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INDUSTRY 5.0: SUSTAINABLE DEVELOPMENT IN BANGLADESH

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Abstract—**After liberation war, Bangladesh emerged as one of the world's largest industrial powers, opening its political and economic influence. The 5th Industrial Revolution is the next industrial revolution, and its goal is to harness human experts in cooperation with smart machines and robots, to obtain manufacturing with higher resource efficiency and easier use compared to the 4th Industrial Revolution. It is expected that the focus will be on the human side, sustainability, and the environment. This paper looks at the industrial policy in Bangladesh, emphasizing the continuous coordinating role of the government in various fields and that Bangladesh will be one of the world's most trends towards investment and a suitable environment to keep pace with the latest industrial transformations. We aim to present a vision of the 5th industry, its applications, the techniques used, and the importance of developing countries in this field. action.**

Keywords—**Artificial Intelligence, Industry 5.0, Internet of Things, Sustainable Development, 6G, Bangladesh.**

I. INTRODUCTION

In the past centuries, it was humans who manufactured homes, clothes, and vehicles but with the advent of the 1st industrial revolution in 1760, the course of the industry changed dramatically. Where the first industrial revolution was based on the development of the infrastructure for the mechanical production of machines that work with steam and water, and this revolution achieved an increase in productivity and a high return on the economy then followed by the 2nd industrial revolution in 1870, that is, almost 100 years after the first industrial revolution, and what distinguished this revolution was the discovery of electric energy and its use in the production of assembly lines, and what distinguished this revolution was the focus on mass production, which led to an increase in the productivity of production companies. The 3rd industrial revolution in 1969, when half-carriers were discovered during this period, which led to the introduction of the concept of automation and information technologies, and only 40 years later came the 4th industrial revolution in 2011, which came with the idea of manufacturing and smart factories, and after less than 10 years came to the concept of the fifth industry revolution, which some consider an industrial revolution and others consider it to be a development and controls for the idea of the fourth industrial revolution. In general, the 5th industry is a future development for the use of creativity and human expertise to work with intelligent machines [1] [2] [3].

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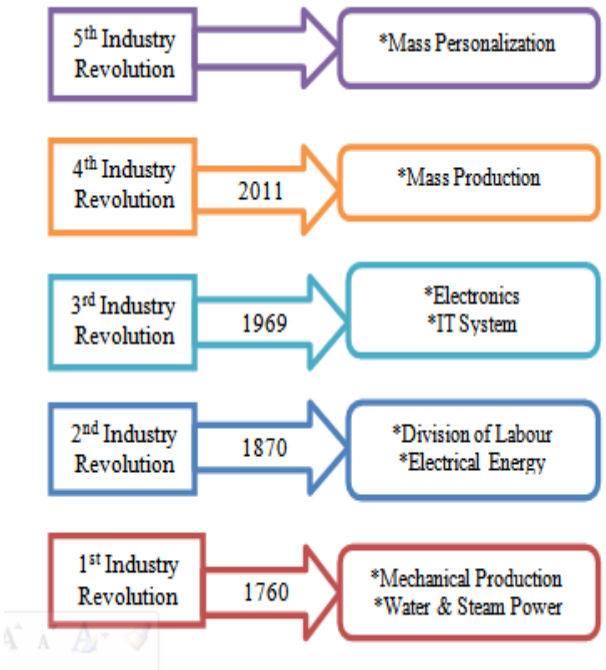


Fig. 1.Industrial Revolutions Over Time

II. FIFTH INDUSTRY DEFINITIONS

Industry 5.0 is the first industrial development that has been driven by humans and is built on the 6R principles (recognize, reconsider, realize, reduce, reuse, recycle), a systemic technology to prevent waste and design logistics efficiency of life-level evaluation, innovations, and manufacture of high- quality customized products [4]. Through the integration of workflow with intelligent systems, Industry 5.0 reintroduces the use of human labor in manufacturing, partnering with man and machine to increase process efficiency [5]. According to the European Economic and Social Committee, Industry 5.0 is a revolutionary new movement that combines the distorted strengths of CPPS and human intelligence to produce factories that work in concert. Policymakers are also searching for creative, moral, and human- centered designs to address the vulnerability of the workforce in Industry 4.0 [6].

Industry 5.0 compels business professionals, IT specialists, and philosophers to concentrate on the integration of human dimensions into industrial systems with technologies [7]. Cobots can communicate with people in the intelligent social factory of Industry 5.0. Utilizing business social networks, The Social Smart Factory enables seamless connectivity between users and CPPS components. Industry 5.0 is the progressive development of Industry 4.0, asymmetric innovation, and the subsequent global governance (asymmetric innovation). By segregating highly connected automated systems for manufacturing and production, it seeks to develop orthogonally safe outlets [8].

Industry 5.0 is a human-centered design approach that enables customizable autonomous manufacturing through business social networks by bringing together the appropriate human partner and Cobots with human resources. In turn, this makes it possible for humans and machines to collaborate. Cobots can detect and comprehend human existence despite not having the ability to be programmed. The Cobot will be employed in this situation for heavy work and repetitive chores, whilst the human will be concerned with an assignment and critical thinking (thinking outside the box) [9].

III. PURPOSE OF UPGRADING INDUSTRY 5.0

Through the integration of numerous technologies with one another, including artificial intelligence (AI), cognitive computing, Cyber-physical systems (CPSs), cloud computing, and the Internet of Things (IoT), the Fourth Industrial Revolution concept has changed the industrial sector. Making the production process "smart" by integrating and connecting machines, gadgets, and technologies that regulate one another throughout their lifetimes was the main goal of Industry 4.0. In Industry 4.0, the first priority was to automate processes, thus reducing human intervention in manufacturing processes. Industry 4.0 seeks to increase overall productivity and improve systems performance by introducing the concept of intelligence between devices and applications using machine learning (ML). One of the most important reasons for moving to the 5th Industrial Revolution was the concern or fear of reducing human intervention in manufacturing processes, as unemployment increased, in addition to the lack of focus on the issue of sustainability and the environment. Therefore, a new industrial revolution had to occur, where it will work to integrate human intelligence with machines to solve the problem [10] [11].

Industry 5.0 is designed to take advantage of the creativity of human experts to collaborate with intelligent machines. Industry 5.0 is anticipated to combine quick, precise machinery with human critical, cognitive, and creative thought. One of the essential things about Industry 5.0 is mass customization so that customers can customize products according to their tastes and needs. It is possible that Industry

5.0 will greatly increase manufacturing efficiency and will create interaction and diversity between people and machines leading to increased production at a rapid pace. And that the use of human intelligence and thought with robots/machines will enhance the quality of production in industry 5.0. The utilization of machines by intellectual professionals makes Industry 5.0, as opposed to Industry 4.0, more supportive of skilled employment. Industry 5.0 is largely intended for personalization and to promote customer satisfaction, as opposed to Industry 4.0, which uses robots to increase large- scale manufacturing. Industry

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4.0 emphasizes CPS connectivity, whereas Industry 5.0 focuses on Industry 4.0 applications and creates a connection among Cobots. In contrast to earlier and contemporary industrial revolutions,which did not prioritize environmental protection, Industry 5.0 aims to create ecologically friendly solutions, which is one of its most significant advantages. Industry 5.0 builds decision-supporting models using operational intelligence and predictive analytics. The majority of industrial processes will be computerized and use real-time data gathered from equipment in conjunction with highly trained professionals [12] [13]

IV. EMPOWERING TECHNOLOGIES IN INDUSTRY 5.0

A. The Internet of Everything (IoE): IoE is the interconnection of people, processes, data, and things. If IoE evolves and enters Industry 5.0, it will create new jobs and provide better benefits to the industry. IoE will increase customer reliability, and customer satisfaction, and the ability to customize based on data generated from IoE will reduce operating expenses by removing bottlenecks in communication channels and lowering latency where service efficiency and supply chain is an Industry5.0 hurdles. [14]

B. Big Data Analytics: Big data analytics are crucial to Industry 5.0 because they allow businesses to better understand consumer behavior, which in turn lowers overhead costs and improves product prices and efficiency [15].

C. Blockchain Technology: Blockchain is the name for a shared distributed database or ledger across computer network nodes. The blockchain offers an electronic database for storing data digitally. The blockchain encourages confidence without the need for a trustworthy third party because it ensures the confidentiality and accuracy of the data record [16]

D. 6G and Beyond: Industry 5.0 apps benefit from 6G networks' intelligent spectrum and power management, mobile EC powered by AI, and smart mobility, all of which help to more effectively and efficiently improve application performance [17].

E. Edge Computing (EC): Using the edge Data processing at the network's edge is known as Edge Computing or EC and this idea was developed as a result of the availability of several cloud services and the Internet of Things' quick development [18].

F. Digital Twins (DT): A Digital Twins is a digital replication of a physical system or object. Although the idea of DT was first put forth in 2002, it wasn't until recently thanksto the rise of the Internet of Things that it came to pass. Through the use of IoT devices, data is transferred from physical objects to their digital counterparts for simulation. Asa result, we can analyze, monitor, and prevent issues before they manifest in the real world. The Internet of Things (IoT) has made DT cost-effective, making it available in many industries. Customization by building virtual environments to see results leads to improving the user experience for the needs of their products [19].

Table - 1: Enabling Technology on Industry 5.0 Applications

Industry 5.0	**IoE**	**Big Data**	**Blockchain**	**6G**	**EC**	DT
Smart Health Care	**H**	**H**	**H**	**H**	**H**	M
Supply Chain Mgt.	**H**	**H**	**H**	**H**	**M**	L
Factory Production	**H**	**H**	**H**	**H**	**H**	H
Disaster Management	**H**	**H**	**M**	**H**	**H**	M
H=High Utilization M=Medium Utilization L=Low Utilization						

*IoE –Internet of Things, *EC-Edge Computing, *DT-Digital Twins

V. APPLICATIONS IN INDUSTRY 5.0

A. Smart Healthcare: Wearable smart devices, including smart watches and sensors, can be used to continually collect patient care data in real time. This data is then stored in the cloud and used with machine learning (ML) algorithms to diagnose the illness and notify/alert the doctor. And through collaborative robots, doctors perform surgery on patients. With Industry 5.0, Cobots can take over routine functions such as routine checkups by doctors, so doctors can focus on a higher level of functionality with the help of Cobots, complex surgeries can be performed with

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complete precision where the doctor is responsible for giving input continuously. These are just a few instances of the ways in which Industry 5.0 might transform the healthcare sector [20] [21]

B. Supply Chain Management (SCM): Industries may be able to meet demand and produce customized products more quickly with the aid of Industry 5.0-enabled technologies like DT, Cobots, 5G and beyond, ML, IoT, and EC. This aids SCM in incorporating mass customization, a crucial idea in Industry 5.0, into their manufacturing processes [22]

C. Factory Production: When the concept of automation and robots began in the industrial environment, this led to a huge difference in the manufacturing industry the world, where robots replaced humans in labor-intensive, dangerous operations like welding and painting in car factories and loading and unloading large things from trucks into warehouses. The goal of Indus- try 5.0 is to make workplace technology smarter and more connected by fusing cognitive computing skills with human intelligence. As a result, Industry

D. 5.0 is predicted to result in new regulations, fundamental alterations in how we think about business and production, and job prospects in collaborative robots [23].

E. Disaster Management: Any event that damages material property or affects human life is considered a disaster and the development of special strategies and management of these events reduce the damages of the disaster. Therefore, disaster relief or emergency management is one of the most important issues in the plan of any country, organization, or institution. Due to the incidence of the COVID-19 pandemic, many disasters recovery plans have been altered; this is expected to introduce long-term resilience as a policy to replace disaster recovery techniques. Qualitative investigation found that Industry 4.0 suffers limitations on disaster recovery and management systems, leading them to recommend the application of the 5th industrial revolution in the context of disaster management. In addition, combining people with AI and the Internet of Things can aid with issues pertaining to catastrophe mitigation. Additionally, by working together, people and sophisticated robots can effectively control not just earthquakes but also other natural calamities like diseases. Since their qualitative investigation found that Industry 4.0 has limitations on disaster recovery and management systems, advised the application of the 5th industrial revolution in the context of disaster management. In addition, combining people with AI and the Internet of Things can assist in resolving issues with disaster mitigation. Additionally, by combining the efforts of intelligent technology and people, calamities like diseases may be effectively controlled in addition to earthquakes [24]

VI. MARKET PROSPECTS OF INDUSTRY 5.0

In a world in which changes have become more rapid than they were before and with the emergence of many closures, quarantines, and restrictions imposed on transportation and production lines due to the recent health crisis accompanying the outbreak of the Corona epidemic, there is an urgent need to shift to a policy of survival for the fastest so that companies and various industries can survive Resilient in light of these changes. The 5th industrial revolution allows companies, institutions, and organizations to adopt and apply the latest technologies, and to modify the way the organization works based on these technologies; Which enables it to adapt to the many different variables around it, and enables it to be creative and innovative, and increases its ability to compete, survive and withstand [25]. Many economic experts have adopted that 3rd and 4th industrial revolutions had great harm to humans and the environment because of the machines used and the lack of consideration for the issue of preserving the environment. However, the 5th industrial revolution moved humans to the center stage in production processes in addition to many other changes, including the following:

a. Expanding the scope of remote work significantly and regularly.
b. 3D printing is widely spread.
c. Increase the interaction between robots and humans even more.
d. Focusing on the use of technologies that have the least impact on human health and the environment.

The epidemic has hastened the development of Industry 5.0, robotics, and digitalization. Industry 5.0 encapsulates these systems and adds more advanced human intelligence, much like Industry 4.0, which emphasizes the use of artificial intelligence (AI), big data, and the Internet of Things (IoT). The primary distinction between the 4th and 5th industrial revolutions is that industry5.0 aims to promote a collaborative working relationship between humans and smart technologies rather than a competitive one, which was feared during the fourth industrial revolution. It is anticipated that these collaborative robots will be integrated into industrial processes to perform more repetitive and manual tasks. Why should work to accelerate the growth of the fifth industrial revolution? [25]. An incomplete summary of some of the changes that spread throughout the 5th industrial revolution is shown below:

a. Many workers will transition to remote employment.
b. Machines will do routine managerial tasks.
c. Wearing implants, bracelets, and smart watches for health and other purposes will become common.



These techniques will seek to preserve human healthfor the longest period.

d. The concept of 3D printing will become popular in many fields.
e. Chatbots will become a standard component of customer service.

Questions that demand clarification and responses include the following:

a. How will white-collar occupations change, first? Will they entirely vanish, and how will employees have to restructure their job descriptions as mundane labor gets automated?
b. What will our society's reaction be to this? Values, organizations, and a sense of self.
c. Which nations will be most impacted? North andSouth.
d. What will transpire in nations where internet usage is low? African nation.
e. How will prices for products and services change?
f. How will businesses create psychological contracts based on trust, as well as how will we all get rid of our old habits and get ready for this new environment?

It is possible to think negatively about these things and that robots will invade our lives and control us and that at some point they will surpass human intelligence that humans will become dependent on this world and dominate the world and that robots will seek to get rid of humans. In the end, they are smarter than humans and there will be nothing to prevent her. But it is also possible to think in a more positive way, which is that these machines and robots have changed the way we live and think, as robots have become repetitive tasks and dangerous and complex tasks, as humans have made less effort and that through artificial intelligence it has become possible for these machines to help us in making decisions and that humans have become, He thinks about the most important issues. And if we compare the previous industrial revolutions at the level of life, society, and the environment, we will find that they led to a lot of disintegration and disasters for humans and the environment that a new industrial revolution is necessary, and that, without a doubt, there will be changes during the 5th industrial revolution [26].

VII. CONCLUSION

To achieve maximum performance, the 5th industrial revolution will witness increasingly sophisticated collaborative interactions between people, technology, processes, and systems. The 5th industrial revolution might bring about a new socioeconomic age that eliminates the disparities between the top and the bottom opening up limitless opportunities for people and improving the earth. Industry 5.0 may still be in its early stages, but for businesses that want to remain ahead of the curve and beat their rivals, it is critical to pick the ideal location and climate (Bangladesh)and to move quickly.

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