In addition to that, ‘Karnafuly tunnel’ will make the journey to Cox’s Bazar very fast and comfortable. The developed transport system will also create job opportunities and will have a positive impact on the economy. The Padma Bridge has already changed the life style of nearly 30 million people living in the south-western region of the country by promoting modern and commercial activities^b.

a <https://researchhub.wtcc.org/product/bangladesh-economic-impact-report>

b <https://www.unwto.org/tourism-statistics/economic-contribution-SDG>

Impact of the 4IR in the sector

The 4IR will significantly transform the transportation sector. Advanced technologies such as AI, big data analytics, autonomous vehicles, and the IoTs will revolutionize how people and goods move from one place to another. These technologies will definitely improve efficiency, safety, and sustainability in transportation. Intelligent transportation systems enable real-time traffic management, optimizing routes, reducing congestion, and enhancing overall transportation operations. Autonomous vehicles are poised to revolutionize the industry by improving road safety, reducing accidents, and enhancing mobility for people who cannot drive. Furthermore, integrating digital platforms and mobile applications has facilitated the rise of shared mobility services, such as ride-sharing and bike-sharing, transforming how people access transportation. Overall, the 4IR has unleashed a wave of innovation in the transportation sector, paving the way for more efficient, connected, and sustainable mobility solutions.

Occupation at Risk

While the Fourth Industrial Revolution (4IR) brings about many opportunities and advancements in the transport sector, it also introduces certain job risks and challenges. These risky occupations and skill set in the transport sector for the 4IR highlight the importance of addressing challenges related to cybersecurity, safety, privacy, and ethical considerations. As technology advances, it is crucial to have skilled professionals who can effectively manage these risks and ensure transport systems' safe and secure operation. Some of the risky occupations within the transportation sector that arise from the implementation of 4IR technologies are enlisted in the following table with approximate projected demand for the year of 2025, 2030 & 2040.

Sl. No.	Occupations	Human Resource (Thousand)		
		2025	2030	2040
1	Vehicle Technician	58	43	26
2	Manual Data checker	60	41	36
3	Manual Maintenance (Welder, Painter & Quality Checker)	87	43	19
4	Driver	65	50	40
5	Helper	71	59	35
6	Traffic Management Specialist	48	21	12
7	Traditional Taxi Driver	70	50	30
8	Manual Traffic Control Personnel	60	40	20
9	Routine Fleet Manager	50	30	10
10	Traditional Urban Planner	40	20	5
11	Conventional Logistics Coordinator	80	50	20
12	Parking Attendant	100	75	50

Emerging Occupations and Skillsets

When the 4IR is implemented in Bangladesh, the country will require the services of welders, painters, mechanics, electricians, dent repair specialists, and service personnel. They require new training and to update their present methods of functioning. They need to acquire more marketable abilities so that they can continue working. The transport sector is undergoing significant changes due to the 4IR. As technology advances, new occupations, and skills sets are emerging to meet the demands of this evolving industry. As the country embraces the opportunities presented by 4IR, the following are some of the emerging disciplines and their skillsets with the projected demand (approx.) are presented in the following table which are becoming increasingly important in transportation sector.

SL. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
Core Occupations					
1	Autonomous Vehicle Technician	Technicians should understand AI, machine learning, and sensor technologies	17.8	34.1	44.6
2	Data Analyst and Scientist	Able to help optimize logistics operations, improve traffic management, and enhance overall efficiency	25.9	36.3	43.9
3	Drone Operator and Technician	Should be responsible for operating and maintaining unmanned aerial vehicles, ensuring their safe and efficient operation	35.7	52.8	73.9
4	Cybersecurity Specialist	Able to protect transport infrastructure, connected vehicles, and data from cyber threats	15	32.4	43.5
5	Sustainable Transport Planner	Should work on designing and implementing solutions that promote eco-friendly modes of transportation	1.8	3.8	7.8
6	Robotics Engineer	Should be able to design, develop and deploy robotic systems to perform tasks like welding, painting, assembling, etc. more efficiently and autonomously	7.5	16.5	23.8

SL. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
7	AR & VR Specialist Specialist	Specialists in AR and VR can create immersive training programs and virtual simulations	36.3	57.0	64.7
8	Mobility Data Analyst	Able to use data analytics techniques to identify patterns, optimize routes, and provide insights	17.8	30.4	36.6
9	Electric Vehicle Infrastructure Specialist	Able to ensure the availability and reliability of charging stations and optimize charging networks	17.2	29.7	34.9
10	Green Logistics Manager	Should be able to develop strategies to reduce carbon emissions and improve fuel efficiency	16.7	29.0	33.3
11	Vehicle Painting (Autonomous)	Technicians with expertise in autonomous vehicle painting systems	18.5	29.2	39.4
12	Autonomous Vehicle Engineer	Engineers who can design, develop and test autonomous vehicle systems and solutions	22.2	37.3	49.6
13	Transportation Data Analyst	Analysts who can analyze transportation data to identify patterns and optimization opportunities	21.3	34.6	45.8
14	Fleet Management AI Specialist	Specialists in applying AI/ML to optimize fleet operations and performance	19.7	32.9	44.3
15	Traffic Optimization Engineer	Engineers who use technology and data to minimize congestion and optimize traffic flow	20.0	33.2	44.3
16	AI-based Logistics Coordinator	Professionals who leverage AI to coordinate and optimize logistics operations	18.9	31.3	43.0
17	Drone Airspace Manager	Manage drone traffic and airspace to ensure safety and efficiency of drone operations	24.1	38.2	52.4

SL. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
18	Airline Pilot (Remote)	Pilots who can monitor and operate commercial aircraft remotely using AI/VR technologies	21.7	35.3	48.4
19	Electric Vehicle Battery Engineer	Develop and test advanced battery technologies for electric vehicles	21	34.4	47.3
20	Autonomous Shipping Technician	Install and maintain autonomous technologies on ships and vessels	19.4	32.6	45.3
21	Naval Robotics Engineer	Design autonomous and robotic systems for naval applications like resource exploration, surveillance etc	18.0	30.3	42.6
22	Space Transportation Planner	Plan and coordinate transportation of passengers, goods & resources to and from space stations/bases	16.8	28.3	39.8
23	Hyperloop Technician	Install, operate and maintain systems for high-speed transportation using hyperloops or vacuum tubes	15.5	26.3	37.1
24	Maritime AI Analyst	Use AI/big data to optimize maritime logistics, improve port efficiencies and ensure safety	14.3	24.3	34.3
25	Subsea Vehicle Pilot	Operate subsea autonomous vehicles for applications like resource mapping, infrastructure inspection etc	12.7	21.2	31.5
26	Aerospace Robotics Engineer	Design and develop robotic systems for applications in aerospace and aviation industries	11.1	18.4	28.8

These emerging occupations and skill set in the transport sector for the 4IR reflect the increasing integration of digital technologies, automation, and sustainability in the industry. As the sector continues to evolve, professionals with expertise in these areas will be in high demand to drive innovation and transform how we transport goods and people.

Recommendations

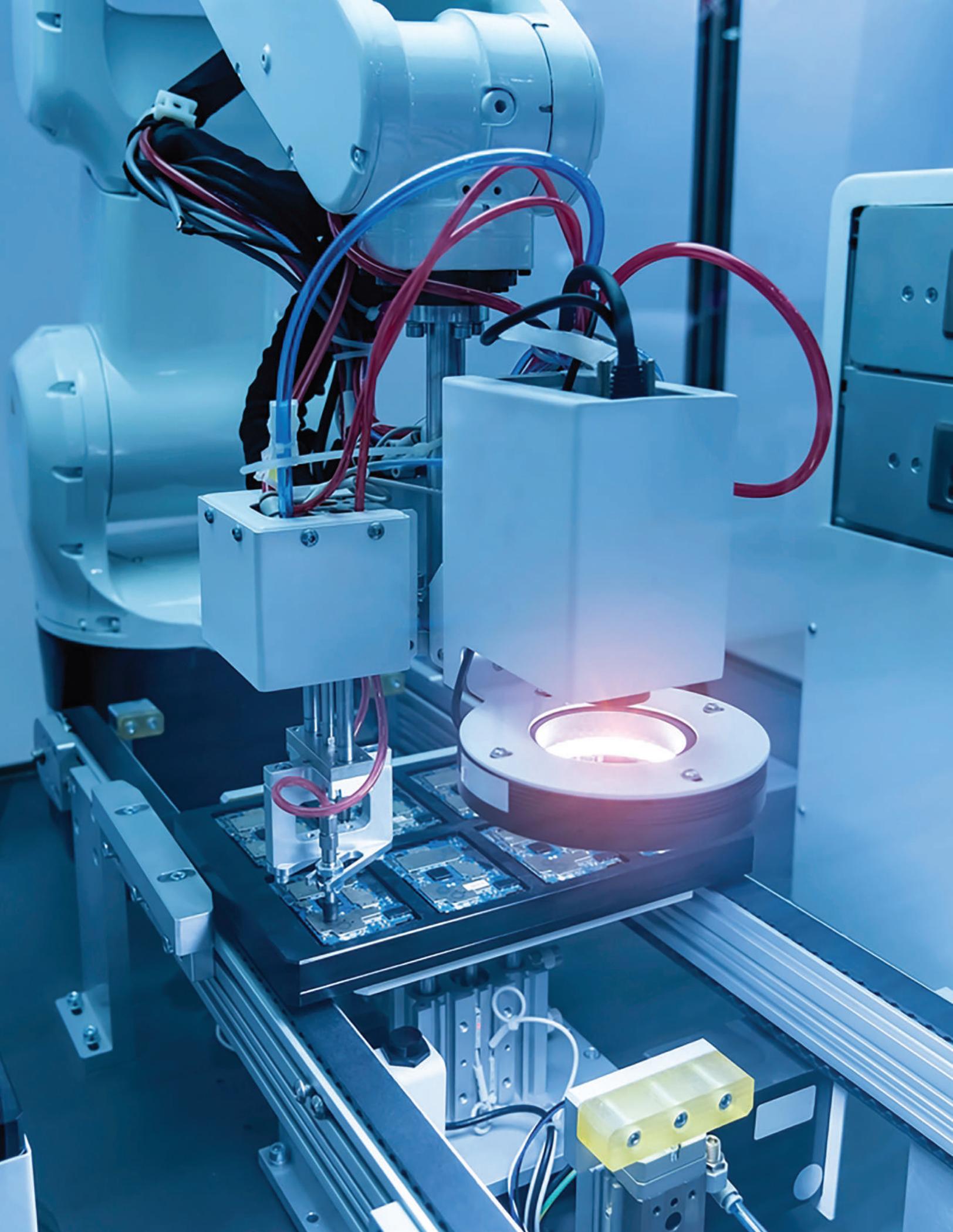
Autonomous vehicles and smart transport systems are emerging while traditional driving and logistics roles are at risk. Upskilling in areas like AI-based traffic management and reskilling for electric vehicle maintenance are essential. New professions in sustainable urban mobility are being shaped by 4IR innovations. Policymakers and governments are requested to adopt several key measures:

- Bangladesh Road Transport Owners Association, Bangladesh Road Transport Workers Federation, Bangladesh Bus Truck Owners Association, Bangladesh Truck Covered Van Owners Association can sensitize their drivers, helpers and other human resources on the impact of 4IR in Bangladesh.
- One of the objectives of Bangladesh Road Transport Corporation (BRTC) is to create skilled human resources for transportation sector. So BRTC can arrange training programs in their existing training centers as per demand of the market.





Light Engineering Sector



Introduction

The Light Engineering (LE) sector is vital to Bangladesh's economic growth and poverty alleviation efforts. With its significant contributions to economic and technical progress, it has potential for job creation and it has become a focal point for policymakers. Considering the 'heart' of industry development in the country, it was even recognized as the 'Product of the Year' for 2020 by the Honorable Prime Minister of Bangladesh. The LE sector's value additions and employment opportunities hold great promise for maintaining the economic balance. By providing diverse equipment, spare parts, and maintenance services, it has catalyzed the growth of other industries. The widespread distribution of LE businesses across Bangladesh signifies increased employment opportunities. Most of these enterprises are small and medium scale, relying on manual and semi-automatic machine tools. The sector's growth potential is evident, with around 40,000 units employing approximately 10 million people directly or indirectly^a. Reducing reliance on imported equipment and spare components can lead to significant gains for the country. However, infrastructure support and a conducive environment are essential for further expansion. To remain competitive and at the forefront of technology, LE businesses must improve their products and services, adopt new technologies, and devise effective marketing strategies. The sector's vision is to advance the economy by becoming a top-tier sector that attracts local and foreign investments, improves services, enhances coordination, and fosters a favorable investment climate^b.

Importance of the Sector

Bangladesh's light engineering sector holds significant importance in our socio-economic development, acting as a crucial 'feeder industry' supporting various sectors such as construction, automobiles, agro-machinery, ship-building, pharmaceuticals, textiles, and more by providing valuable products and services. With an annual turnover of approximately BDT 30 million, LE enterprises serve local and foreign markets, supplying value-added engineering goods and services. Within the country, there are 31 LE clusters identified by the SME Foundation among 177 SME clusters, accounting for 17.5% of the total. These LE clusters are vital in keeping the national economy running by offering cost-effective maintenance services, spare parts, and capital machinery. The activity and operation of LE industries align with several SDGs, making significant contributions to their achievement. SDG 1 (No Poverty) is supported through job generation, reducing poverty, and contributing to the economy. SDG 4 (Quality Education) is advanced by training vulnerable populations and creating skill development for various industries. SDG 8 (Decent Work and Economic Growth) is facilitated by adopting modern technologies, increasing productivity, and fostering economic growth^b.

Moreover, the LE sector is crucial in SDG 9 (Industry, Innovation, and Infrastructure) by supporting industrialization through innovative product and infrastructure development ideas. Additionally, it contributes to SDG 11 (Sustainable Cities and Communities) by making cities inclusive, safe, resilient, and sustainable. The LE sector's impact on the socio-economic development of Bangladesh is noteworthy. While it currently contributes around 2% to the GDP, it has the potential to become a significant source of export earnings through technological advancements. Fulfilling nearly 50% of the domestic demand reduces import dependency and positively affects the country's Balance of Payment ^{a,b}.

^a <https://www.tbsnews.net/economy/industry/light-engineering-keeps-growing-yet-below-potential-458010>

^b <https://idlc.com/mbr/article.php?id=420>

Impact of the 4IR in the sector

The 4IR has significantly impacted the light engineering sector, revolutionized traditional manufacturing processes and transformed how products are designed, produced, and distributed. Integrating advanced technologies such as automation, robotics, artificial intelligence, and the Internet of Things has increased the sector's efficiency, productivity, and customization.

Automation and robotics have streamlined manufacturing operations in light engineering, reducing human error, improving precision, and enhancing productivity. Robots are now widely used in assembly lines, carrying out repetitive tasks faster and more accurately. This has resulted in faster production cycles and reduced costs. AI has been crucial in optimizing various aspects of the light engineering sector. AI-powered systems can analyze large volumes of data, identify patterns, and make intelligent decisions. This has improved quality control processes, predictive maintenance, and inventory management. AI algorithms are also employed in product design, enabling engineers to create innovative and efficient solutions. The IoT has facilitated the development of smart factories in the light engineering sector. IoT devices and sensors are interconnected, allowing real-time monitoring and data collection. This data can be utilized for predictive maintenance, ensuring that machines are repaired or replaced before breakdowns occur. IoT also enables remote monitoring and control, empowering manufacturers to manage their operations from anywhere.

Overall, the 4IR has brought about a paradigm shift in the light engineering sector. It has enabled manufacturers to optimize processes, reduce costs, enhance product quality, and respond swiftly to customer demands. However, it has also raised concerns about job displacement, as specific tasks previously performed by humans are now automated. Therefore, the industry needs to focus on upskilling and reskilling the workforce to ensure a smooth transition and harness the full potential of the 4IR in the light engineering sector.

Occupations at Risk

The most active occupations in LE enterprises are machine (lathe/milling/shaper) operator, foundry worker, welder, master craftsman, surface grinder, CNC engineer/operator/troubleshooter, heat treatment plant (HTP) operator, CAD-CAM designer, fitter, and others. The workers engaged in the LE sector can be classified as unskilled (the freshers who have no prior experience), semi-skilled (have some sort of prior experience and can-do routine work with guidance from experienced worker), skilled (has prior experience and can-do routine work independently) and highly skilled (have special training and experience- can do routine and new job plan). Skilled and highly skilled workers occupy about 68%, semi-skilled workers 30%, and unskilled workers 2% of the total workforce based on the current technology used in this sector. Very few female employees have been noticed in fitting operations and mold finishing jobs. Most of the current workers will be in low-skilled zones (jobs at risk) if 4IR-based technologies are adopted except CNC engineers/operators/troubleshooters and CAD-CAM designers who are in a profession in the current scenario. Some of the risky occupations within the light engineering sector that arise from the implementation of 4IR technologies are enlisted in the following table with approximate projected demand for the year of 2025, 2030 & 2040.

Sl. No.	Occupation	Human Resource (Thousand)		
		2025	2030	2040
1	Machine Operator	21	16	10
2	Welder	67	53	27
3	Metal Fabricator	30	21	13
4	Maintenance Technician	63	38	19

Emerging Occupations and Skillsets

To keep the 4IR technology moving forward, certain notable vocations will be developed. This sector's new rising employment includes 3D modeling and animation experts, 3D graphics designers, cloud-based CNC machining operators, industrial robotics experts, CAD & CAM designers, and Foundry molding 4.0 experts.

We need to make plans for re-skilling the workers/employees by providing training such that they can work as AR/VR developers, robot operators, robot programmers, cyber security experts, IoT engineers, 3D printer operators, circuit assemblers, 3D designer simulations, etc. In addition to these, there is also a demand for network engineers, machine learning, software developers, and automation system designers and developers. As the country embraces the opportunities presented by 4IR, the following are some of the emerging disciplines and their skillsets with the projected demand (approx.) are presented in the following table which are becoming increasingly important in Light Engineering Sector.

Sl. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
Core Occupations					
1	3D Designer and Molding 4.0 Expert	Able to design a product using CAD and produce the product using the techniques of Molding 4.0	3	6	12
2	Robotics Technician	The ability to install, program, operate, and maintain robotic systems is increasing	10	33	56
3	3D Printing Specialist	Able to operate and manage 3D printers is in demand	19	37	68
4	Data Analyst	Able to extract insights from large datasets, identify trends, and provide valuable information	22	44	58

Sl. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
5	IoT Expert	<p>Experts in IoT possess knowledge of networking, cybersecurity best practices, data architectures and management, IoT protocols and standards, sensor integration, edge and fog computing, AI/ML applications for IoT, and using IoT to drive efficiencies in areas like predictive maintenance, supply chain visibility, remote monitoring and more.</p> <p>They understand how to deploy IoT solutions from end to end to solve real business problems and extract value from connected devices and systems</p>	10	15	23
6	Sustainable Manufacturing Specialist/ Sustainability Specialist	Able to focus on reducing energy consumption, minimizing waste, and implementing eco-friendly processes	9	30	44
7	Supply Chain and Logistics Professional/ Supply Chain and Logistics Manager	Able to ensure timely materials delivery, streamline operations, and optimize supply chain networks for cost-effective and reliable operations	9	30	44
8	Technical Sales and Marketing Specialists	Able to possess technical knowledge and communication skills (ICT-Based)	10	33	56
9	AI Integration Engineer	Able to integrate AI systems with existing software and infrastructure	10	20	30
10	AI-based Quality Control Specialist	Able to utilize AI for automated quality inspection and defect detection	15	30	50
11	Data-driven Process Optimization Manager	Able to analyze process data and implement continuous improvement strategies	12	25	40

Sl. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
12	Predictive Maintenance Analysts	Able to predict equipment failure and optimize maintenance schedules using data analytics	8	18	28

Recommendations

Manual roles in light engineering are increasingly risky due to the rise of automation and robotics. Workers must upskill in advanced manufacturing techniques and reskill for smart production processes. Emerging professions in robotics engineering and sustainable design are being driven by 4IR advancements. Policymakers and governments are suggested to adopt several key measures:

- BEIOA (Bangladesh Engineering Industry Owners Association), IDEB (Institution of Diploma Engineers, Bangladesh), IEB (Institution of Engineers, Bangladesh), and BAWMS (Bangladesh Association of Women in the Metal Sector) can establish a 4IR cell to guide their member industries, foster industry-academia collaboration, and arrange continuous policy dialogue.
- Creating skilled human resources is one of the functions of BSCIC. So, they can introduce 4IR related skills development programmes.
- Research and development (R&D) are the core component of the Bangladesh Industrial Technical Assistance Center (BITAC). So continued study & research regarding 4IR in this sector can be facilitated by the BITAC.
- Launch awareness campaigns to promote the benefits of 4IR technologies among light engineering businesses.







Insurance and Banking Sector



Introduction:

Money functions as a medium of exchange, a unit for measuring value, a means of storing wealth, and sometimes as a standard for deferred payments. A monetary system refers to the mechanisms through which a government supplies money to the economy of a nation, often involving institutions such as the national treasury, central bank, and commercial banks.

On the other hand, insurance is a financial arrangement in which one party guarantees to compensate another for specified losses, damages, or injuries in exchange for a premium payment. It is a risk management strategy primarily employed to protect against uncertain or contingent losses. Banks, which are financial entities, collect deposits from the general public, offer demand deposits, and provide loans directly or indirectly through the capital markets.

Following Bangladesh's independence, the country's insurance industry initially consisted of two nationalized insurance companies (one focused on life insurance and the other on general insurance) and one international insurance company. In the mid-1980s, private insurance companies entered the market, leading to its expansion. 62 insurance businesses operate under the Insurance Act of 2010 in Bangladesh. These include 18 life insurance companies, one foreign company, one state-owned company, and 44 general insurance companies, with one of them being state-owned^a.

Insurance companies in Bangladesh offer various services, including life insurance, general insurance, reinsurance, micro-insurance, and Takaful or Islamic insurance.

The banking sector is a significant contributor to the development of Bangladesh's economy. Because it satisfies the monetary requirements for credit in every aspect of societal life, it functions similarly to the central nerve in the country's economy. A paradigm shift has occurred throughout the banking operations and system landscape due to the expansion and technological improvements. The continued growth of online banking has resulted in a significant shift in how businesses meet the various requirements of their clients.

Importance of the Sector:

Insurance plays a crucial role in fostering overall economic progress within society by ensuring stability in various processes. It aids in the growth of financial institutions and minimizes uncertainties by enhancing financial resources. Insurance serves as a financial safety net, mitigating risks and uncertainties in both business and personal life. It offers protection and security against unforeseen events and sudden losses. By collecting premiums, insurance generates funds that are then invested in government securities and stocks. These funds are effectively utilized to promote industrial development, thereby generating additional resources for the economic advancement of a country. Moreover, insurance not only safeguards against risks but also serves as a chance for investment. Life insurance, for instance, facilitates systematic savings through regular premium payments and provides investment opportunities. Insurance significantly impacts the economy by mobilizing domestic savings and channeling accumulated capital towards productive investments. It enables the mitigation of losses, fosters financial

^a <https://www.thedailystar.net/> (The Daily Star on Bangladesh's Insurance Landscape)

stability, and supports trade and commerce activities. Particularly in the context of healthcare, medical insurance is considered indispensable for managing health risks. Critical illnesses can strike unexpectedly, and the escalating costs of medical care are a major concern. Medical insurance policies provide insured individuals with the necessary financial support. Insurance also facilitates risk-sharing, distributing the burden from the insured individuals to the insurers. The fundamental principle of insurance is to distribute risk among a larger pool of people, with many individuals acquiring insurance policies and paying premiums to the insurer. The accumulation of substantial funds through premiums is then directed towards industrial development, leading to accelerated economic growth and increased employment opportunities.

It does this through preserving the public's faith in the financial system, which helps in sustaining economic stability. In the absence of public faith, financial institutions would be unable to provide loans and would instead be required to hold all the money always deposited by customers in liquid form. One can preserve his wealth over the long term with some insurance products, which can provide a steady income to satisfy his requirements after retirement. Because of this, individuals in Bangladesh who are interested in establishing a safety net and a financial plan have many interesting alternatives available to them via insurance purchases.

Impact of the 4IR in the sector:

Bangladesh's financial industry is going to be significantly impacted by 4IR. The total overhaul of the technology used in banking and financial institutions has led to an increase in the number of transactions that can be handled in each amount of time and the number of services that can be offered. AI may correctly make risk management simpler and more efficient. Additionally, integrating these technologies will enable us to do better analytics, making forecasting simpler and more accurate, and we will be able to provide services at a lower cost. Although cryptocurrency trading is a component of the 4IR, the Central Bank of Bangladesh does not permit it since it violates the country's financial legislation. Digital currency is another component of the 4IR. Blockchain technology is the world's future in accomplishing the Sustainable Development Goals by 2030. This is because many developed and developing nations have recognized the potential of the technology.

Although facing challenges from various factors, the banking sector is a crucial component of Bangladesh's monetary system. The advent of information technology has presented one such challenge. A robust technological infrastructure is imperative for the banking industry to ensure smooth functioning. The success of banking businesses now heavily relies on information technology and communication. Consequently, the banking sector has assumed a more prominent role in Bangladesh's economy. Technology plays a vital role in developing a well-functioning financial system that can effectively adapt to the demands of a growing economy. Over the past decade, Bangladeshi banks have made substantial investments in technology, encompassing telebanking, mobile banking, internet banking, automated teller machines (ATMs), credit and debit cards, electronic payment systems, and data warehousing and mining solutions. These investments have resulted in enhanced customer service quality and expedited banking operations. With the expectation of improved performance, banks have allocated significant resources to information technology. IT implementation, application, and efficiency can greatly influence a company's overall success.

Occupations at Risk:

4IR is characterized by the fusion of technologies, including artificial intelligence, robotics, the Internet of Things (IoT), and blockchain. Some of the risky occupations within the insurance and banking sector that arise from the implementation of 4IR technologies are enlisted in the following table with approximate projected demand for the year of 2025, 2030 & 2040.

SL No.	Occupation	Human Resource (Thousand)		
		2025	2030	2040
1	Bank Teller	35	22	14
2	Customer service Representative	45	34	25
3	Bank mMarketing Representative	35	18	12
4	Collector	33	25	11
5	Credit Analyst	25	16	12
6	Insurance Agent	36	21	17
7	Claims Representative	32	18	16
8	Traditional Risk Analyst	30	15	5
9	Conventional Insurance Solutions Architect	35	18	7
10	Non-specialized Cybersecurity Professional	40	20	8
11	Traditional Banking Analyst	45	25	12

Emerging Occupations:

4IR is reshaping the insurance and banking sectors, creating new occupations, and demanding specific skill sets. As the country embraces the opportunities presented by 4IR, the following are some of the emerging disciplines and their skillsets with the projected demand (approx.) are presented in the following table which are becoming increasingly important in Insurance and Banking sector.

SL No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
Core Occupations					
1	Data Analyst/ Scientist	Able to possess skills in data mining, statistical analysis, machine learning, and data visualization to derive insights, develop predictive models, and make data-driven decisions	7	23	33

SL No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
2	AI and Machine Learning Specialist	Skills in programming, data modeling, algorithm development, and deep learning techniques are necessary to harness the power of AI/ML in areas like risk assessment, fraud detection, and customer service automation	8	25	42
3	Cybersecurity Expert	Able to identify vulnerabilities, develop robust security measures, and respond effectively to cyber incidents are crucial. Skills in network security, encryption, incident response, and knowledge of emerging threats are essential	15	28	51
4	Blockchain Specialist	Experts with knowledge of blockchain platforms, cryptography, smart contract development, and regulatory frameworks can help organizations leverage blockchain's potential while addressing security, privacy, and compliance challenges	17	33	44
5	Customer Relationship Management (CRM) System Operation & Maintenance	Skilled in user experience (UX) design, human-centered design thinking, data-driven customer insights, and knowledge of digital channels to create customer-centric solutions and enhance customer engagement	8	12	17
6	Insurtech Innovators	Able to contribute to the development and implementation of innovative insurance solutions	7	22	30
7	ATM Machine Maintenance and Operation Technician	Skills in machine repair, maintenance, diagnostics, troubleshooting, parts replacement, and compliance with security protocols	10	18	25

SL No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
8	Robo-Advisory Developer	Programming skills for automating investment strategies and algorithms. Knowledge of financial products, risk profiling, and regulatory standards	12	21	32

It's important to note that these emerging occupations and skill sets still need to be completed, and the specific needs may vary based on organizational goals, industry segments, and regional contexts. Nonetheless, professionals who acquire these skills will be well-positioned to thrive in the evolving insurance and banking sectors in the 4IR.

Recommendations:

Traditional roles in insurance and banking are at risk as fintech and AI disrupt the industry. Upskilling in data analytics and reskilling for digital finance are critical. New professions in cybersecurity and AI-driven financial services are emerging, fueled by 4IR technologies. Policymakers and governments are requested to adopt several key measures:

- **Bangladesh Insurance Academy (BIA)** can collect the demand on 4IR occupations from insurance companies and initiate new skilling, reskilling and upskilling programs based on the market demands.
- **Bangladesh Institute of Bank Management (BIBM)** can collect the demand on 4IR occupations from banks and provide training based on the market demand.
- **Financial Institutions Division** can provide necessary policy support to accommodate 4IR occupations in this sector.







Construction Sector



Introduction:

Construction' encompasses the art and science of creating objects, systems, and establishments. Mainly, it pertains to the industrial sector that deals with building, renovating, and maintaining infrastructure within the realm of manufacturing and commerce. It plays a crucial role in expanding a country's infrastructure development, which often contributes to its overall progress in ensuring sustainability. However, the construction industry is currently one of the leading contributors on GDP in Bangladesh. In Bangladesh, critical areas of construction activity include commercial, industrial, infrastructure, energy and utilities, institutional, and residential construction.

Key Sectors	Sector's Description
Commercial Construction	The project categories within this industry encompass various structures such as buildings for leisure and hospitality, office buildings, outdoor recreational facilities, retail buildings, and other constructions for commercial purposes
Industrial Construction	The categories of projects within this industry encompass a range of sectors such as chemical and pharmaceutical facilities, manufacturing facilities, metal and material production and processing facilities, and waste management facilities
Infrastructure Construction	The project categories within this industry encompass railway infrastructure, roadway infrastructure, and various other infrastructure initiatives. Investments to enhance and update Bangladesh's road, rail, and airport infrastructure will contribute to the sector's growth
Energy and Utility Construction	The categories of projects within this industry encompass electricity and power generation, oil and gas operations, telecommunications services, sewage system infrastructure, and water system infrastructure
Institutional Construction	The categories of projects within this industry encompass various types of buildings such as educational facilities, healthcare centers, institutional structures, research establishments, and religious edifices
Residential Construction	The categories of projects within this industry encompass both individual homes and residential complexes

Various well-known companies are responsible for managing different sectors. These companies include State Atomic Energy Corporation Rosatom, Kajima Corporation, China Railway Construction Corporation Group, POSCO, IHI Corporation, China Railway Engineering Group Company Ltd., Power Construction Corporation of China, China Communications Construction Group Ltd., Sumitomo Corporation, and Coal Power Generation Company Bangladesh Ltd. BCL Associates Ltd., PADECO Co. Ltd., TYPASA Group, Nippon Koei Co. Ltd., Temasek Holdings (Private) Ltd., Oriental Consultants Holdings Company Limited, Japan Atomic Energy Agency, Development Design Consultants Ltd., and Heerim Architects & Planners Co. Ltd. There are also a good number of small and medium enterprises in this sector who are associated with designing, developing and consultation^a.

^a <https://www.sumitomocorp.com/en/global> (The Business Standard on the Role of International Companies)

Importance of this sector:

The construction sector holds immense importance in Bangladesh, playing a pivotal role in the country's economic development and infrastructure growth. With a rapidly growing population and urbanization, there is an increasing demand for housing, commercial buildings, transportation networks, and other essential infrastructures. The construction sector in Bangladesh not only contributes significantly to the country's GDP but also creates employment opportunities for a large workforce. It catalyzes economic growth by attracting investments, stimulating related industries, and fostering innovation and technological advancements. Moreover, the sector plays a crucial role in improving the quality of life for the population by providing better housing options, modern amenities, and upgraded public infrastructure.

The construction sector strives to establish a more sustainable world via projects and infrastructure. Developments in waste management, green buildings, and environmentally friendly materials are all significant, and the sector offers a variety of job opportunities, including that of a sustainability expert.

The growth of commercial construction will be bolstered by an increase in consumer and investor confidence. Investments in expanding and modernizing Bangladesh's road, rail, and airport facilities will sustain infrastructure construction production during the projected period. The government emphasized its funding for the transportation and communications infrastructure development.

The construction industry is regarded as one of the primary contributors to national economic growth and development. This sector is contributing to the attainment of the nation's socioeconomic development objectives like providing housing, infrastructure, and jobs. It serves a vital role in ensuring that the inhabitants of the nation have a healthy environment in which they can live.

The construction industry can support sustainability by following the United Nations' Sustainable Development Goals (SDGs). There are six relevant goals for the industry: ensuring clean water and sanitation, promoting affordable and clean energy, encouraging industry innovation and infrastructure development, fostering sustainable cities and communities, promoting responsible consumption and production, and addressing climate change. By aligning their actions with these goals, the construction industry can positively impact on sustainability.

The construction sector also acts as a driving force for urban development, helping to transform cities and towns into modern and sustainable centers. Additionally, infrastructure development in transportation, energy, and communication enhances connectivity, trade, and overall economic competitiveness. Overall, the construction sector in Bangladesh is vital for the country's progress, as it facilitates economic growth, improves living standards, and supports sustainable development.

Impact of the 4IR in the sector:

4IR in Construction focuses on a decentralized link between the physical area and cyberspace, facilitated by extensive connectivity. The link between these two worlds already exists in the building business through technical means. In 4IR, many technologies will eventually replace

this human function, reducing human participation and tending toward a decentralized merger of physical reality and its internet representation.

Construction is always growing toward future development. New technological advancements produce attractive structures during construction projects' planning and development phases. The emergence of 3D modeling, VR, and AR technologies has created attractive new occupations, such as architectural technologists and hydrographic surveyors.

The construction industry in the era of the 4IR relies on a wide range of technologies, such as the Internet of Things, digital twin, additive manufacturing, cloud computing, cyber-physical systems (CPS), and Building Information Modeling (BIM). While many industries in the 4IR era are built upon technologies that facilitate constant connectivity, decentralized cyber-physical systems, and real-time decision-making, the construction sector's reliance on these technologies is not exclusive. It encompasses a broader range of technologies, including the IoT, digital twins, additive manufacturing, cloud computing, and cybersecurity.

In the 4IR age, providing customized, intelligent, and connected building goods is feasible. This requires the industry to undergo a digital revolution with digitalized design, building, and operation. Such a digital change in the building business requires a paradigm shift.

Occupations at Risk:

4IR is characterized by integrating advanced technologies, such as automation, artificial intelligence, robotics, and the Internet of Things, into various industries, including construction. While 4IR brings many benefits and opportunities, it also poses risks and challenges for certain occupations within the construction sector. Therefore, adapting to the changing landscape of the construction industry and acquiring relevant technological competencies will be crucial for individuals working in the sector. Some of the risky occupations within the construction sector that arise from the implementation of 4IR technologies are enlisted in the following table with approximate projected demand for the year of 2025, 2030 & 2040.

Sl. No.	Occupation	Human Resource (Thousand)		
		2025	2030	2040
1	Manual Laborer	41	21	10
2	Equipment Operator	34	22	10
3	Traditional Tradespeople	41	32	11
4	Traditional Draftsperson	36	26	12
5	Conventional Surveyor	38	28	13
6	Standard Welder	39	29	14
7	Traditional Construction Safety Officer	35	25	15

Emerging Occupations:

The construction sector is transforming remarkably with the emergence of 4IR technologies. As digitalization and automation revolutionize various industries, the construction sector is no exception. Innovative technologies such as robotics, artificial intelligence, building information modeling (BIM), drones, 3D printing, and advanced analytics are reshaping traditional construction practices and giving rise to a new wave of emerging occupations. These occupations are at the forefront of leveraging 4IR technologies to drive efficiency, productivity, and sustainability in construction projects. From drone operators and 3D printing technicians to data analysts and virtual reality specialists, these new roles require a unique blend of technical skills, creativity, and adaptability. As the construction industry embraces the potential of 4IR, these emerging occupations are poised to play a pivotal role in shaping the future of construction, transforming how buildings and infrastructure are designed, constructed, and maintained. As the country embraces the opportunities presented by 4IR, the following are some of the emerging disciplines and their skillsets with the projected demand (approx.) are presented in the following table which are becoming increasingly important in construction sector.

SL No	Occupations	Skills sets	Human Resource (Thousand)		
			2025	2030	2040
Core Occupations					
1	Drone Surveyor	Able to perform digital surveys, Operate Drone	30	38	45
2	XR Developer	Able to develop architectural visualization using VR technology	41	50	64
3	3D Model Developer	Able to use 3D AutoCAD/ design software	33	60	95
4	Automation Specialist	Knowledge of Using, operating, and maintaining RMC machine, automation of pre-fabricated material production, digital monitoring of construction using ICT and ensure safety	40	63	74
5	Building Information Modeling (BIM) Specialist	Proficiency in BIM software (Revit, ArchiCAD, SketchUp Pro, etc.), 3D modeling and design skills, Construction documentation generation (plans, sections, elevations), Building physics and energy modeling, Clash detection and coordination Cost estimation and scheduling	35	50	75

SL No	Occupations	Skills sets	Human Resource (Thousand)		
			2025	2030	2040
6	Green Building Consultant	Knowledge of sustainable building principles (LEED, WELL, etc.), Life cycle assessment (LCA) and material selection, Renewable energy technologies and systems, Building performance simulation and energy modeling	30	45	70
7	Construction Robotics Technician	Knowledge of robotics technology and principles, and data analysis	38	58	78
8	Advanced Construction tools Technician	Programming and operation of Advanced Construction tools (3D printing drones, autonomous vehicles), (BIM)	35	55	75
9	Prefab and Modular Construction Expert	Knowledge of prefab and modular construction principles and methods, Design and engineering of modular units Supply chain management and logistics, Quality control and inspection procedures, BIM for off-site construction	28	43	68
10	Prefab and Modular Construction Assembler	Assembling Prefab and Modular Construction infrastructures	38	53	78
11	Construction Project Management (CPM) Specialist	Able to minimize cost, time, manpower, materials and processes	55	73	96

Recommendation:

Manual labor in construction is becoming riskier with the advent of automation and smart building technologies. Upskilling in BIM and reskilling for sustainable construction practices are vital. Emerging roles in smart infrastructure and green building are growing due to 4IR. Policymakers and governments are suggested to adopt several key measures:

- The Ministry of Housing and Public Works (MoHPW) can
 - » conduct continual market analysis for emerging jobs and jobs at risk in order to accommodate skilled workers with the transition.
 - » undertake capacity-building measures for our government and non-government professionals related to this area for smooth execution of 4IR skills and employment initiatives.
 - » Create a supportive ecosystem for startups working on 4IR solutions for the construction sector.
- Local Government Engineering Department (LGED), PWD Training Academy & Testing Laboratory, Housing and Building Research Institute (HBRI), Bangladesh Association of Construction Industry (BACI), and relevant training institutes can improvise the training program and initiate new skilling, upskilling and reskilling programmes in the context of 4IR.
- Bangladesh Association of Construction Industry (BACI), Bangladesh Land Developers Association (BLDA), Bangladesh Cement Manufacturers Association (BCMA) and Bangladesh Electrical Merchandise Manufacturers Association (BEMMA) can collect job demand from their member industries and accommodate skilled manpower according to their needs.



Creative Media Sector



Introduction

Creative media sector encompasses many activities involved in producing, developing, and disseminating various forms of content across multiple mediums. From music, films, and television shows to video games, advertisements, and informative materials, creative media plays a pivotal role in shaping our modern society. It allows us to construct a comprehensive understanding of the world while providing the freedom to choose information that aligns with our interests and needs. At the core of creative media lies storytelling, which aims to elicit emotional responses from audiences. This can be achieved through various mediums, such as the written word, captivating podcasts, expressive visual arts, or thought-provoking conversations. The essence of creative media lies in the unique and compelling ways individuals share their knowledge and perspectives with others. Additionally, creative media is closely intertwined with the business realm, where harnessing and controlling content becomes crucial for seeking innovative ways to utilize it effectively.

In today's digital age, creative media has emerged as a transformative force, encompassing various mediums, platforms, and content forms. It revolutionizes the way we communicate, express ourselves, and consume information. It plays a pivotal role in capturing and engaging audiences in a world where information flows incessantly, and attention spans are fragmented. By providing a window into diverse perspectives, cultures, and ideas, creative media enables individuals to compile a comprehensive image of the world. Moreover, it empowers us to personalize our experiences by choosing resonating information. Storytelling forms the foundation of creative media, aiming to strike emotional chords with audiences. Whether through written essays, captivating podcasts, visual arts, or conversations, the power of creative media lies in sharing knowledge and experiences in a unique and captivating manner. It fosters connections, understanding, and empathy among diverse communities, allowing meaningful interactions and dialogue. Furthermore, creative media extend their influence beyond artistic expression. It intersects with the realms of business, technology, and innovation. Creative media fuels industry advancements, facilitates the creation of new revenue streams, and drives economic growth. By understanding the potential and implications of creative media, we can unlock new possibilities for communication, artistic expression, and social progress.

In this sector, there are approximately 1500 media organizations including the backward and forward chain of the main media industries where 5,00,000 workers are engaged in different levels of professional activities^a.

Importance of the Sector

There has never been a period in which media technologies have played such an important role as they do now. The information delivered in the news is transformed to the masses of people very quickly. The landscape of advertising and media is always changing, and this shift is occurring at a pace that is far faster than it ever has been before. This influences every aspect of the media, including how we consume it (in super-fast, byte-sized chunks, pictures, and video over text, second screening, and so on), the types of media we engage with (AI, chatbots, instant messaging, and social media), and the visuals and messaging we are exposed to (e.g., AI-

^a <https://www.statista.com/> (Overview of Bangladesh's media industry)

generated advertising, AI-generated news anchor). In addition, media needs to exercise extreme caution about the deal with clients, making assured that maintaining privacy rules as well as the role and obligations of the communication industry. Importantly, creative media aligns with the SDGs set forth by the United Nations. It contributes to the Goal 16 of SDGs: Peace, Justice, and Strong Institutions by promoting transparency, inclusivity, and accountable governance. Moreover, it supports Goal 9: Industry, Innovation, and Infrastructure by acting as a catalyst for technological advancements, fostering innovation, and building sustainable infrastructure. It strongly helps in developing a knowledgeable society.

Impact of the 4IR in the sector

The 4IR is developing such an environment in which disruptive technologies and trends (such as ubiquitous data, infinite connectivity, ever-increasing computing power, and advanced monitoring technologies) are significantly transforming our lives. Several components of 4IR have been accelerated and executed by many people during the COVID-19 epidemic, which has surprised the whole globe. Surprisingly, most of the teachers and students could run their study online. ‘Working from home’ was also practiced and run very well with standard performance. Even business and social life activities are increasingly being held on internet platforms. The worldwide pandemic and the 4IR have had the combined effect of bringing about rapid and significant changes in the way we communicate and connect across a variety of spheres of existence. The transition to digital platforms, which was hastened by the introduction of widespread lockdowns, has also been a driving force behind the development of the ways in which we consume media. Increased competition for the attention of customers and stakeholders is another effect that may be attributed to 4IR. As with every other revolution, the Fourth Industrial Revolution brings a lot of problems, but it also brings a lot of opportunities.

The traditional media must become more technologically adept, innovative, and strategic to take advantage of 4IR. The established media can better use the technological tools available to expand the audience for noteworthy information. Traditional media must also acknowledge social media’s importance and its transformative role for average citizens. When executed properly, partnerships with competent amateur content makers have the potential to provide genuine benefits for all involved parties and enable established media outlets to expand their audience base by reaching members of previously untapped demographic groups. Talented amateur makers can be very useful if they work together, just like citizen journalism and private content production did well when camera phones came out.

Media organizations must put as much emphasis as they can on 4IR and the pillars it supports. They are going to need to make a concerted effort to use AI and IoT to combine content and advance ease. Even though 4IR technologies aren’t cheap, there are ways to solve money problems by investing creatively and wisely in technological advances.

In addition, 4IR mandates that companies train their employees further and invest in their workforce’s abilities. This goes beyond just educating or recruiting individuals with certain technological capabilities. Experts in the industry are now pushing for skill development models that aim to educate people on how to cope with the complexities and changes in their environments. They suggest that the rate of change in 4IR would always outstrip the training of skills. As a result, organizations would be better served by educating their people on how to

handle complexity and cope with rapid change efficiently. Very important issue in this sector to understand the audience. Due to advancement in the IT sector, doing so is easier than it has ever been. Because of this issue; Facebook, Google, Instagram, Apple, and Amazon have grown into the successful companies that they are today. Sometimes, using AI, they can know us better than we know ourselves. There is no question in my mind that they comprehend the significance of specificity and targeted product distribution to achieve success at the age of 4IR. The media also must focus more resources on narratives and messages using the 4IR based technologies.

Occupations at Risk

Traditional professions in this sector are in risk to loss their position and demand. While the creative media industry offers many exciting and rewarding occupations, some have inherent risks due to low skills and inability to use the technologies. These occupations may involve physical danger or psychological challenges also. Some of the risky occupations within the creative media sector that arise from the implementation of 4IR technologies are enlisted in the following table with approximate projected demand for the year of 2025, 2030 & 2040.

Sl. No.	Occupations	Human Resource (Thousand)		
		2025	2030	2040
1	Photojournalist	28	20	13
2	Stunt Performer	59	36	18
3	Live Event Producer/Coordinator	30	25	12
4	Documentary Filmmaker	28	20	11
5	Content Moderator	20	10	5
6	Investigative Journalist	22	14	6
7	Conventional Set Designer	30	22	10
8	Linear Storyline Developer	26	18	9
9	Manual Music Composer	25	17	7
10	Conventional Video Editor	22	14	6
11	Routine Coding in Creative Media	32	24	12

Emerging Occupations and Skillsets

Light set-up operators, IT experts, graphic designers, creative directors, news directors, broadcasters, software engineers, machine operators, and program arrangement directors will need 4IR skills soon. Both the government and commercial businesses are working to upgrade their current systems, but the underlying infrastructure still needs to be ready for upgrade. So, they are increasing the organization's financial value by employing the HD format and digital channels. Tools for augmented scripting, artificial intelligence, cloud computing, digital storage, digital marketing management, and digital accounting management should be offered to those now employed in the country to keep pace with other nations. The creative media industry is

constantly evolving, especially in the context of 4IR. This revolution will bring advancements in technology and automation, significantly impacting the job market and creating new opportunities in the media sector. As the country embraces the opportunities presented by 4IR, the following are some of the emerging disciplines and their skillsets with the projected demand (approx.) are presented in the following table which are becoming increasingly important in creative media sector.

Sl. No	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
Core Occupations					
1	Animation Specialist	Computer vision, programming, UX design, AR & VR application	31	46	72
2	3D Designer	Able to provide expertise in 3D modeling, rendering, texturing, lighting	26	38	58
3	Game Developer	Able to develop gaming apps & programming, strong coding skills in multiple languages	32	44	62
4	Transmedia Storyteller	Able to have a deep understanding of storytelling techniques, multimedia production, audience engagement strategies, and cross-platform integration	33	51	71
5	Content Creator	Writing, editing, social media management, branding	28	36	52
6	Social Media Influencer	Skilled in content production (e.g., writing, photography, videography), digital marketing, audience engagement, and platform-specific knowledge	13	27	36
7	UX Researcher	Capable of being skilled in user research methodologies, usability testing, data analysis, and having a deep understanding of human-centered design principle	1	1	6
8	Artificial Intelligence (AI) Creative	Able to possess artistic skills, programming knowledge (particularly in machine learning and deep learning), and an understanding of AI ethics and responsible design	3	18	26

Sl. No	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
9	Creative Technologist	Able to be knowledgeable about the latest technologies and have skills in prototyping, coding, hardware integration, and problem-solving	35	58	66
10	Digital Marketing Specialist	Able to have expertise in digital advertising, search engine optimization (SEO), content marketing, analytics, and social media management	42	67	78
11	Algorithmic Artisan	Strong coding and creative skills for algorithm-generated art/design	30	50	72
12	Virtual Set Maestro	Skilled in virtual/augmented set design and 360 video/imaging	32	54	72
13	Narrative Code Weaver	Ability to programmatically generate story and text	28	46	66
14	Synthetic Harmony Maestro	Skills in music composition, sound design with AI/generative tools	26	42	62
15	Creative Code Choreographer	Expertise in creative coding, data visualization, interaction design	34	56	70
16	Virtual Production Specialist	LED wall integration, camera tracking, virtual set design, compositing	40	62	82
17	Digital Twin Creator	Sensor integration, simulation programming, AI/ML, complex system modeling	38	60	80
18	Autonomous Journalist	NLP, knowledge graphs, summarization, generation with BERT, GPT-3	10	19	30
19	Interactive Narrative Developer	Twine, Unity, programming choices & branches, visual novel creation	32	52	72
20	Holographic Artist	Spatial mapping, computer graphics, 360 video/animation, HoloLens app dev	36	58	78
21	Synthetic Character Animator	Motion capture, rigging, keyframe animation, deep learning animation	4	24	34

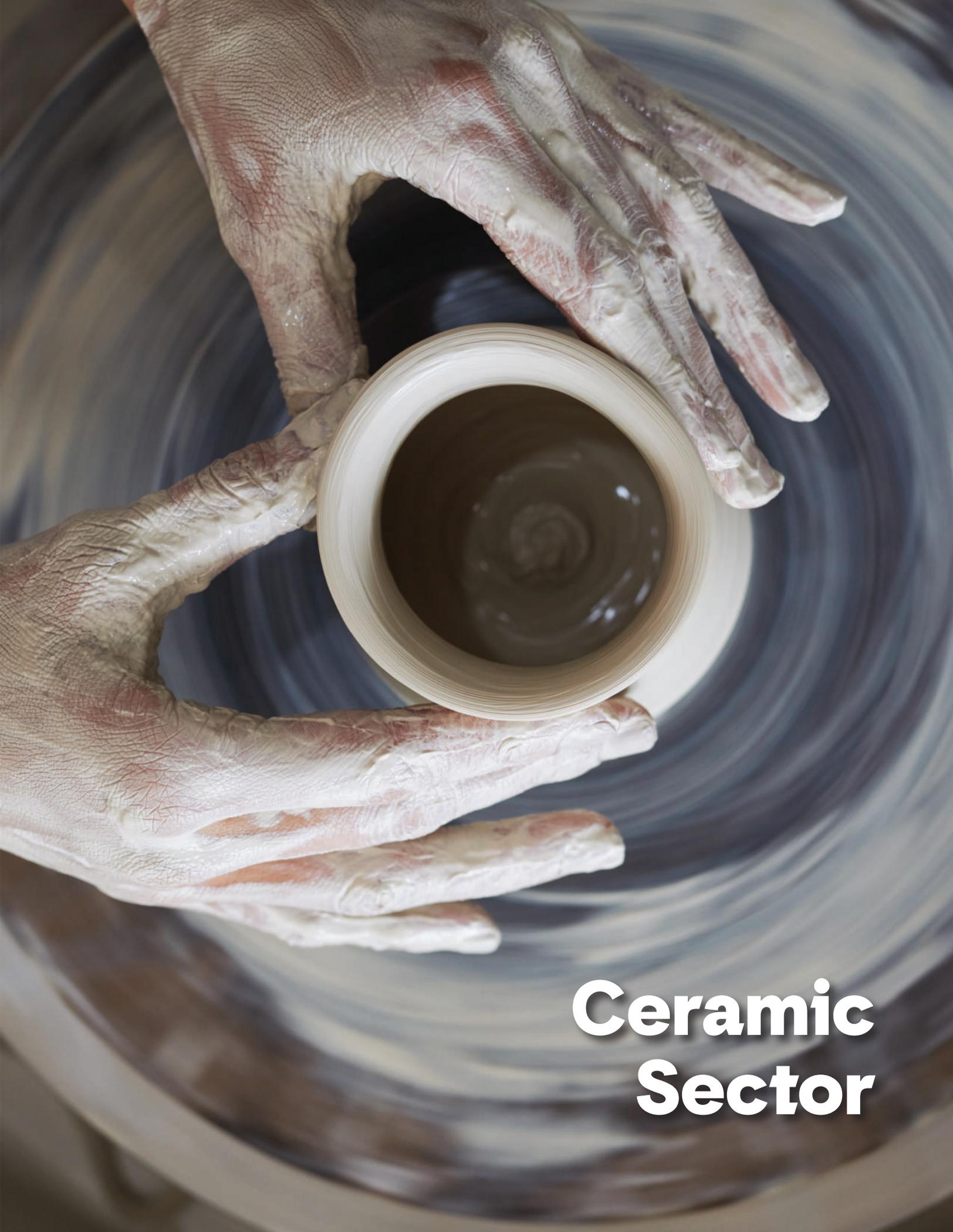
Sl. No	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
22	Computational Artist	Programming, ML, creative AI safety, art & tech prototyping skills	6	28	40

These emerging occupations in the Creative Media industry for the 4IR require technical skills, creativity, adaptability, and a willingness to keep up with the latest technological advancements. Additionally, a strong foundation in traditional creative skills, such as storytelling and design, is often valuable in these roles.

Recommendations

With the rise of AI-generated content and digital platforms, traditional media roles are at risk. Upskilling in areas like digital content creation and reskilling for AI-driven media production are crucial. New professions in virtual reality design and AI-enhanced storytelling are emerging, driven by 4IR technologies. Policymakers and governments are suggested to adopt several key measures:

- The Creative Media Industry Skills Council can arrange dialogues/seminars on challenges and opportunities of 4IR.
- The Creative Media Industry Skills Council can collect the market demands on 4IR occupations.
- The public-private skills service providers can provide skills development on 4IR based emerging occupations.



Ceramic Sector



Introduction:

The ceramic industry in Bangladesh has witnessed significant growth and plays a crucial role in the country's economy. With a rich history of pottery and ceramics dating back centuries, Bangladesh has harnessed its expertise and resources to establish a thriving ceramic industry. The sector encompasses various products mainly ceramic tiles, sanitary ware, tableware, and decorative items.

The ceramic industry in Bangladesh has become a vital contributor to the country's export earnings, as it caters to both domestic and international markets. The industry's success can be attributed to abundant natural resources, skilled labor, favorable investment policies, and continuous technological advancements. The demand for ceramic products has steadily risen, driven by infrastructure development, urbanization, and an increasing middle-class population. The industry's commitment to quality, innovation, and sustainability has positioned Bangladesh as a competitive player in the global ceramic market. With its diverse product range, artistic designs, and commitment to excellence, the ceramic industry in Bangladesh continues to expand and contribute significantly to the country's economic growth and development.

Nowadays, ceramics are used for various purposes. There is a massive market for ceramic products on both the domestic and international levels. Its strategic location makes the ideal for manufacturing and selling a wide range of ceramic products to satisfy the needs of both domestic and international markets. Raw materials for the ceramic industry include ball clay, kaolin or china clay, feldspar, fire clay, bone ash, quartz, talc, limestone, zircon ore or concentrate, zirconium silicate, etc. Generally, China, Malaysia, Thailand, Vietnam, Egypt, India, Pakistan, and Indonesia supply the raw materials. For tableware, major makers or brands include FARR, Shinepukur, Monno, Paragon, Artisan, and Protik; for tiles, Akij, RAK, Star, Great Wall, and Mir; and for sanitaryware, RAK, Abul Khair, and Excellent. Local ceramics and Chinese manufacturers have helped to meet domestic demand and grow the sector's exports.

The ceramic sector aims to become a Center of Excellence for market-driven scientific, industrial, and technical research and innovation in ceramic technology by 2031. The goal is to do scientific, industrial, and technical research on ceramics, promote it, and direct it for the benefit of the people of Bangladesh.

Importance of this Sector:

The ceramic industry emerged in 1958 and presently comprises about 65 manufacturers engaged in the production of various types of ceramics, including dinnerware, tiles, sanitaryware, insulators, and heavy clay products such as earthenware, pottery, terracotta, and roof tiles. In the fiscal year 2017-18, the consumption of ceramic goods in the domestic market reached a value of USD 660 billion. The country's own production satisfies 96% of the demand for dinnerware, 77% for tiles, and 89% for sanitary ware. The growth of the real estate sector has been the main catalyst behind the expansion of the domestic market ^a.

^a <https://research.eblsecurities.com/> (Overview of the Ceramic Industry in Bangladesh)

The ceramics industry in Bangladesh is an emerging manufacturing sector. The industry primarily focused on the production of dinnerware, sanitaryware, and tiles. In 2011, there were 21 ceramic manufacturing plants in Bangladesh, providing employment to around 500,000 individuals approximately. After meeting 80% of the domestic demand, Bangladesh exported over USD 36 million worth of ceramic products during the first nine months of the 2013-14 fiscal year. The primary export destinations include the EU, the United States, and the Middle East. Bangladeshi ceramics are sold in more than 50 countries, including the United Kingdom, the United States, Italy, Spain, Norway, France, the Netherlands, and Australia. The Export Promotion Bureau (EPB) reported that ceramic exports generated profits of over USD 70 million in FY2018-19 (increasing from USD 52 million in FY2017-18), making it the seventh-largest export item for Bangladesh and it is projected to become the third-largest export item within the next five years ^b.

The ceramics industry employs approximately 48,000 individuals, with managerial personnel comprising roughly 10% of the total workforce. When considering the individuals employed in related industries, indirect employment is expected to exceed 500,000 people (Source: IDLC Business Review). Over the past ten years, the ceramics sector has grown by over 20% on average. After fulfilling local demand, this industry, dependent on imported raw materials, has a significant presence in the export market. There are 66 ceramic brands in Bangladesh, including those producing dinnerware, tiles, and sanitary ware. Ceramic items worth around Tk 6,000 crore are sold annually in the local market ^c.

Impact of the 4IR in the sector:

The 4IR has significantly impacted the ceramic sector, revolutionizing various production, design, and distribution aspects. One of the key areas influenced by 4IR is the manufacturing process itself. Automation and robotics have greatly enhanced efficiency and precision in ceramic production, reducing errors and waste while increasing productivity. Advanced sensors and data analytics systems monitor and optimize manufacturing processes, improving quality control and cost-effectiveness.

Furthermore, integrating AI and machine learning algorithms has revolutionized ceramic design. AI-powered software can generate intricate and complex patterns, textures, and shapes that were previously difficult to achieve manually. This has opened new creative possibilities, allowing designers to experiment with innovative and personalized ceramic products.

In addition to manufacturing and design, the 4IR has also transformed the distribution and marketing aspects of the ceramic sector. E-commerce platforms and online marketplaces have expanded the reach of ceramic products, allowing manufacturers to tap into global markets more easily. VR & AR technologies enable customers to visualize and experience ceramic products before purchasing, enhancing the shopping experience, and reducing the need for physical showrooms.

Moreover, the 4IR has played a significant role in enhancing sustainability in the ceramic sector. Manufacturers can reduce waste and minimize environmental impact by optimizing material

^b <https://www.tbsnews.net/> (The Business Standard on the Bangladesh Ceramic Industry)

^c <https://www.ceramicworldweb.com/> (Ceramic World Web on Bangladesh's Tile Industry)

usage through AI algorithms. Advanced energy-efficient technologies are also employed in ceramic production, reducing energy consumption and carbon emissions.

The 4IR has revolutionized the ceramic sector, transforming traditional processes, expanding design possibilities, improving distribution channels, and promoting sustainability. These advancements have increased the ceramic industry’s competitiveness and enriched the customer experience, offering them a wider range of innovative and personalized ceramic products.

Occupations at Risk:

The ceramic sector has traditionally been associated with various risks and hazards due to the nature of its operations. However, the 4IR has the potential to revolutionize the industry and mitigate these risks, making it a safer and more efficient sector. By integrating advanced technologies such as automation, artificial intelligence, robotics, and IoT, the ceramic sector can significantly reduce occupational hazards and create a safer working environment for its workforce. This shift towards 4IR technologies can address specific risky occupations within the sector, such as kiln operators, who are exposed to high temperatures and harmful fumes, and manual material handlers, who face physical strain and injury risks. Through automation and robotics, tasks involving direct contact with hazardous materials can be automated, minimizing workers’ exposure to harmful substances. AI-powered systems can monitor and control kiln operations, ensuring optimal temperature and ventilation conditions without human intervention. Additionally, IoT devices can collect real-time data on various safety parameters, enabling proactive monitoring and the timely detection of potential hazards. Adopting 4IR technologies in the ceramic sector enhances safety and improves productivity and efficiency, leading to a more sustainable and competitive industry. Some of the risky occupations within the ceramic sector that arise from the implementation of 4IR technologies are enlisted in the following table with approximate projected demand for the year of 2025, 2030 & 2040.

Sl. No.	Occupations		Human Resource (Thousand)		
			2025	2030	2040
1	Manual Ceramic Production Worker	<ul style="list-style-type: none"> • Molding • Shaping • Glazing 	31	13	9
2	Quality Control Inspector		38	25	10
3	Machine Operator		21	14	3
4	Packaging and Shipping Worker		17	12	2

Emerging Occupations and Skillsets:

Several occupations are anticipated to emerge in the context of 4IR in Ceramic, which encompasses integrating advanced technologies and digitalization in the ceramic industry. These occupations align with the technological advancements and changing needs of the sector.

Ceramic 4.0 adaptation presents a lot of challenges. The target group's degree of expertise, method, trust, and preparedness determines this. These problems are common when promoting new ideas but must be solved for the new paradigm to work. PLCs, automated quality control equipment, high-pressure toilets, sophisticated glozing equipment, robotic quality control systems, auto molding, and 3D casting technology may all be crucial to the expansion of Ceramic industries. Technology will produce several noteworthy jobs to guarantee steady growth during the fourth industrial revolution. Examples of developing positions in the technological industry include PLC operator, Technician for mechanical position & electrical positions, robotics operator, automation expert, 3D printing expert, and data analyst. As the country embraces the opportunities presented by 4IR, the following are some of the emerging disciplines and their skillsets with the projected demand (approx.) are presented in the following table which are becoming increasingly important in ceramic sector.

Sl. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
Core Occupations					
1	Technician (Mechanical)	Repairing maintenance and service of kilns, mills, extruders, presses and other process equipment. Diagnosis and resolution of issues related to equipment vibration, thermal stress, pressure controls etc	0.7	0.9	1.1
2	Technician (Electrical/ Electronics)	Testing, repair and calibration of electrical panels, motors, drives, sensors and instrumentation. Wiring of new machines. Programming of Human Machine Interface (HMI) screens in control cabinets	0.6	0.7	1.0
3	Automation Engineer	Design, integration and commissioning of robotic work cells, Automated Guided Vehicle (AGVs), conveyors using PLCs, HMIs, vision systems. Programming robots for material handling, inspection, packaging	0.3	0.5	0.8

Sl. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
4	3D Printing Expert	3D CAD modeling, generation of support structures, slicing, process planning for 3D printed ceramic tools/parts. Operation of FDM, SLA, SLS printers with ceramics	0.2	0.3	0.5
5	Data Analyst	Production data analytics, customer churn analysis, demand forecasting, process optimization using statistical methods, data visualization	1.0	1.2	1.4
6	Kiln Expert	Kiln process control, firing schedules, maintenance of burners, insulation, sensors, unloading systems. Root cause analysis of defect	0.5	0.7	1.0
7	Software Technician	Configuration of Supervisory control and data acquisition systems (SCADA), manufacturing execution systems (MES). Integration of IoT sensors, edge devices. Remote connectivity, cybersecurity of manufacturing network	0.5	0.6	0.9
8	Control Systems Engineer	Programming, configuration, operation and monitoring of Programmable Logic Controllers & DCS controllers to control machinery in ceramic production lines. Network integration using TCP/IP, OPC-UA, MQTT. System diagnostics, cybersecurity compliance. Troubleshooting and resolving issues in control system	0.5	0.7	0.8
9	AI-powered Design and Product Development Specialists	Conceptualization of AI prototypes for design automation, generative design, data-driven process optimization for ceramics manufacturing	0.1	0.3	0.6

Sl. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
10	AI-assisted Maintenance and Quality Control Specialist	Deployment of computer vision, machine learning models for automated defect detection, predictive maintenance, process monitoring in factories	0.1	0.2	0.4

Recommendations:

Traditional roles in the ceramic industry face challenges due to automation and digital manufacturing techniques. Upskilling in advanced ceramic design and reskilling for smart production are essential. Emerging professions in sustainable ceramics and 3D-printed ceramics are growing as 4IR reshapes the sector. Policymakers and governments are requested to adopt several key measures:

- Bangladesh Institute of Glass and Ceramics (BIGC) can include or suggest 4IR elements/skills in different academic interventions like short courses, diploma and graduate curriculum development to prepare future work force.
- Research and development (R&D) are the core component of BIGC. So, continuous study & research regarding 4IR in this sector can be facilitated by BIGC.
- Bangladesh Ceramic Manufacturers & Exporters Association (BCMEA) can establish a 4IR cell to guide their member industries, foster industry-academia collaboration and arrange continuous policy dialogue.





Informal SME Sector



Introduction:

Bangladesh's current development paradigm is focused on accelerating growth, reducing poverty, economic inequality, and regional imbalance. To achieve these objectives, the country emphasizes the creation of productive jobs in the manufacturing even in the sector of SMEs. A key component of this development plan is the growth and expansion of small and medium-sized businesses (SMEs). SMEs play a crucial role in attaining growth in manufacturing and are seen as a strong tool in rural development, poverty reduction, and the mitigation of regional inequality. In Bangladesh, SMEs encompass a diverse range of 33 subsectors of goods and services, making significant contributions to the country's economy.

Statistics reveal the significance of SMEs in Bangladesh's economic landscape. They account for 50.91% of the micro-economic sector, employ 35.41% of the labor force, and contribute 48.41% to the country's gross domestic product^a.

While the informal sector is the most vital economic activity in terms of GDP and employment, the contribution of SMEs to the gross domestic product is relatively low at 20.25% compared to other emerging countries. Bangladesh is home to a significant number of microenterprises, with 17,384 in total, including 15,666 classified as tiny, 6,103 as medium-sized, and 3,639 as large-scale enterprises. Currently, industries such as agro- and geoprocesing, aquaculture, furniture, leather, light engineering, power and energy, and wholesale and retail are driving the growth of the SME sector in Bangladesh ^{b, c}.

The expansion of small and medium-sized enterprises is a vital component of Bangladesh's development strategy to achieve economic growth, reduce poverty, and address regional imbalances. The significant contributions of SMEs to employment and GDP highlight their importance in the country's economic landscape. As various industries continue to drive the growth of SMEs, there is a growing recognition of the need to support and nurture these enterprises to unlock their full potential and contribute further to Bangladesh's overall development.

Importance of the Sector:

SMEs are not only vital for economic reasons but also hold significant social importance. In the European Union (EU), they make up an astounding 99.9% of the estimated 23 million businesses and provide approximately 75 million jobs, representing two-thirds of total employment. Industries such as textiles, construction, and furniture heavily rely on SMEs, accounting for up to 80% of employment. This trend is observed in most economies worldwide, especially in emerging nations. Globally, SMEs account for many businesses and contribute significantly to job creation and economic growth. They represent around 90% of enterprises and over 50% of employment. In developing countries, formal SMEs can contribute up to 40% of national income (GDP), and when informal SMEs are considered, their impact is even more substantial. Given the projections that 600 million jobs will be required by 2030 to accommodate the expanding global labor force, the growth of SMEs has become a top priority for governments globally. However, one of the major challenges faced by SMEs is access to capital, which remains a significant barrier to their development, particularly in emerging markets and developing nations ^{d, e}.

a <https://www.thedailystar.net/business/economy/news/how-much-sme-potential-have-we-realised-3618551>

b <https://www.cipe.org/resources/small-and-medium-enterprises-in-bangladesh-an-assessment-report/>

c <https://cgs-bd.com/article/9361/SMALL-AND-MEDIUM-ENTERPRISES-IN-BANGLADESH>

d <https://www.weforum.org/agenda/2024/01/chart-drive-eu-economy-small-business-sme/>

e <https://www.eurofound.europa.eu/en/topic/small-and-medium-sized-enterprises>

Recognizing the importance of SMEs and the need for improved financing, Bangladesh has taken initiatives to bridge the funding gap. The Access to Finance for Women SMEs Project aims to enhance access to finance for women-owned small and medium-sized enterprises (WSME) through the establishment of a credit guarantee scheme (CGS), the formulation of an SME Finance Policy, and the strengthening of regulatory and sectoral capacities. The introduction of Bangladesh's first comprehensive SME Finance Policy in September 2019 marked a significant milestone achieved through concerted efforts, regulatory capacity strengthening, and the inclusion of gender-sensitive perspectives. The Men-owned small and medium-sized enterprises (MSME) sector in Bangladesh currently faces a funding gap of \$2.8 billion, with 60% of women's SME financing requirements remaining unmet due to limited access to collateral. Addressing this issue requires a systematic approach and a comprehensive strategy. The SME Finance Policy is expected to play a crucial role in enhancing SME financing, considering that over 10 million SMEs contribute 23% to the country's GDP, account for 80% of employment in the industrial sector, and employ 25% of the entire labor force ^e.

SMEs are indispensable for both economic and social development. They are the backbone of many economies worldwide, including Bangladesh, contributing significantly to employment, GDP, and overall economic progress. By implementing supportive policies and initiatives like the SME Finance Policy and the Access to Finance for Women SMEs Project, Bangladesh aims to enhance SME financing and create an environment conducive to their growth and success. The continued focus on SMEs is essential for driving economic growth, reducing poverty, and creating sustainable employment opportunities in the country.

Impact of the 4IR in the sector:

4IR has significantly impacted SMEs. Rapid technological and digitalization advancements have presented challenges and opportunities for businesses operating in the informal sector. 4IR has facilitated increased connectivity, access to global markets, and enhanced productivity through automation and digitization. This has allowed informal SMEs to reach a broader customer base, improve operational efficiency, and streamline processes.

However, the 4IR has also created certain challenges for informal SMEs. Adopting technology requires financial resources, technical expertise, and access to infrastructure, which may be limited for many businesses in the informal sector. Additionally, the fast-paced nature of technological advancements necessitates continuous learning and upskilling, which can be challenging for entrepreneurs with limited resources and educational opportunities. Nonetheless, the 4IR has opened new avenues for innovation and entrepreneurship within the informal sector. It has provided opportunities for individuals to engage in e-commerce, digital marketing, app development, and other emerging occupations. These technological advancements have allowed informal SMEs to overcome traditional barriers to entry and compete in the digital economy.

Furthermore, the 4IR has enabled informal SMEs to leverage digital platforms and social media to reach customers, promote their products or services, and build brand awareness. The ability to connect directly with customers through online marketplaces and social media channels has reduced the dependence on intermediaries, creating a more level playing field for informal businesses. When considering the perspective of Bangladesh and the 4IR, here is a list of risky occupations within the SMEs sector.

Occupations at Risk:

In the realm of SMEs, adopting 4IR technologies introduces opportunities and challenges, particularly in risky occupations. While 4IR technologies can greatly enhance productivity and efficiency, they also require careful consideration to mitigate potential risks. For example, in sectors like construction or manufacturing, integrating automation, robotics, and machine learning can streamline processes, improve safety, and boost productivity. However, introducing these technologies may require upskilling or reskilling of the workforce, creating a temporary knowledge gap. Additionally, the reliance on digital systems and connectivity introduces cybersecurity risks that must be addressed to protect sensitive data and operations. Some of the risky occupations within the small and medium enterprise sector that arise from the implementation of 4IR technologies are enlisted in the following table with approximate projected demand for the year of 2025, 2030 & 2040.

Sl. No.	Occupation	Human Resource (Thousand)		
		2025	2030	2040
1	Street Food Vendor	24	19	11
2	Handicraft Artisan	51	31	16
3	Waste Collector/Recycler	27	15	5
4	Street Vendor/Seller	25	13	6
5	Informal Transport Operator	29	13	8
6	Garment Worker	63	43	27
7	Small-scale Farmer	24	15	11
8	Beauty Salon/Hairdresser	51	31	16
9	Home-based Worker	32	25	10
10	Street Performer/Busker	23	18	9

Emerging Occupations and Skillsets:

4IR has brought significant changes to the global economy, including the growth of the informal sector. Professionals in this sector require specific skills to succeed. Some emerging occupations in the informal sector include hair stylists, parlor workers, small agro-farm owners, gymnasium owners and workers. To thrive in this sector, professionals need adaptability, an entrepreneurial mindset, digital literacy, networking abilities, and a commitment to continuous learning. Adaptability allows professionals to adjust quickly to changing market conditions. An entrepreneurial mindset encourages risk-taking and creativity. Digital literacy is crucial to leveraging technology for business growth. Networking helps professionals build connections and learn from others. Continuous learning ensures professionals stay up-to-date and competitive in the rapidly changing 4IR era. Investing in personal growth through education and staying informed is essential for success in the informal sector. As the country embraces the opportunities presented by 4IR, the following are some of the emerging disciplines and their skillsets with the projected demand (approx.) are presented in the following table which are becoming increasingly important in informal sector.

Sl. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
Core Occupations					
1	Data and Web Management	Web design, analytics, infrastructure security	30	50	70
2	AI System Maintenance and Support	ML/DL coding, maintenance, analytics	5	15	30
3	Online Product and Service Delivery	E-commerce platforms, fulfillment, customer support	25	45	65
4	Online Grocery Shopkeeper	Inventory systems, online ordering tools, payment processing	12	28	42
5	Fintech	Programming, analytics, cybersecurity, payments infrastructure	35	55	75
Common Occupations					
6	E-commerce Entrepreneur (Others)	Skilled in digital marketing, website development, online payment systems, logistics management, customer service, and data analytics	7.2	22.95	33
7	Social Media Influencer (Others)	Skilled in content creation, social media management, branding, audience engagement, negotiation, and digital marketing	55	75	92.4
8	Digital Content Creator (Others)	Skilled in creative writing, video editing, graphic design, storytelling, search engine optimization (SEO), and social media marketing	54.5	78	91.3

Sl. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
9	Online Tutor/ Instructor (Others)	Skillsets needed include expertise in a specific subject area, teaching or instructional design skills, communication, patience, and familiarity with online learning platforms	16.5	33.3	45
10	Digital Marketer (Others)	Skilled in digital advertising, search engine optimization (SEO), social media marketing, content marketing, analytics, creativity, and understanding of consumer behavior	0.75	1.7	7.5
11	Smart Irrigation System (Other)	Sensors, IoT, app development, robotics, PLCs	5	15	25
12	Quality Management System (QMS) (Other)	Auditing, ERP systems	8	18	28
13	Cyber Security (Other)	Software security, coding, network protection	20	40	60
14	Data Analytics (Other)	Programming, big data, cloud platforms	40	65	85
15	Supply Chain Management (Other)	ERP systems, logistics, operations	15	30	45
16	Automated Design and Manufacturing (Other)	CAD, CAM, robotics, 3D printing	10	25	40

It is essential for individuals engaged in these emerging occupations within the informal SME sector to continually update their skills, stay informed about industry trends, and adapt to technological advancements. Access to relevant training programs, mentorship, and supportive ecosystems can contribute to their professional growth and success in the digital age.

Recommendations:

SMEs are particularly vulnerable as automation and digitalization change the business landscape, putting traditional roles at risk. Upskilling in digital marketing and reskilling for e-commerce are vital for survival. New professions in digital entrepreneurship and tech-driven business management are emerging with the influence of 4IR. Policymakers and governments are requested to adopt several key measures:

- Small and Medium Enterprise Foundation (SMEF), Bangladesh Small and Cottage Industries Corporation (BSCIC), and Bangladesh Industrial Technical Assistance Center (BITAC) can arrange reskilling and upskilling programs to accommodate the workforce at risk due to automation.
- National Association of Small & Cottage Industries of Bangladesh (NASCIB), Dhaka Chamber of Commerce & Industry (DCCI), Bangladesh Electrical Merchandise Manufacturers Association (BEMMA), and Bangladesh Plastic Goods Manufacturers & Exporters Association (BPGMEA) can establish a 4IR cell to guide their member industries, foster industry-academia collaboration, and arrange continuous policy dialogue.





Leather Sector



Introduction:

The leather industry in Bangladesh has made substantial contributions to the country's development. The Bangladesh Tanners Association (BTA) plays a crucial role in supporting the industry's growth by maintaining government interaction and providing export certification. Every year, according to an analysis by EBL Securities LTD a, Bangladesh produces 350 million square feet of leather, with only 20% to 25% used domestically and the rest being exported.

The industry encompasses various sub-sectors, including tanning and finishing. Bangladesh is home to 200 tanneries and 3,500 MSMEs, as reported by Leather goods and Footwear Manufacturers & Exporters Association of Bangladesh (LFMEAB). The footwear and footwear component manufacturing sector are also significant, with 2,500 footwear units and 90 large enterprises. The domestic footwear market in Bangladesh has seen notable growth.

Bangladesh has become a major player in the global footwear market, with many renowned retailers sourcing their leather and footwear. By 2020, it was projected to be the eighth-largest footwear manufacturer in the world, accounting for 2.1% of global shoe production. In addition to footwear, producing leather accessories such as belts, purses, coats, luggage, wallets, and fancy items is a significant component of the Bangladeshi leather industry.

Importance of the Sector:

Leather holds a significant historical position in Bangladesh as one of its oldest industries. The country's leather sector accounts for 10% of the global demand for leather, making it the second-largest source of foreign income after RMG. Bangladesh's favorable environment for raising livestock has contributed to its success, as it possesses 2% of the world's livestock population. The country is renowned for producing high-quality fine-grain leather with a silky feel and natural texture, and it is now striving to manufacture processed raw leather and leather goods sustainably ^b.

In the fiscal year 2020-2021, the leather and leather goods industry emerged as the second-largest export industry in Bangladesh, shipping products worth \$941.67 million, which accounted for around 2.43% of the country's total export profits. The leather footwear sector leads the way, contributing 60.5% of overall leather industry exports, followed by processed or semi-processed leather and other leather goods. Despite this notable success, the leather sector faces challenges, including a high poverty rate and hunger-related issues. Integrating the fourth industrial revolution, Industry 4.0, into the leather industry may benefit the nation's socioeconomic development and contribute to achieving various SDGs, including no poverty, zero hunger, decent work and economic growth, and responsible consumption and production ^a.

Employing over 0.85 million people, 60% of them women, the leather sector contributes significantly to employment in Bangladesh. The sector has set a vision to generate \$3 billion in revenue by 2023, aiming to improve efficiency and production. Its goal is to enhance productivity, quality, and profitability, thereby contributing to the country's development and achieving the status of a developed nation ^b.

a <https://businessinspection.com.bd/tannery-industry-of-bangladesh/>

b <https://theconfluence.blog/leather-industry-of-bangladesh-a-lost-export-potential-or-a-recoverable-bottleneck/>

While the leather sector is a significant contributor to Bangladesh's economy, it has experienced a recent decline in export revenues. This decline raises concerns about the industry's growth and competitiveness. To sustain its position as a major export earner, the leather sector should address these challenges, foster innovation, and efficiency, and ensure responsible production practices. By doing so, Bangladesh's leather industry can continue to substantially impact the country's socio-economic development and achieve its ambitious goals for the future.

Impact of the 4IR in the sector:

The 4IR concept represents a significant shift in the industrial sector, moving away from centralized mass production centers towards decentralized production and minimizing logistics. This shift enables the adoption of energy and waste-saving technologies based on the principles of the circular economy and web-controlled automation to enhance process safety and reliability. In the context of the leather industry, embracing the 4IR brings forth opportunities for tanneries to autonomously produce a portion of their required retaining agents, contributing to sustainability efforts.

To ensure the sustainable growth of the leather industry, it is crucial to analyze various methods for tannery modernization and improvement within the framework of the 4IR. This analysis should consider key advancements made in relevant fields to the leather industry. From a holistic perspective, strategies must be developed to enhance the industry's environmental characteristics and promote a cleaner image. The primary objectives include achieving near-zero chemical discharge, minimizing waste, adding value to products, enhancing productivity, and creating a safe and healthy environment within tanneries. This involves incorporating concepts of upgradation, implementing modern leather processing techniques, and integrating engineering inputs such as process control systems, automation tools, and the IoT. These elements collectively contribute to transforming the leather industry towards a more sustainable and technologically advanced future.

Occupations at Risk:

In the context of the leather sector in Bangladesh during the 4IR, several occupations may involve certain risks. Some of the risky occupations within the leather sector that arise from the implementation of 4IR technologies are enlisted in the following table with approximate projected demand for the year of 2025, 2030 & 2040.

Sl. No.	Occupation	Human Resource (Thousand)		
		2025	2030	2040
1	Tannery Worker	35	25	16
2	Leather Processor	74	45	23
3	Machine Operator	35	25	14
4	Maintenance Technician	25	17	11
5	Quality Control Inspector	91	62	39
6	Warehouse Worker	35	25	16

Employers and workers in the leather sector need to prioritize occupational safety and health measures, provide appropriate training, and implement safety protocols to mitigate these risks and ensure a safe working environment during the 4IR era.

Emerging Occupations and Skillsets:

In the context of the leather sector in Bangladesh and the emerging opportunities brought about by the Fourth Industrial Revolution (4IR), several occupations and skill sets are gaining significance. As the country embraces the opportunities presented by 4IR, the following are some of the emerging disciplines and their skillsets with the projected demand (approx.) are presented in the following table which are becoming increasingly important in leather sector.

Sl. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
Core Occupations					
1	Data Analytics Manager	Skilled in analyzing data from IoT sensors, RFID tags, automated machinery etc. to optimize skin processing and production lines and improve quality	11	35	50
2	Sustainable Leather Technologist	Proficiency in sustainable materials and green chemistry, coupled with strong knowledge of environmental regulations and life cycle assessment (LCA) methodologies. Ability to optimize processes for minimal waste and energy consumption, ensuring environmental compliance	10	25	40
3	Digital Leather Designer	Expertise in 3D modeling and CAD software, with a strong sense of creative design and virtual prototyping skills. Familiarity with digital fabrication techniques, such as laser cutting and digital printing, and a deep understanding of user-centered design principles	15	30	50

Sl. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
4	Leather Quality Control Data Analyst	Advanced skills in data analytics using tools like Python, R, or SQL, combined with a solid understanding of quality management systems (QMS) and statistical process control (SPC). Capable of integrating machine learning for predictive quality control and process optimization	8	20	35
5	AI-Driven Leather Production Manager	Deep knowledge of AI and machine learning, particularly in optimizing production workflows and predictive maintenance. Expertise in automation technology and data-driven decision-making to enhance production efficiency and quality	5	12	25
6	Circular Economy Specialist in Leather	Proficient in circular economy principles, with skills in material recovery, sustainable product design, and ethical supply chain management. Ability to engage stakeholders and implement circular initiatives within the leather industry	8	20	40
7	Smart Leather Wearable Engineer	Expertise in wearable technology and IoT integration, with a strong background in material science and product development. Focused on creating user-friendly, functional wearables that combine aesthetics with advanced technology	4	10	20
8	Bio fabrication Leather Scientist	Advanced bioengineering skills for lab-grown leather development, with strong material science knowledge and sustainability expertise. Capable of leading R&D efforts in bio fabrication and navigating regulatory compliance	3	8	15

Sl. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
9	Robotics and Automation Specialist (Leather Manufacturing)	Skilled in robotics engineering, automation programming, and precision engineering. Knowledgeable in industrial IoT and maintenance of automated systems to ensure high efficiency and minimal downtime in leather production	5	15	30
10	Ethical Leather Supply Chain Manager	Mastery in supply chain management, ethical sourcing, and blockchain technology for tracking leather products. Strong abilities in sustainability reporting and stakeholder collaboration to ensure ethical practices throughout the supply chain	4	10	20
11	Production Manager	Experienced in implementing and managing automated production lines for activities like splitting, shaving, trimming, finishing using robotics, blockchains and Artificial Intelligence	11	38	64
12	Sustainability Manager	Skilled in developing and implementing strategies for sustainable and ethical raw material sourcing, cleaner tanning techniques, solid & liquid waste recycling to reduce environmental footprint	22	42	78
13	Quality Control Manager	Proficient in digital quality control systems, chemical testing of leather and implementing quality standards like ISO	25	50	67
14	E-Commerce Manager	Skilled in B2B and B2C online sales, virtual product design and customization, social selling and influencer marketing	11	18	27
15	Supply Chain Manager	Experienced in optimizing global procurement, inventory and distribution logistics using IoT, blockchain, predictive analytics and automated warehouses	11	35	50

Sl. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
16	IT Security Manager	Experts in securing digital infrastructure, ERP systems, online payment gateways from cyber threats like data breach and financial frauds	11	35	50
17	R&D Scientist	Skilled in material research, biochemical & biomechanical product innovations, prototype development using 3D bioprinting for specialized leather goods	11	38	64
18	VR/AR Designer	Capable in creating virtual & augmented reality applications for virtual product prototyping, visualization, customization and online retail experiences using metaverse technologies	15	46	72
19	Automation Engineer	Experienced in setting up automated and robotic production processes using PLCs, HMIs, vision systems, robot programming for hide processing, leather cutting and quality testing	12	40	60
20	3D Design Engineer	Skilled in conceptualizing and modeling specialized leather goods (prototypes using 3D modeling, CAD software and augmented design tools	14	42	60
21	Robotics Technician	Experienced in installing, programming, operating and maintaining automated robotics solutions for material handling, machine tending, quality inspection	13	41	61
22	IoT Solutions Architect	Proficient in setting up comprehensive IoT infrastructure linking machines, inventory and business systems for real-time monitoring, predictive maintenance and data analytics	14	41	63
23	Blockchain Developer	Able to build distributed ledger applications for supply chain traceability, smart contracts, product certification and authentication using blockchain	14	42	64

Sl. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
24	Biomaterials Scientist	Skilled in biological research for developing environment-friendly and biodegradable materials from Agro/animal waste for leather alternatives	16	48	72
Grand Total			273	740	1176

These emerging occupations and skill set in the leather sector align with the demands of the 4IR, enabling Bangladesh's leather industry to harness the benefits of technological advancements and position itself for sustainable growth and global competitiveness.

As the leather industry evolves with automation and sustainable practices, traditional roles are becoming riskier. Upskilling in digital design and reskilling for eco-friendly leather production are necessary. Emerging professions in sustainable fashion and tech-enhanced leather processing are gaining momentum due to 4IR. Policymakers and governments are requested to adopt several key measures:

- Institute of Leather Engineering and Technology (ILET) can include 4IR based elements in the curriculum of BSC and MSC.
- ILET can introduce short courses on 4IR based emerging occupations in leather sector.
- Leather Research Institute under the Ministry of Science and Technology can conduct continuous studies on 4IR in leather sector.
- Centre of Excellence for Leather Skill Bangladesh Limited (COEL) can introduce skills on emerging occupations based on market demand.
- Leathersgoods And Footwear Manufacturers & Exporters Association of Bangladesh (LFMEAB), Bangladesh Finished Leather, Leather goods and Footwear Exporters' Association (BFLLEA), and Bangladesh Tanners Association (BTA) can
 - a. conduct continuous market analysis for emerging jobs and jobs at risk in order to accommodate skilled workers with the transition.
 - b. undertake capacity-building measures on 4IR.
 - c. establish a 4IR cell to provide continuous guidance for their member industries







Pharmaceuticals Sector



Introduction:

The pharmaceutical sector carries out the exploration, advancement, manufacturing, and promotion of medications and pharmaceutical drugs designed to be used as treatments for patients. These drugs aim to cure patients, vaccinate them, or alleviate their symptoms. Pharmaceutical companies may deal with both branded and generic versions of medical products. They operate under various rules and regulations that oversee the patenting, testing, safety, and efficacy of drugs through drug testing. These laws and regulations also govern the advertising and promotion of pharmaceutical products.

One of the most developed technological industries in Bangladesh is the pharmaceutical business. Bangladesh is home to some of the world's most innovative pharmaceutical companies also. The pharmaceutical industries can fulfill 97% (approx.) of the overall need for pharmaceutical products that the local market has. The pharmaceutical business also participates in the export of medications to markets worldwide, particularly in Europe. Companies in the pharmaceutical industry are growing their operations in preparation for entering new international markets. The pharmaceutical sector consists of different types of drug manufacturers. Allopathic drugs are produced by 199 companies, Ayurvedic drugs by 172 companies, Unani drugs by 500 companies, herbal drugs by 29 companies, and homeopathic & biochemical drugs by 28 companies. These numbers illustrate the wide range of specialization within the pharmaceutical industry, as various companies focus on different types of drugs to meet consumers' diverse healthcare requirements and preferences.

In Bangladesh, there are two organizations responsible for overseeing pharmaceuticals and pharmacies. The Directorate General of Drug Administration (DGDA) operates under the Ministry of Health and Family Welfare and serves as the national drug regulatory body. The DGDA oversees various activities such as importing and exporting raw materials and packaging materials, manufacturing, sales, pricing, licensing, and registration of all kinds of medications, including Ayurvedic, Unani, herbal, and homeopathic medicines. Another organization called the Pharmacy Council of Bangladesh (PCB) was established in 1976 under the Pharmacy Ordinance Act to regulate the pharmacy profession in the country. The Bangladesh Pharmaceutical Society is affiliated with the International Pharmaceutical Federation and the Commonwealth Pharmaceutical Association. The National Drug Policy of 2005 mandates strict adherence to the World Health Organization's Good Manufacturing Practices (GMP), and the DGDA regularly inspects manufacturing facilities.

Importance of the Sector:

The pharmaceutical industry in Bangladesh is advanced in technology and has experienced significant growth in the past two decades. This progress can be largely attributed to the expertise and knowledge of industry experts and the innovative approach of industry participants. Around 300 active pharmaceutical businesses are currently in the country, with only 3% of medications being imported while the remaining 97% are locally manufactured. The positive advancements in this industry have enabled Bangladesh to export medicines to international markets. By addressing existing barriers, the pharmaceutical industry has the potential to expand further and become a productive export sector for the country.

The pharmaceutical industry in Bangladesh exports a diverse array of goods, including APIs (Active Pharmaceutical Ingredients) and finished pharmaceutical products, across all main therapeutic categories and dosing formats. Products such as tablets, capsules, syrups, and more specialist goods, including HFA inhalers, CFC inhalers, suppositories, nasal sprays, injectables, and IV infusions, are exported to 79 nations. Bangladeshi medicines have been well accepted by the medical community, the pharmaceutical industry, consumers, and regulatory bodies in those nations that have been allowed to import the medicine from Bangladesh^a.

Impact of the 4IR in the sector:

The impact of Industry 4.0 in the pharmaceutical sector is substantial, bringing transformative changes and advancements to manufacturing and operations. Digitalizing complex processes along the pharmaceutical value chain enhances efficiency, accuracy, and security. The use of the Industrial Internet of Things (IIoT) enables the creation of a “smart factory,” connecting devices and sensors for seamless data exchange and real-time monitoring. This connectivity improves supply chain management, tracking raw materials, and ensuring quality throughout the production system.

Incorporating artificial intelligence (AI) and robotics optimizes manufacturing processes and reducing human error. AI algorithms analyze data for pattern identification, drug formulation optimization, and quality control. Robots perform precise tasks, increasing productivity and cost-effectiveness. Integrating internal and external data sources enhances decision-making and responsiveness. Combining patient feedback, market demand, supplier inventories, and public health information provides insights into consumer needs, enabling production adaptation and swift response to market changes.

Industry 4.0 revolutionizes manufacturing, enhancing product quality, efficiency, and agility. It accelerates drug development, improves patient outcomes, and drives innovation. Advanced digitalization enables proactive operations, leveraging machine learning and adaptive control to improve efficiency. IoT technologies are able to monitor products’ conditions, usage, and performances and can give feedback to manufacturers. AI techniques, particularly machine learning, significantly impact pharmaceutical production and product development in the IoT. Industry 4.0’s potential in the pharmaceutical sector is vast, fostering a proactive and prescriptive digital environment with enhanced capabilities.

Occupations at Risk:

In the context of the 4IR in the pharmaceutical industry, several occupations may involve certain risks. These risks can vary depending on the specific tasks and technologies involved. It is important to note that many of these risks can be mitigated through proper training in the scheme of upskilling/reskilling and adherence to industry regulations and guidelines. Ensuring a developed working environment and appropriate measures regarding training are essential to minimize the potential risks associated with these occupations. Some of the risky occupations within the pharmaceutical sector that arise from the implementation of 4IR technologies are enlisted in the following table with approximate projected demand for the year of 2025, 2030 & 2040.

^a <https://businessinspection.com.bd/pharmaceutical-industry-of-bangladesh/>

Sl. No.	Occupations	Human Resource (Thousand)		
		2025	2030	2040
1	Manufacturing and Quality Control Personnel (Conventional)	59	39	23
2	Statistician and Data Analyst (Conventional)	63	45	27
3	Machine Operators	74	45	22
4	Routine Laboratory Technician	80	60	30
5	Manual Data Entry Clerk	85	70	35
6	Traditional Clinical Research Associate (CRA)	70	50	25
7	Routine Quality Control Inspector	75	55	27
8	Traditional Regulatory Affairs Specialist	72	48	24
9	Routine Laboratory Technician	80	60	30
10	Manual Data Entry Clerk	85	70	35

Emerging Occupations:

Pharmaceuticals in Bangladesh with respect to 4IR is still in the early stages, with a need for infrastructure development and a skilled workforce. The purpose of using modern technology is to improve the pharmaceutical industry's competitiveness, increase efficiency and quality. The pharmaceutical industry is experiencing significant transformations due to 4IR. Advancements in technology, automation, and data analytics are shaping emerging occupations and skill sets within the industry. As the country embraces the opportunities presented by 4IR, the following are some of the emerging disciplines and their skillsets with the projected demand (approx.) are presented in the following table which are becoming increasingly important in pharmaceutical sector.

SL. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
Core Occupations					
1	Bioinformatics Specialist	Able to use computational tools and algorithms to analyze complex biological datasets and contribute to drug discovery and development. Skills include genomics, transcriptomics, proteomics, database management systems, statistical analysis, cheminformatics	25	35	42.4
2	Regulatory Affairs Specialist	Able to ensure compliance with regulatory guidelines and work with cross-functional teams to prepare and submit regulatory documentation for drug approvals. Skills include regulatory documentation, clinical research, quality assurance	14.5	31.3	42
3	Supply Chain Analyst	Need to utilize data analytics and optimization techniques to manage and optimize the flow of pharmaceutical products, ensure timely delivery, reduce costs, and mitigate supply chain risks. Skills include analytics, procurement, inventory management, logistics	35	55	62.4
4	Computational Biologist	Analyze vast amounts of biological data using advanced mathematics, bioinformatics, computer programming. Skills include genomics, transcriptomics, proteomics, database management systems, statistical analysis, cheminformatics, algorithm development	20	30	40
5	Clinical Data Scientist	Analyze healthcare data to improve outcomes using techniques like machine learning, deep learning, and artificial intelligence. Skills include EHR data, statistics, clinical domain knowledge, programming	15	25	35

SL. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
6	Drug Discovery Informatics Specialist	Leverage data science to facilitate drug target identification, lead optimization and other stages of drug discovery. Skills include cheminformatics, bioinformatics, programming, statistics	18	28	38
7	Pharmacovigilance Analyst with AI expertise	Monitor safety of medical products using advanced analytics and AI. Skills include pharmacology, data analysis, AI/ML, regulatory compliance	12	22	32
8	Regulatory Affairs AI Specialist	Ensure quality and safety of AI and other digital health products. Skills include regulatory policy, AI safety, quality management, ethics.	10	20	30
9	Precision Medicine Analyst	Support personalized treatment approaches using diverse patient data. Skills include genetics, clinical trials, data analytics, healthcare IT.	13	23	33
10	Lab related Emerging Occupation	Laboratory skills, data science, programming, machine learning etc.	5	15	25
11	Computational Biologist	Analyze vast biological datasets using computing math, Bioinformatics, programming, stats & algorithms	8	18	28
Grand Total			175.5	302.3	407.8

These emerging occupations and skill sets highlight the impact of the 4IR on the pharmaceutical industry. Professionals with expertise in data analysis, bioinformatics, automation, digital health, genetics, regulatory affairs, and supply chain management will be in high demand as the industry continues to evolve and embrace new technologies.

Recommendations:

The following recommendations seek to harness the potential of 4IR technologies in Bangladesh's pharmaceutical sector to create a transformative impact, fostering innovation, efficiency, and improved healthcare outcomes for the population. Policymakers and governments are requested to adopt several key measures:

- The Ministry of Health and Family Welfare (MoHFW) can create a supportive ecosystem

for the pharmaceutical sector on 4IR skills & employment in Bangladesh.

- Bangladesh Association of Pharmaceutical Industries (BAPI) can conduct continual market analysis for emerging jobs and jobs at risk in order to accommodate skilled workers with the transition and can establish a 4IR cell to guide their member industries, foster industry-academia collaboration, and arrange continuous policy dialogue.
- Different public-private universities can include 4IR elements/skills in different academic interventions like short courses, diplomas, and graduate programs to prepare the future workforce.





Real Estate Sector



Introduction:

The real estate industry in Bangladesh is highly attractive for investment due to the rapid urbanization in the country. According to the World Bank, Bangladesh has an annual urbanization rate of approximately 3%, with around 38% of the population currently residing in urban areas. This has resulted in a significant shortage of available housing in major metropolitan areas, which is expected to worsen as the demand for new dwellings increases. Over the years, the real estate sector in Bangladesh has experienced remarkable growth, driven by the establishment of new real estate companies and the construction of various projects. The government has also implemented measures such as tax advantages and developing dedicated residential and commercial zones to support the real estate industry. This has led to the creation of numerous jobs and a positive impact on the nation's economy. The future of the sector looks promising, with several upcoming projects and investment opportunities. As the urban population grows rapidly, there is a rising demand for housing, office spaces, and other commercial properties. In present-day Bangladesh, “real-estate” encompasses developers involved in apartment complexes, model towns, retail centers, significant infrastructure, and commercial buildings, all driven by profit motives. The government is actively encouraging private investment in the real estate sector. As a result, the real estate market is expected to expand further in the coming years, providing investors with multiple opportunities.

All enterprises in the real estate market supply the same service: land and apartments. Some businesses specialize in one or the other, as well as those that provide both. However, one provision remains constant: lodging. Inferring differences in quality and service from the items themselves is impossible. In this example, land and apartments are distinguished by their differences in variety, quality, design, amenities, and premium brands. Although over a thousand businesses are operating in the United States, only a chosen handful succeed in providing excellent customer service. The Real Estate and Housing Association of Bangladesh (REHAB) is the sole organization in Bangladesh dedicated to representing and supporting commercial real estate businesses and professionals. Established in 1991 by eleven of the country's largest real estate companies, REHAB's purpose is to safeguard its members' interests and promote the sector's growth. Currently, over 1500 companies are operating in the real estate market, with 1191 of them being REHAB members. Every major development firm in the country is affiliated with REHAB. As an esteemed member, REHAB holds the “A Class” designation recognized by the Federation of Bangladesh Chambers of Commerce and Industry (FBCCI). In recent years, REHAB members have made significant strides in real estate development, crucial to the nation's overall economic expansion. They also contribute significantly to the National Treasury through registration fees, income taxes, and utility service charges. The real estate industry in Bangladesh comprises three primary sectors: residential, commercial, and industrial real estate.

Importance of the Sector:

The real estate market in Bangladesh is about 6,000 billion BDT. The number of apartments between 1200 and 1400 square feet has increased by 39% during the last five years. Dhaka and Chittagong are Bangladesh's two main cities where the real estate market thrives. The ever-busy urban society of Dhaka and Chittagong has a massive need for smaller dwellings. First, the real estate industry in Bangladesh saw a boom from 2006 to 2009 and then again from 2015

to 2018. In the years 2022–2025, we may anticipate a rise. In addition, during the last decade, Bangladesh has rapidly expanded in residential zones. Associated construction firms such as brick, concrete, ready-mix, ceramics, MS bars, and sanitary supplies have benefited from this sector's expansion. All these interdependent businesses have a combined market value of approximately 60 trillion BDT. The rise in bank-issued mortgages reflects a rising preference among middle-class households for this financing. In 2019–20, the demand for house loans was BDT 1,496 billion; in 2020–21, it was BDT 1,544 billion. Consequently, the real estate business accounts for a more significant proportion of the national GDP than almost any other industry. According to REHAB, real estate, and allied industries contribute 12% of the gross domestic product. The real estate market has produced over 20 billion BDT in sales and approximately 2 billion BDT in tax income for the government each year. Real estate and associated businesses now employ over 2 million people. This category includes architects, engineers, management officials, and direct and indirect workers. On average, these firms contributed 12-14% of the gross domestic product in the previous five years ^{a, b, c}.

REHAB presents its most popular annual event, the REHAB Housing Fair, every year in Bangladesh for its member developers, financial institutions, and construction material suppliers. Numerous successful housing fairs have been held. REHAB plans to conduct housing fairs abroad so that Bangladeshis living in other countries may acquire their nation's houses, land, and commercial assets. REHAB has organized housing fairs in the United States, the United Kingdom, Australia, Canada, Italy, and the United Arab Emirates.

Impact of the 4IR in the sector:

The 4IR represents advanced technological advancements emphasizing integrating automated systems, machine learning, and real-time data. The widespread use of technology in our daily lives has influenced various industries, including real estate. Online platforms for buying and selling properties and listing real estate have become prevalent. Initially, these platforms served as a space to showcase different real estate types, such as retail, commercial, and residential properties. Some argue that these platforms have significantly reduced the role of traditional brokers and physical real estate agents since they offer their services for a lower fee than the higher charges typically demanded by traditional brokers and agents.

IoT, modern homes are equipped with devices remotely operated via the Internet or Wi-Fi. A recent study conducted by Jones Asset Management highlights that people are willing to invest more in technology-ready real estate, including innovative home technologies like smart thermostats, leak detection sensors, and home security systems. These technologies enhance the convenience and desirability of homes for prospective buyers, making them more future-ready. The impact of 4IR on the real estate industry will be positive, leading to an improved quality of life. Virtual property transactions will save buyers money on fees and eliminate the risks of paper records.

a <https://anwarlandmark.com/blog/real-estate-industry-in-bangladesh/>

b <https://www.mirrealestate.com/blog/the-real-estate-sector-in-bangladesh/>

c <https://jonesasset.com/real-estate-guide/articles/millennials-in-real-estate-navigating-the-path-to-home-ownership/>

Occupations at Risk:

In the real estate sector in Bangladesh, the integration of 4IR technologies can bring numerous benefits, but it may also introduce certain risks and challenges for some of the jobs in this sector. Some of the risky occupations within the real estate sector that arise from the implementation of 4IR technologies are enlisted in the following table with approximate projected demand for the year of 2025, 2030 & 2040.

Sl. No.	Occupations	Human Resource (Thousand)		
		2025	2030	2040
1	Managers (Mid Level)	35	15	3
2	Development Coordinator	24	14	10
3	Machine Operator (Construction)	24	13	10
4	Project Consultant	38	32	13
5	Clerk	47	23	16
6	Data Privacy and Compliance Officer	35	17	9
7	Conventional Energy Auditor	20	10	2
8	Non-Tech Savvy Real Estate Agent	40	20	8

Emerging Occupations and Skillsets:

The real estate industry in Bangladesh has already created approximately a job market of 27 million workers. Most haven't had adequate training and aren't up to date on the latest innovations in their fields. 4IR is transforming Bangladesh's real estate sector, leading to new occupations and skill sets that harness the potential of advanced technologies. As the country embraces the opportunities presented by 4IR, the following are some of the emerging disciplines and their skillsets with the projected demand (approx.) are presented in the following table which are becoming increasingly important in real estate sector.



Sl. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
Core Occupations					
1	Prop-Tech Specialist	Prop-Tech (Property Technology) specialists should be able to improve property management, tenant experiences, and real estate development operations	46.1	62.3	85.3
2	Smart Building Engineer	Able to optimize energy usage, enhance security, and improve overall building performance	35.8	48.4	66.4
3	VR & AR Developer	VR and AR developers produce engaging virtual property tours for buyers and investors	10.2	13.8	18.9
4	Sustainable Construction Specialist	Sustainable Construction Specialists focus on incorporating these technologies and practices into real estate projects	10.2	13.8	19
5	Data Analyst/Data Scientist	Data analysts and data scientists help real estate companies grow, advertise, and invest by analyzing massive volumes of data	20.5	27.7	37.9
6	Blockchain Real Estate Specialist	Blockchain Real Estate Specialists understand how to implement blockchain solutions to improve transparency, security, and efficiency in the real estate sector	1.6	2	2.9
7	Cybersecurity Analyst	Able to safeguard sensitive data, prevent breaches, and secure 4IR technologies in real estate operations	46.1	62.3	85
8	Real Estate Drone Operator	Real estate agents employ drones for aerial surveys, property inspections, and beautiful marketing material	35	48.4	66.3
9	Smart Building Manager	Responsible for optimizing building operations using IoT and automation	30	40.5	55.3
10	Sustainability Consultant	Advises on sustainable building practices and technologies	15	20.2	27.6

Sl. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
11	Virtual Reality (VR) Property Tour Creator	Develops engaging VR property tours for marketing	12.5	16.8	23.00
Grand Total			263	356.2	487.6

As the real estate sector in Bangladesh continues to embrace 4IR technologies, these emerging occupations and skill sets will play a pivotal role in driving innovation, efficiency, and sustainability in the industry.

Recommendations:

The real estate sector is transforming with the rise of smart buildings and AI-driven property management, putting traditional roles at risk. Upskilling in digital real estate tools and reskilling for smart infrastructure development are critical. Emerging professions in sustainable urban planning is becoming more prominent due to 4IR. Policymakers and governments are suggested to adopt several key measures:

- REHAB can establish a 4IR cell to guide their member industries, foster industry-academia collaboration and arrange continuous dialogue on 4IR
- REHAB Training Center can take the initiative to improvise the training program in the context of 4IR and collaborate with the training institution to offer specialized courses in 4IR-related fields.





Healthcare Sector



Introduction:

Bangladesh's health industry guarantees the population's well-being and access to healthcare. The country confronts many healthcare issues, but in recent years, it has made substantial progress in improving overall health indices. The government has been working relentlessly to improve the nation's healthcare infrastructure, advance public health, and increase access to high-quality medical treatment in collaboration with several development partners and organizations. However, the government has made considerable advancements in the development of healthcare over the decade and has had notable triumphs in health-related fields.

Most current national healthcare efforts need to pay more attention to the national statistics of the WHO. This study emphasizes secondary and primary sources to enable nurses, medical technicians, and doctors to fill knowledge and experience gaps. Bangladesh still faces some formidable challenges in fulfilling the basic medical necessities to all levels of society and its international commitment to achieve the Millennium Development Goals (NDGs) and Sustainable Development Goals (SDGs) in health due to a lack of qualified specialists and technicians to satisfy the huge population volume. Due to a substantial 'skills gap' an imbalance between demand and supply, an 'inappropriate skill mix' and an 'unequal distribution' between rural and urban regions, Bangladesh is reportedly experiencing a shortage of Health Care Practitioners (HCPs). According to the World Health Organization (WHO), three registered nurses and five medical technicians are necessary for each physician to provide satisfactory health services to patients.

In 2022, the total number of hospitals in Bangladesh was 5,816. The government also runs over 5,000 health centers and 10,000 rural health clinics. These facilities provide a range of services, including primary care, maternal and child health services, and emergency care. There are 112 recognized medical colleges in Bangladesh, 37 of which are public and 70 privates. Healthcare professionals are more unevenly dispersed in rural areas than in cities. In rural regions, where 65% of the population resides, just 20% of HCPs are available. The urban areas of Bangladesh are suggested for HCP distribution. The Standard Operating Procedures (SOP) and National Healthcare Standard were created as solutions. Plans are in the works to establish a vast healthcare network that goes down to the village level, even though most institutional facilities (human and technological) are still in the nation's capital. This activity determines the healthcare competencies required to achieve the nation's healthcare objectives and SDGs. A vast workforce and technicians are needed to digitalize and reach a satisfactory stage using the revolutionary techniques of IoT, robotics, 3D printing, waste management systems, autoclave systems, central data management machines, etc^a.

Importance of this sector:

The size of a country's population, as well as its growth, composition, distribution, and morbidity pattern, are all factors that influence the amount and nature of the demand for healthcare services. The size of the population is an indication of the demand for medical services as well as the dimensions of the market. The pattern of mortality illustrates the need for healthcare services, and the trajectory over time displays the size of the market and its primary emphasis.

^a <https://www.lightcastlebd.com/insights/2022/09/taking-the-bangladesh-health-sector-into-the-future/>

It is essential to understand the factors that drive demand in the healthcare industry to assess market imbalances properly. With a population of 170 million (approx.), Bangladesh is the seventh most populous nation in the world. With an average annual growth rate of 1.2%, the population is projected to reach 190 million in 2020 and 210 million in 2025.

The mortality rate in Bangladesh has been decreasing, which is a good sign for improvement in healthcare sector. Infectious diseases such as diarrhea, malaria, TB, smallpox, diphtheria, measles, and polio have been controlled in recent decades through proper vaccination plan. The incidence of non-communicable illnesses is increasing where medical attention is more required. According to the Bangladesh Health and Morbidity Status Surveys, the mortality rate was 188 for every 1,000 persons in 2000, dropping to 186 in 2012. Simultaneously, the number of people suffering from illnesses that are not communicable faced a significant increase. The prevalence of diabetes increased from 2.7 % to 7.8 %, heart disease increased from 1.6% to 3.3% and cancer increased from 0.4% to 0.6% Diabetes, arthritis, and high blood pressure are more common nowadays. For caring the diabetes patient, there are a few numbers of specialized hospitals for treatment. The Bangladesh government played a vital role during COVID-19 and after the Corona impact. The infrastructure was good enough to tackle the situation and overcome the worst scenario compared to some world-leading countries. The medical service workers in every sector made it possible to ensure the safety of the general population. “SUROKKHA” application development and usefulness for the mass population was one of the challenging tasks for the government, and the Bangladesh government is in the chair of a champion. So, in many respects, Bangladesh health care sector has improved a lot and properly caring the people. But, in ere of 4IR this sector needs to go more further to adopt the 4IR based technologies in medical services.

Impact of the 4IR in the sector:

The 4IR has empowered people with health-related information using the mobile and communication technology. Diagnosis, treatment, and follow-up have become simplified through mobile devices. One of the challenges in healthcare is patients avoiding treatment due to social and cultural difficulties, but customized technologies have helped in reducing these negative impacts by enhancing healthcare acceptability. Data-driven techniques and translation software have been instrumented in handling conditioning factors and improving doctor-patient communication, especially when language problems arise. Additionally, Smart House Healthcare has revolutionized how daily activities are monitored for residents in intelligent houses. Equipped with sensors and devices, these homes add intelligence, automation, adaptability, and functionality, improving the health and well-being of their residents and decentralizing the health sector. The aging population also benefits from 4IR technologies, such as IBM Watson, which uses AI to classify clinical, biochemical, and genomic data to aid in cancer diagnosis and treatment. Machine learning and AI have shown excellent efficiency and efficacy in the health sector of developing nations, where a lack of medical experts has increased mortality rates. Algorithms predict health concerns and illnesses, improving diagnosis and medical history. While job loss or computerization concerns are apparent, healthcare practitioners should embrace 4IR technologies to enhance patient-centered treatment and ensure clear communication between people, processes, and technology. Implementation should focus on strengthening healthcare links, whereas 60% of healthcare operations are already using automated information sharing. These technologies hold promising potential for cutting costs, enhancing productivity, and making

enterprises more autonomous in problem-solving and market monitoring. Cost-benefit and cost-utility studies are crucial for effective health technology integration in 4IR, as automation reduces treatment costs, and digital technologies make duplication and marginal costs affordable. Ultimately, it requires global engagement from governments, health professionals, stakeholders, and society to develop the necessary infrastructure for change, mitigating risks and maximizing benefits. On the other hand, a rigorous training plan should be developed for reskilling/upskilling the workforces who are engaged in this sector.

Occupations at Risk:

While healthcare professions are generally associated with providing care and ensuring the well-being of others, certain occupations having their current level of skills can be considered risky due to adoption of 4IR based technologies. Some of the risky occupations within the healthcare sector that arise from the implementation of 4IR technologies are enlisted in the following table with approximate projected demand for the year of 2025, 2030 & 2040.

Sl. No.	Occupations	Human Resource (Thousand)		
		2025	2030	2040
1	Traditional Medical Transcriptionist	51	38	16
2	Radiologists and Pathologist	37	25	13
3	Medical Coders and Biller	43	23	10
4	Traditional Pharmacist	68	38	15
5	Medical Device Technician	87	62	30
6	Traditional Nurses and Caregiver	71	50	31
7	Laboratory Assistant (Manual)	40	30	20
8	Patient Data Record Keeper	45	35	25

Emerging Occupations:

With the modernization of healthcare sector, new career options are being created. Data science, healthcare informatics, biomedical engineering, nanotechnology, and other developing fields can affect the future skillset of healthcare sector. These new occupations enhance patient care and healthcare efficiency. Digital technology will benefit all areas of the sector. Thus, healthcare 4.0 will include many new tools and procedures. 3D printing, AI, IoT, virtual reality, blockchain, big data, cloud storage, digital health mobile apps, intelligent health kits, machine learning, technology and a digital empathy and doctor guidance tracking system are needed to bring Bangladesh up to fourth industrial revolution standards. Some statisticians have to record all the data manually and electronically. After adoption, these professionals must reskill or lose their jobs.

When the technologies are deployed, professionals will be needed to handle issues and guarantee public trust. Technology will create several new medical jobs. Smart health kit, digital pharmacist,

and digital healthcare service provider positions will emerge as this business digitizes. Each assignment will contribute differently. 3D printing, AI, IoT, VR, and blockchain professionals must develop new abilities to automate and digitize healthcare. Professional healthcare providers, health visitors, pharmacy workers, and paramedical professionals must upskill to keep up with health technology. Doctors and dentists also need training. These specialists assist healthcare institutions in evaluating patient needs and designing better therapies. These specialists may improve processes and make health care easier. These new occupations will help healthcare succeed. As the country embraces the opportunities presented by 4IR, the following are some of the emerging disciplines and their skillsets with the projected demand (approx.) are presented in the following table which are becoming increasingly important in healthcare sector.

Sl. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
Core Occupations					
1	Machine Operator	Skilled in CT/MRI/X-ray technology, AI Imaging	45	60.8	83.3
2	Health Kits Expert (Unit)	Skilled in advanced medical devices, IoT, Telehealth	35	47.3	64.8
3	Digital Healthcare Service Provider	Skilled in Telehealth, AR/VR, AI, Cloud Computing	10	13.5	18.5
4	Robotics Surgery, Brain Surgery	Skilled in Robotics, Computer-assisted surgery	5	12.8	23.3
5	Pharmacy Inventory System	Skilled in AI Inventory Management, IoT, Analytics	10	13.5	18.5
6	IT Professionals/ IT officer (MIS)	Skilled in Healthcare IT, EHR, Cybersecurity, Cloud	20	27.0	37.0
7	Biomedical Specialist	Skilled in Bioinformatics, Genomics, AI Diagnostics	1.5	2.0	2.8
8	CARP Specialist	Skilled in Computer-assisted rehabilitation, Robotics, Sensors	5	8.5	9.3
9	Macroscopy Specialist	Skilled in Digital Pathology, AI Image Analysis	7	12.0	19.0
10	Automation Expert	Trained in AI, IoT, Robotics, Automation Engineering	9	16.8	29.0
11	Medical Equipment Technician	Skilled in Medical devices, Robotics, AI maintenance	15	20.3	27.8

Sl. No.	Occupation	Key Skillsets	Human Resource (Thousand)		
			2025	2030	2040
12	AI-assisted Laboratory Specialist	Skilled in AI Diagnostics, Genomics, Digital Pathology	5	6.8	9.3
13	Patient Data Analyst	Capable in Big Data, AI Analytics, Data Visualization	8	13.5	18.5
14	Remote Patient Monitoring Specialist	Expert in Telehealth, IoT, Wearables, AI Analysis	10	19	28
Grand Total			185.5	273.5	388.8

Recommendation:

Traditional healthcare roles are under pressure as AI, robotics, and telemedicine reshape the industry. Upskilling in digital health technologies and reskilling for AI-driven diagnostics are vital. New professions in telehealth management and AI-powered healthcare solutions are emerging, driven by the 4IR revolution. Policymakers and governments are suggested to adopt several key measures:

- Medical Education and Family Welfare Division can include 4IR elements in medical curriculum.
- Bangladesh Medical Association can establish 4IR to build awareness among the doctors.





Conclusion

Bangladesh prepares to navigate the profound transformations introduced by the Fourth Industrial Revolution (4IR). Every sector stands to get benefit from the thoughtful integration of advanced technologies. AI, robotics, cloud computing, blockchain, big data analytics, 5G, AR, VR, cybersecurity, robotics, and other recent innovations are reshaping global production systems, supply chains, and competitive landscapes. For Bangladesh, a labor-centric economy, 4IR presents unique challenges but also unprecedented opportunities for growth, skill enhancement, and economic progress. Through proactive measures, Bangladesh has the potential to position itself as a resilient, forward-looking nation capable of adapting to this new industrial landscape.

Developed nations are increasingly investing in automation to localize production and enhance efficiency through advanced robotized factories. While this trend may pose challenges to labor reliant economies such as Bangladesh, the country possesses distinct advantages. With relatively lightweight infrastructure, Bangladesh has already demonstrated capacity to take over technologies with the evidence through the rapid adoption of mobile technology over desktop computers in rural areas. Bangladesh is well positioned to bypass outdated systems and adopt innovative future ready solutions.

The shift towards the 4IR necessitates a recalibration of skills across sectors. Bangladeshi organizations must urgently focus on upskilling and reskilling workers to prevent widespread displacement. Specialized entities are already fostering skill development programs, market research, and public-private partnerships to prepare the workforce for an automated future.

The nation's journey towards 4IR calls for a united approach where industry bodies, government agencies, and educational institutions collaborate on targeted upskilling and reskilling initiatives. This report highlights several common strategies across sectors:

1. Public-Private Collaboration:

Encouraging organizations like BHTPA, BASIS, BACCO, BGMEA, and others to work closely with public and private educational institutions will facilitate the development of 4IR-specific training programs tailored to the needs of each sector. Such partnerships can accelerate the creation of a skilled workforce capable of handling next-generation technologies.

2. Sector-Specific Training and Upskilling:

In Bangladesh, each sector necessitates a distinct set of skills for sustainable growth. For instance, the ICT sector requires training in cybersecurity and big data analytics, while the Tourism and Hospitality sector emphasizes the importance of digital marketing and customer experience design. Additionally, the Manufacturing sector benefits from expertise in lean production techniques, and the Agriculture sector focuses on implementing sustainable farming practices. To effectively address these sector-specific requirements, comprehensive upskilling programs facilitated by organizations such as BCC, BASIS, BKMEA, and the Agricultural Extension Department are crucial for fostering a skilled workforce and promoting sustainable development across all sectors.

3. Establishment of 4IR Cells:

Industry associations such as the Bangladesh Light Engineering Owners' Association (BEIOA), the Creative Media Industry Skills Council, and the Bangladesh Furniture Exporters Association (BFEA) can establish 4IR advisory cells to coordinate technology adoption and promote industry-academia collaboration. Additionally, organizations like the Bangladesh Textile Mills Association (BTMA), the Bangladesh Association of Software and Information Services (BASIS), the Bangladesh Electronics Manufacturers' Association (BEMA), and the BGMEA can enhance these efforts by providing valuable insights and resources, fostering a comprehensive approach to the 4IR across various sectors.

4. Focus on Sustainable and Eco-Friendly Practices:

Industries like RMG, Leather, and Construction face increasing pressure to adopt sustainable practices where a focus on eco-friendly production methods is paramount. Institute of Leather Engineering and Technology (ILET) and the Bangladesh Leather Service Centre can provide insights into sustainable practices and ensure that industry practices are aligned with global environmental standards.

5. Encouragement of Digital Literacy:

All sixteen sectors are undergoing rapid digitalization and digital literacy has become essential. Training programs can bridge the digital divide and prepare workers at all levels to engage with digital tools and platforms.

However, this research has several limitations. The sample may not fully represent the diverse range of industries, and the subjectivity in expert opinions could affect the findings' overall. Limited access to specific stakeholders and time constraints hindered data collection depth, while reliance on self-reported data may lead to inaccuracies regarding industry preparedness for 4IR. Additionally, a primary focus on urban sectors may overlook the unique challenges faced by rural industries.

By strategically integrating traditional roles with emerging, technology-driven occupations, Bangladesh can foster a robust workforce that balances automation with employment generation and economic stability. This requires a cohesive strategy focused on policy support, cross-sector collaboration, and workforce development. Prioritizing the upskilling and reskilling of its people, nurturing public-private partnerships, and adopting sustainable growth approaches will enable Bangladesh to navigate the challenges of Industry 4.0. Ultimately, these efforts will transform challenges into opportunities, promoting economic resilience and preserving economic identity.

