Situating Bangladesh in the New Industrial Revolution: Adopting Lessons from Developed Countries

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Abstract

The New Industrial Revolution (NIR) or Fourth Industrial Revolution (4IR) was first attempted by Germany in 2011. NIR broadly focuses on building an ultra-smart society by integrating digital technologies, such as the Internet of Things (IoT), machine learning, artificial intelligence (AI), and robotics, into auto-manufacturing. NIR is an indispensable element of the centennial vision statement of the University of Dhaka. Many advanced economies, such as the UK, Germany, and Japan, have already implemented I4.O in their national policies. To fulfil the national and global targets and aspirations to keep pace with the worldwide speed of technological advancement towards the fourth industrial revolution, Bangladesh needs to learn from Industry 4.0 and Society 5.0 to adopt NIR in the policy agendas in its own ways. Through a qualitative approach, this paper is intended to familiarise NIR with the mass people and the stakeholders to accustom to the internalisation process of the fourth industrial revolution by developed countries with recommendations to internalise the exclusive benefits of NIR through adopting in the developmental policy agendas Bangladesh.

Keywords: *New industrial revolution (NIR) · Society 5.0 · Policy agenda of Bangladesh · development targets*

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Introduction

Globally, with time, there have been some significant revolutions. Experts define them from various perspectives. The invention of the steam engine shed light on the first industrial revolution. Then, gradually, with the advancement of science and technology, the revolution moved forward at its own pace, meeting the demands of time. The world is currently enchanted with a new industrial revolution (NIR), the fourth industrial revolution (4IR). European country Germany initiated this term first and incorporated it into its policy. Gradually, other countries like the United Kingdom, Japan, and China have also included this strategy in their own ways (Majstorovic & Mitrovic, 2019). Japan included 4IR and worked on building an ultra-smart society named Society 5.0, emphasising 4NIR/4IR (Fukuyama, 2018). Bangladesh has a vision of being a developed country by 2041, and materialising NIR can assist in achieving the goal to a large extent. The lessons from developed countries and countries that have already incorporated NIR in their policy agendas can fuel the engine of achieving the growth targets on time. By mitigating the challenges of adopting NIR, it will be accessible to be on track with 4IR, mainly by concentrating on specialised education, digital training, and knowledge on adopting technological innovation.

Evolution of 4th Industrial Revolution

Mechanisation, mass production, automation and the Internet of things and services represent Industry 1.0, Industry 2.0, Industry 3.0 and Industry 4.0 respectively. With the passage of time, the advancement of technology, and the need-based requirements, there are multidimensional changes in every aspect of life. There will be many changes in the 4th industrial revolution. The business model is changing. Car firms will get more revenue from selling data and mobility services. Firms offering digital solutions will make more revenue than firms offering services done by people. Technology plays a vital role in business transformation and addressing resource constraints to a great extent. Chemical products will not be made from petroleum only but from bio-based ingredients and recycled materials. In the future, mining will mainly be done in asteroids and deep seas. Carbon emission will be an issue when considering investment in the energy sector. The computers will generate the news. Financial exchanges will occur in a block blockchain structure (Kodama, 2018).

Illustration: Evolution towards the Fourth Industrial Revolution
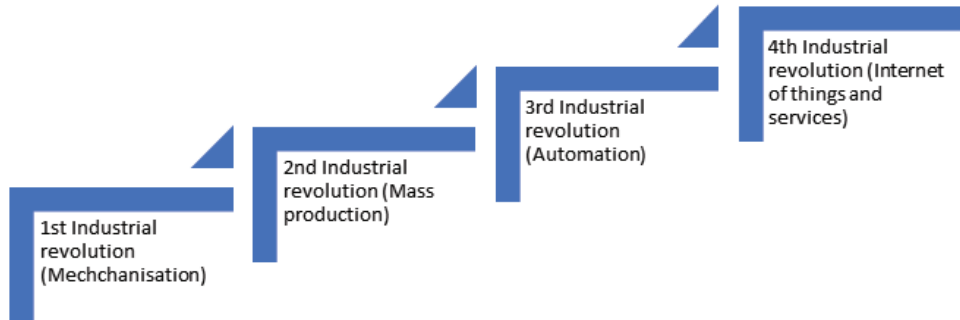
Source: Developed by authors based on Kodama (2018).

As depicted in the illustration above, the evolution towards the fourth industrial revolution focuses on the following—

1st industrial revolution- steam-powered machines;

2nd industrial revolution- mass production by division of labour and electrical energy;

3rd industrial revolution- electronics and IT, more automation, and

4th industrial revolution- cyber-physical production systems.

Methodology

This paper aims to derive lessons from developed countries that have already incorporated NIR in their development strategies to include in Bangladesh's developmental policy strategy. A qualitative approach is used in this paper. Books, scholarly journal articles, and reports from the World Economic Forum, European Union, etc., were used to develop the conceptual framework. Analysing the situation of developed countries, the challenges that Bangladesh can face are elaborately explained, and potential and possible solutions are mentioned. Based on existing literature, an attempt was made to identify the upcoming challenges that Bangladesh might face while materialising 4IR/NIR based on the experience of other developed countries, especially from Europe and East Asia.

Advantages of 4IR/NIR

Social and environmental problems are often created when the country strives for economic development. 4IR/NIR will resolve social problems while maintaining economic development. 4IR will add significant value to transportation, manufacturing, infrastructure maintenance, and health care. In 4IR/NIR, there will be many self-driving cars and more advanced network systems. Because of self-driving vehicles, older people can also move in quickly as they do not have to drive

themselves. The advanced data collection and network will mean fewer accidents, and artificial intelligence (AI) can choose the best route more quickly and easily, so travelling will be safer and more comfortable. In NIR/4IR, robots can regularly perform health check-ups. It will lead to early detection and cure of diseases. Plus, there will be more helper robots, reducing the pressure on healthcare personnel. The robots can do the check-ups on older people at home, so it will be convenient for them too, as they do not need to go to the hospitals regularly because it is far away from their homes. AI and big data can be used to analyse the market, leading to better product development. Robots can control the manufacturing process; this will be an excellent solution to labour shortages. It will lead to a more competitive business environment that will benefit the economy. With more information, better manufacturing processes can reduce greenhouse gas emissions and help the environment. In NIR/4IR, AI will analyse crop quality and weather, leading to more production. Robots will be used to control farming machines and will solve labour shortage issues. Self-driving cars can deliver goods to markets, and there will be no supply problems.

In markets, machine learning AI will provide suggestions for people about what food to buy based on their preferences and allergy conditions. AI will also be used to manage market inventory, leading to efficient food item management. AI will also make suggestions at home about what to buy and what to cook; thus, it will make cooking and eating a better experience for people. Again, 4IR/NIR will lead to better disaster management. There will be better monitoring of infrastructures such as roads and bridges through sensors, and they will be adequately maintained to reduce accidents. Disaster-prone areas will also be carefully observed using satellite information and drones. People will be appropriately notified of disaster and shelter information quickly through apps. Robots will facilitate rescue operations and relief efforts. 4IR/NIR will emphasise energy saving by efficient household energy consumption. It will try to increase energy output from renewable sources. Electric cars and renewable energy will also lead to less Greenhouse gas emissions and pollution, so this will be beneficial for the environment (Xu et al., 2018; GOJ, 2022; Vaidya et al., 2018; Mrugalska & Wyrwicka, 2017).

NIR / 4IR in Developed Countries
The world is undergoing rapid globalisation and technological transformation. Like Japan's Society 5.0, other countries have goals such as China aiming for "Made in China 2025", Asia trying to develop smart cities, Europe planning for Industry 4.0 and North America developing Industrial Internet. The goal is to achieve economic growth while resolving social and environmental problems. The UN also set a 2030 Agenda for Sustainable Development goal in 2015, in which all countries

will work together to achieve sustainable development (Majstorovic & Mitrovic, 2019; Fukuyama, 2018; Li & Pogodin, 2019).

Takakuwa et al. (2018) strived to find out the industrial development situation in Croatia- how far are they in implementing Industry 4.0, which another European country, Germany, developed. They showed that Croatia is still behind Europe in its manufacturing sector. They are still mainly in Industry 2.0, whereas the rest of Europe is in 3.0 and aiming for 4.0. Just 30% of all Croatian industries were in Industry 3.0. They realised they needed to develop a region-specific development model (Innovative smart enterprise model) to help them compete with other European countries. It aims to achieve Industry 4.0 Goals that develop smart companies and bridge the gap between machine and man.

The paper of Balland & Boschma (2021) aimed to find out the regions in Europe that can contribute to Industry 4.0 technologies. First, the researchers used patent data from the OECD REGPAT database and conducted co-occurrence tests to identify the topics related to Industry 4.0. Secondly, they examined the relationship between existing Industry 4.0 technologies and those introduced in those areas.

Lastly, they used the geography of Industry 4.0-related technologies in Europe to determine which regions will lead to knowledge production in this sector. They found that I4Ts are for the integration of manufacturing with information and communication technology. Their studies found that the technologies will penetrate a region if there are related pre-existing technologies. It strengthens the idea that technologies do not suddenly develop. They found out that some of the I4Ts existed before the start of Industry 4.0. Secondly, patenting increased in 2002-2011. Most patents were developed in cybersecurity. Most I4Ts saw an increase in the number of patents, but quantum computers saw a decrease.

The researchers found that the density of technology-relatedness can be used to find the potential of developing I4Ts of regions in the EU. They found that most of the top 20 regions are from Germany, France and the UK. There is variation in each region, that is, what type of technology they are making, e.g., German regions have high scores in developing autonomous vehicles but low scores in selling cyber securities. UK regions are advanced in augmented reality. UK, France and Finland are advanced in cybersecurity.

Japan incorporated the fourth industrial revolution strategy in its development agenda to develop an ultra-smart society based on NIR, Society 5.0. It can be defined as "A human-centred society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace and physical space"). Before society 5.0, there were also societies 1.0, 2.0, 3.0 and 4.0. Society 1.0 was a hunter-gatherer society, 2.0 was an agrarian society, 3.0 was

an industrial society, and 4.0 was an information-based society. The information distribution was inadequate in Society 4.0 because people had to collect, analyse, and store most of the data. It was challenging to do this because there were problems with the ageing population and decreasing population, so there were fewer people for these jobs. In Society 5.0, the data collection will be done by sensors mainly and Artificial Intelligence, and the analysed data will do the analysis will be presented to humans again. All these will make life more comfortable for people in many ways (Fukuyama, 2018).

Society 5.0 is Japan's growth plan for achieving Sustainable Development Goals (SDGs). Other countries that face Japan's problems will need to learn from Japan how to solve these problems in the future. Bangladesh also has many things that it can learn from Japan's Society 5.0 initiative. First, because of digitalisation, security risks and privacy issues are becoming a major threat. Bangladesh needs to observe Japan and study how they deal with it. Bangladesh can use their findings to create a better digital environment.

Impact of Society 5.0 on Japanese Society and Technology

The ultra-development of information and communication technology (ICT) is responsible for the massive variation in society and industry. The changes are massively related to digitisation, which means digital transformation will originate new valorisation, which is why it is becoming the latest pillar of industrial policy. The Japanese government has pursued an aspiring policy program, "Society 5.0", to materialise this concept by following global trends. It was recognised as Japan's growth strategy.

The impact of 'Society 5.0' on Japanese society and technology can be expressed through three-dimensional perspectives. These are Social Impact, Economic Impact, and Technological Impact.

1.   Social Impact

By achieving the goal of Society 5.0, Japan aims towards a human-centred society where anyone can benefit from their life through the newly invented innovation. The main advantages that humans can have are comfort, vitality, and high-quality lives. It benefits everyone regardless of age and gender and makes life more convenient, secure, and accessible. Humans can be liberated from cumbersome work and utilise their time effectively. As a result, everybody's life will be full of fun and happiness. Society 5.0 equilibrates economic development with societal improvement through offsetting social issues.

2. Economic Impact

Society 5.0 will not discriminate based on religion, sex, caste, language, or gender. In this system, everyone works according to their needs and capabilities, which is undoubtedly positive. It is expected to reduce income inequality. Society 5.0 has been crafted so that no one will be left from getting opportunities in the job and education sectors. Its motive is to provide benefits and enjoyment to all people in society, so there is a high possibility of reducing income inequality. But it is expected, and we still cannot see the whole outcome of this.

3. Technological Impact/ Digital Transformation

The core elements of Society 5.0 are IoT, AI, machine learning, robotics, and fintech. By using these instruments, the central vision of Society 5.0 will be accomplished. Lastly, by adding new values and creating communication between 'people and things' and 'between reality and virtuality, it hopes for a better and sustainable society.

The roles of Institutions and Private Sectors

The concept of "Society 5.0 for SDGs" was initiated to link industry and academia. In Society 5.0, the most required thing is Creativity, where institutions can contribute a lot by educating people and creating new knowledge through research. Institutions can also provide widespread and objective input to design innovation, social systems, and economic mechanisms.

A tremendous positive side is that the private companies of Japan, such as Panasonic, NEC, Toyota, Fujitsu, and Hitachi, have also started incorporating Society 5.0 in their companies' strategies. They have also implemented IoT, AI, and Robotics into their corporations, and the outcome is much more satisfactory. So, their response is mesmerising (Holroyd, 2022).

Society 5.0 would be realised by some potential sectors where the outcome of society 5.0 can be realised are discussed as follows:

1. Healthcare: In healthcare, the data will be shared and connected through all the users, including medical check-ups, reports, medical care, and nursing support, besides the use of remote-control medical care services and the use of AI and Robotics technology in the medical sector to support people's independence.

2. Mobility: In transportation like buses, taxis, and cars, there will be an autonomous driving system that will make the rural transformation system more available. Robots and drones will also be available for mobility.

3. Infrastructure: Sensors, artificial intelligence, and robots will diagnose and maintain physical infrastructures, especially transport and communication.

4. FinTech: Society 5.0 promotes a cashless society. Besides FinTech firms and banks, it introduces 'Open Application Programming Interfaces. Lastly, for money transfers, blockchain technology will be used.

The Major Societal Problems in Japan

There are many societal problems in Japan, such as a declining birth rate, a Shrinking Economy and labour force, an increasing senior population, and an increase in social security costs, which Japan needs to consider; otherwise, shortly it will create conditions for harmful impact on the economy and society. There is an assumption that other developing countries will also face those problems. Thus, Japan is denoted as "An advanced country with advanced issues".

Bangladesh and the 4ᵗʰ Industrial Revolution

Rumi et al. (2020) found that our fear of the fourth industrial revolution is that technology will replace low-skilled jobs. Bangladesh has a high proportion of unskilled workers, so that it will be a concern for us in the future but not in the present. This is because most of Bangladesh's industries cannot switch to smart industries quickly, plus many people work in the agricultural sector, so job loss will not occur soon. However, Bangladesh needs to keep pace with the NIR/4IR. To do so, Bangladesh needs to invest in technologies such as robotics and set up AI and computer research centres. The education system must also be transformed to keep up with changing demands. People need to work with critical thinking and bring innovations. The new jobs will require highly skilled people, and the education system needs to prepare graduates for them.

Moavenzadeh (2015) suggested the following elements which should be present in government policies for the growth of the economy:

- Tax policies should be simple for manufacturers but should also ensure competition.
- Policies that ensure free and fair trade should be implemented.
- Some policies should be taken to help develop talented individuals from schools and the workforce.
- The policies should encourage technology and innovation.
- Energy and infrastructure demands should be met.

Islam et al. (2018) found the following issues of Industry 4.0 in Bangladesh:

- Lack of government support- The government does not have clear policies about implementing automation in industries like RMG and shipbuilding.
- Lack of Knowledge- Key planners and people in upper management have

> limited knowledge about implementing automation and technological integration.

- Poor Infrastructure- Bangladesh has poor road communication and network issues, plus there is no large market for technological goods and services.

- Availability of Cheap Labor- Cheap labour is available in RMG industries, so owners are not eager to introduce automation.

- Expensive installation of technologies- It is initially expensive to install the technologies, but it will be more profitable in the long run. Still, many companies are not ready to invest in the first step.

Bhuiyan et al. (2020) investigated the prospects of Industry 4.0 in agriculture and stated that some features of Industry 4.0 are being used in agriculture on a tiny scale. Advanced devices are used to find soil moisture solar irradiation and mobile apps are used to see weather forecasts. They stressed that policy-makers, authorities, business people, scholars and consumers should be fully aware of Industry 4.0. To make them more aware, some programs, such as seminars, trade fairs, and overseas training programs, should be held. Introducing technological advancement requires substantial financial investment. However, banks are unwilling to take such risks, so the government should incentivise banks to give loans to SMEs to begin automation. The elements of Industry 4.0, such as AI and robotics, are viewed with distrust, and people are reluctant to change from traditional ways. There are also legal issues related to the implementation of these technologies. These must be resolved to bring about the 4th Industrial Revolution in Bangladesh.

Jobs involving physical labour will be replaced by intelligent machinery and robots. New technically skilled jobs will be created, including working with robots. The government should invest in skill transformation so that there will be enough work force for future jobs and people from other professions can join this sector. Industry 4.0 will create an integrated online network. For this, digital infrastructure needs to be strong; otherwise, data-leaks security breaches and hacking will be common. More research and education are necessary in this sector (Bhuiyan et al2, 020).

Shabur et al. (2021) found that 4IR is not yet established in many places of Bangladesh, not even Industry 3.0, because of a lack of adequate knowledge, inadequate infrastructure, an abundance of cheaper labour, lack of willingness and expensive installation of technologies the following outcome can be found if proper implementation of 4IR is possible in Bangladesh:

1. Economic growth (improvement of production, supply chain, smartness of production)

2. Mass production, mass personalisation, made-to-measure, agile production.

Bangladesh has a vast garment sector that employs almost 4 million people, and there are nearly 5000 factories throughout the country. There are 67 Leadership in Energy and Environmental Design (LEED) green factories in Bangladesh. Out of these 67, 13 are platinum rated. It shows that the RMG sector has an excellent opportunity for Industry 4.0.

All factory owners, employees, government officials and experts need to work together to put Industry 4.0 into action. Everyone needs to be appropriately educated. Training sessions and seminars need to be held regularly. ICT infrastructures must be improved to initiate and sustain Industry 4.0, and manufacturing patterns need to be reconfigured to introduce smart production lines. At first, there will be issues such as lower profits and waste management. Gradually, profits will increase, and waste management will be more efficient, so employees and employers must be patient and stay motivated. Experts should be brought from countries where Industry 4.0 have already been installed, such as Germany. The government must provide tax incentives for companies developing smart systems (Shabur et al., 2021).

Moktadir et al. (2021) identified the critical problems in implementing Industry 4.0 in Bangladesh. Lack of technological infrastructure, data insecurity, high investment, proper connectivity among companies, lack of skilled management teams, decreasing job opportunities, and adverse environmental impacts were noteworthy. If technological infrastructure could have been developed, other challenges could have been overcome more quickly, so designing it is of utmost importance. Industrial activities may destroy the environment. If smart and cleaner processes are adopted, the environment will be saved. Using smart machines, human contact with harmful chemicals will also be reduced so that people will be safe from different types of danger present in the current processes. Industries can make environmentally friendly production processes using Industry 4.0 technology.

The paper of Chowdhury and Kibria (2021) concentrated on the present status of Industry 4.0 in Bangladesh, what can be done in the future, and how COVID-19 has hampered the transformation of existing industries into industry 4.0. The researchers observed some industries in various sectors and conducted semi-structured interviews. They concluded that most industries are now in beginner or level 1 according to the IMPULS Industry 4.0 readiness model. However, many sectors have plans to implement Industry 4.0 in the future.

Garments and other industries also intend to get more technology in their production process. Most industries were affected by the pandemic, but some were less affected due to their previously installed automation, and many industries plan to install industry 4.0 technologies in the post-Covid era.

Challenges of Implementing NIR in Bangladesh, including Potential Solution

The Internet of Things and artificial intelligence are the core elements of the fourth industrial revolution. Excessive dependency on the internet has drawbacks as well. There is an increased risk of substantial structural unemployment due to the replacement of labour by machines, which includes wider inequality in the labour market. Thus, blended education and technical training skills will be advantageous for employment. Therefore, a drastic change in the overall education system prioritising vocational and practical orientation of knowledge might assist in mitigating the adverse impacts. Specialised, scientific, technical, technological, and need-based education for adopting new inventions and innovation of technology should be given prior importance while formulating the new education system to keep pace with the NIR/4IR.

Maintaining sufficient digital security in financial transactions will be required. Since the upcoming financial world will focus on FinTech, cyber security will be crucial in the digital economy. Strong knowledge of DigiTech can mitigate the probable data theft and offset the cyber threats. Initiatives should be taken from the current period to prepare a workforce that can face the challenges of 4IR and possess immense potential to integrate into the digitally developed world, such as Bangladesh.

Investment in research and development on multifaceted aspects is highly recommended to mitigate the challenges of coping with the global industry.

Conclusion

The advent of the fourth industrial revolution can hardly be denied due to its immense importance. The developed countries have incorporated the NIR/4IR strategies in their development goals to keep their growth target aligned with their respective and global targets. Bangladesh is not an exception. The government of Bangladesh has taken many initiatives to familiarise itself with NIR. However, there is a vast scope of work to offset the upcoming challenges, and there is no alternative to digital education and practical ways of learning, including hands-on training. The government agenda should prioritise fundamental knowledge of science, FinTech, research and innovation. The target of being a developed country by 2041 largely depends on how close Bangladesh can reach the threshold level towards materialising the fourth industrial revolution. The lessons from developed countries can assist to a great extent.

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