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Industrial revolution (IR) 4.0

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Abstract
Industrial Revolution (IR) is growing rapidly in the world. India is also not exception. However, the coming years are going to be the years of artificial intelligence because many business and industrial activities has already been adopted artificial intelligence in the empowered system, security system, and data analysis in the production system. Thus Industry revolution is primarily stem from artificial intelligence. It has become the main engine of transformation that is being undertaken by industrial sector of India. In India, there is a wide scope for artificial intelligence because the nation is on the way of growing business and foremost lucrative investment destination in the world. In recent past, the nation expressed more intention about technology and realizing that technology is an important component of economic development in India. There are so many industries in the industrial sector of India that are being used artificial intelligence for its mass production such as automobile, power and energy, pharmaceutical, heavy metal and machinery manufacturing industry, semiconductors and electronics, food and beverages, agriculture sector, banking sector and defense system. However, there are also so many challenges in adapting artificial intelligence in the path of industrial sector of India subject to lack of data about artificial intelligence, lack of skilled person, lack of funds, issues in data management etc.

Keywords: Industrial revolution, artificial intelligence, and manufacturing sector of India

Introduction
The transition to from Industry 1.0 to Industry 4.0 is significantly dependent on a range of critical technologies that facilitate automation, data exchange, and improved efficiency in manufacturing and industrial processes. These technologies include the Internet of Things (IoT), artificial intelligence (AI), cyber-physical systems (CPS), and big data analytics, among others. Each of these technologies plays a pivotal role in enabling smart manufacturing and contributing to the overall goals of enhanced productivity and sustainability. These technologies are classified as Artificial Intelligence in the world. Artificial intelligence is a phenomenon and developing area along with robots and machine learning and received greater importance in the recent past in the world. With the growing intensity of machine learning (ML), we can develop the new technology that can promote their parent concert by assessing from the dada over time in the world. AI is the new revolution in the industrial sector of the world. There are four types of industrial revolution in the world with respect to development in the industrial sector. The first industrial revolution was introduced in (1712) through the usage of steam engine and electricity. With the invention of steam engine and the construction of rail road's the birth to first industrial revolution between (1760 and 1840). The second industrial revolution attributed to economic, commercial, and social change in the period (1870-1914). The main drivers of second industrial revolution were transformation, communication, acceleration of trade with the new transportation opportunities and the development of automotive industry. During 1990s, the third industrial revolution was found in the field of electricity, electronic and computer technology, flexible automation with robotic and lean production. In the 21st century, the fourth industrial revolution took place in the industrial development process in terms of combination of communication, computer and internet technology, artificial intelligence, industrial robots, additive manufacturing, and smart production. Artificial Intelligence has revolutionized in the world and attributed to high level cognitive ability such as thinking, perceiving, learning, and problem-solving and

decision making. Besides, with the highly quality method data collection, segregation, and analysis, the artificial intelligence has presented various opportunities to human intelligence. Moreover, the industry 4.0 is the backbone and subject matter of recent times and mainly drawn from the combination of big data, cloud computing, artificial intelligence that changed the course of manufacturing sector in the world. Today's, AI is continuously adopted in tasks ranging from commonly used search engine like Google etc. to high profile using such as manufacturing, medicinal diagnoses, autonomous vehicles, etc. In modern time, AI can be classified according to their strength, cognitive abilities, and the present technology in application currently in the industries. In the world, there has technological revolutionized in the industrial sector. The different wave of technology changes can be seen in the journey of industrial sector. Over the past years, flexibility is considered an important element in the production system and especially in Industry 4.0. The main aim of Industry 4.0 is to enhance the role of visualization, decentralization in place of traditional production network system (Singha, 2020) [9]. Today's, there are so many companies that are advertising for increasing their sale of product in the marketplace with different packaging sizes. Thus, increasing the product mix in the market leads to high productivity because companies are investing in new product and in the existing one. With the help of Industry 4.0 connectivity, automation and fast information, a new dimension of production flexibility can be designed moreover, cloud-based manufacturing is a technology that can contribute significantly for realization of industry 4.0 in the world. The usage of cyber physical system, industrial network, and the incorporation of robotic in the production process have opened the way for industry 4.0 in the stage of mass production. The manufacturing sector and modern industry has gained momentum in productivity with the development of automation. As the manufacturing industry was the first sector in this context and later technological advancement gave shape other industries in India. During 1990s, the idea of machine was growing and gradually gaining attention in replacing human in tasks such as object recognition and computer vision tasks in India (Fragapane *et al.* (2020) [2]. However, there are some industries already being employed artificial intelligence technique for its mass production such as Automobile, Power and energy, Pharmaceutical, Heavy metal, Semiconductors and Electronics, Food and Beverages, Agriculture sector, Banking sector and in Defense as well (Singha, 2020) [9].

The study, thus, will analyze the scenario of 'Industrial Revolution' in the Indian industries especially in manufacture sector due to the speeding role of AI in the industrial sector. In order to identify the possible impact of AI on the industries we will also go on review of literature and government policies. The present study has reviewed the relevance of artificial intelligence in the industrial sector or industry-4.0 in India, provided future way forward for Indian industrial sector. Finally, the study has also underlined the major challenge and future scope for industry and technology in India.

Industrial Revolution (IR) and Artificial Intelligence in the Indian industries

The review of literature has been clarified the trends in artificial intelligence subject to industrial sector of India. We will discuss a brief review of literature to understand the different perspective of artificial intelligence in the industrial sector of India reviewed the artificial intelligence (AI) in the Indian industries. They have pointed out that AI can increase the competitiveness of all the major areas of the economy. As they also underlined the area that are being used AI those are public health and safety, agribusiness, banking and financial services, education, marketing and customer case, energy sector, defense and national security, general utility services and finally AI enabled assistive technology for physically challenge. Moreover, the manufacturing sector has gained momentum with the application of, AI But all these areas require the infrastructure development, constructing regulatory framework for data privacy and security and more research and development. Rizvi *et al.* (2021) [8] discussed the application of artificial intelligence in the Indian manufacturing sector. This study revealed that manufacturing sector witnessed the massive transformation in terms of machine-based technology that led to automation in this sector. Moreover, the manufacture sector of India is still dominant with technology equipment and process with respect to industry 2.0. However, Indian manufacturing sector not able to adopt the relevant technology of artificial intelligence in the entire sector such as computer number control, direct numerical control, automated guided industry specially in the manufacturing sector vehicles, robotics, flexible manufacturing sector because of inability to function with these technologies. Nawaz (2019) [7] made attempt to access the impact of artificial intelligence in the recruitment process in the software industry in India especially in Bangalore and Hyderabad. The study underlined that artificial had positive impact on human replacement in the recruitment task. The study also revealed that in terms of searching jobs, artificial intelligence most of the effective way than human, no doubt technology can't be replace the human interaction with machine. Moreover, artificial intelligence can't replace the entire process of recruitment in the software industries in India. Fragapane *et al.* (2020) [2] analyzed concept of autonomous mobile robots (AMR) in the manufacturing sector in terms of productivity, flexibility, and costs. They found that the cost of autonomous mobile robots and the number of shifts are the key factors for improving the flexibility and productivity in the manufacture sector. They also underlined the importance of connectivity in production system that can enhance the data accuracy in the field of market share. This study can guide firms in strategic decision from both perspectives like an economical and technical perspective with regard to install a new production network with respect to AMR system and also to use existing production system more optimally. Singha (2020) [9] underlined the implementation of Artificial Intelligence in the manufacturing sector of India and found that AI continuously increasing in the manufacturing sector. The study also is overviewed of the artificial intelligence in the manufacturing sector and concluded that AI is working like transformation technology in the nation in the different fields such as from enterprises, agriculture and education to healthcare and transportation in India. Kurt (2019) [5] examined the possible impact of AI with respect to industrial relation on labour life in Turkey. This study underlines the following impact of industry 4.0 on labour life as the need for unskilled workers will be reduced, the need for skilled workers will be increased,

there will be transformation in social structure, man and machine will work together, wages for skilled workers will increase and it reduce for unskilled workers in the marketplace. Thus, industrial revolution is due to the AI is being employed in the manufacturing industries of India.

Objectives of the Study

- To explain the origin and various component of Industrial Revolution (Artificial Intelligence (AI)
- To elaborate the Government Initiatives for Artificial Intelligence in the field of Industrial Revolution in India
- To examine the Challenges for adapting Artificial intelligence in the Industrial Sector of India
- To report the Risks of AI-Centric Approach in the path of Industrial Revolution in India.
- Current status of Industrial revolution in India

Now, we will discuss the above major objectives:

Origin and various component of Industrial Revolution

The concept 'Artificial Intelligence' was originated in 1956 and developed by computer scientist John McCarthy and Marvin Minsky, Allen Newell, Herbert Simon, and Arthur Samuel. No objection the term AI grew rapidly in the late 1990s and the early twenty-first century due to the emphasized on computational power and problem-solving areas. In the 18th century, the Industrial Revolution took place in England and gradually spread to other European countries. For trade purposes, various routes were discovered, including a sea route to India by the Portuguese explorer Vasco da Gama in 1498. This led to the arrival of the English, French, Portuguese, and Dutch in India, not only for trade but also to spread missionary activities. The beginning of the modern period in Indian history is marked by the arrival of these European powers. The article aims to explore the evolution and journey of British colonialism in India and its impact on the economic, social, and cultural spheres of the country. The British established their presence and dominance in India, and the far-reaching consequences this had on the Indian subcontinent. It delves into the various facets of British colonial rule and its influence on India's development, offering insights into this crucial period of the country's history (Zai and Ganaie, 2018) [10].

Briefly, the fourth industrial revolution as it is called, is emerging globally as a powerful force and is being touted as the next industrial revolution. It is characterized by the increasing digitization and interconnection of products, value chains and business models. Industry 4.0 is driven by an amalgamation of emerging technologies like data volumes, computational power, Internet of Things (IoT), business analytics, augmented reality, artificial intelligence, elemental design, simulation, advanced robotics, additive manufacturing, sensor-based technologies and cyber-physical systems. Industry 4.0 would mean the convergence of real and virtual worlds - the next phase in bringing together conventional and modern technologies in manufacturing. This will result in the "Smart Factory", which is characterized by versatility, resource efficiency, ergonomic design, and direct integration with business partners for manufacturing (Jadhav and Mahadeokar, 2019) [3]. Thus, the term Industry-4.0 is nothing but fourth industrial revolution in the journey of industrial production in the world. The credit of this industrial revolution primarily goes to German government that gave emphasized on the computerization of manufacturing. Moreover, this revolution focuses on interconnectivity, machine learning, automation, and real-time data especially the usage of the cyber physical system (CPS), the internet of thing (IOT), radio frequency identification (RFID), cloud computing, cognitive computing and artificial intelligence without the need of the human interaction. As we know that fourth industrial revolution is highly diversified in the production system in the world. This revolution is a convergence of different emerging technologies such as digital production technologies,

Government initiatives for Artificial Intelligence in the field of Industrial production India.

India has depended on three supporters such as government, private sector, and academia for AI related research programmes. India is undertaken several type initiatives and development projects in the fields of AI and machine learning for enhancing industrial production. Thus, the ministry of commerce and industry, Government of India plans to stimulate the uses of AI with respect to India's trade and industry transformation.

Moreover, (2018) financial statement also expressed government's interest more in the research activities related to AI, robots, and machine learning. For providing financial support to AI Programme the Ministry of Electronic and Information Technology, Government of India are funding by educational institutions in the sphere of computing and wireless sensor networks. The ministry also undertakes a scheme as Technology Incubation and Development of Entrepreneurs (TIDE) for enhancing technology over the last decade in India. There are so many ways for companies for setting up research and development initiatives along with the government support and encouragement by way of 'Digital India' and 'Make in India' that are attributed to favorable environment for AI in India.

In recent years, the Indian government has started various programmes to accelerate AI, big data, and robots. In (2020), the government of India increased expenditure for 'Digital India' with a tune of $477 million for AI, Internet of thing (IOT), big data, cyber security, machine learning and robotics. In the Union Budget (2019), Finance Minister Nirmala Sitharaman underlined the industry-relevant skill training for 10 million youth in the nation for promoting technologies like AI, Big-Data, and robotics. A report by AIM Research titled "How the Indian Government Is Championing the AI Revolution". Moreover, the Ministry of Electronics and Information Technology, NASSCOM and Defense Research and Development Organization (DRDO) have undertaken the groundwork and future roadmap for AI in India. In (2014) one initiative as Centre for Artificial Intelligence and Robotics (CAIR) had undertaken for the research and development in AI, robots, networking, information, and communication security.

Besides, the government has recently announced the launch of a mission on Cyber-Physical Systems (CPS) allotted an initial corpus of INR100 crore for commencement. Once fully implemented, these plans would be key tools to enhance the contribution of manufacturing output (Jadhav and Mahadeokar, 2019) [3].

National Manufacturing Policy 2017: - In July 2017, the government rolled out a new policy to push the manufacturing share to 25 per cent of the GDP by consolidating Make in India initiative, with focus on

adoption of digital platforms for 4.0.

Centre of Excellence (CoE) on IT for Industry 4.0: - This center would act as knowledge for entrepreneurs and startups, propagating the concept of IT and its application in 4.0.

National Program on Artificial Intelligence: - In the Union Budget 2018-19, the government announced that NITI Aayog will create a road map for national AI Programme focusing on developing new AI applications.

Mission on Cyber-Physical Systems: - As per the Union Budget 2018-19, the Department of Science and Technology will launch CPS mission to support establishment of CoE for training in robotics, AI, digital manufacturing.

Challenges for adapting Artificial intelligence in the Industrial Sector in India

AI requires so many formalities for doing function properly in the India. The impact of AI on human lives and economy is unpredictable. But some companies are predicting that AI can boost business productivity around 40%. AI can also explore new innovation way for accelerating industrial productivity and design in the world. But in India, there are so many challenges for adapting AI in the industrial sector (Kalayanakrishnan *et al.,* 2018) [4]. We will make an attempt to describe them as follows.

- **Computing Power:** Computing power is a serious task when we are working with AI. Machine learning and deep learning are major tools of AI that are demanding more cores and GPUs to work efficiently. There are various areas where we have ideas for implementing deep learning such as asteroid tracking, healthcare and tracking of cosmic bodies. But they require computing power that is not available on cheap rates in India. Thus, not everyone can afford data and increasing algorithms.
- **Trust Deficit:** This is the major factor when we are dealing with AI because we don't know the nature and how AI predicts the output in the marketplace. Besides, how inputs can provide plausible solution for different kinds of problem is also difficult to predict it. There are so many people in the world that has no ideas about the use or existence of AI such how it is integrated with every item in the world such as Smartphone's, smart TVs, and banking.
- **Limited Knowledge:** As, there are many marketplaces where we can directly use AI in place of traditional ones. But limited knowledge itself prohibits the use of AI in the market. Among the college student and researchers, there is limited number of people who have knowledge about AI. There are also so many SMEs (small and medium enterprises) which have good knowledge how AI can facilitate their production activities. Moreover, they have no knowledge about the services such as Google Cloud, Amazon Web Services etc.
- **Human-Level:** It is the major challenge for every company that is using such type of technology. A company want to join AI must keep in mind the level of human. In order to predict the optimal output and minimal input it requires good level human. Beside this, we can't proper function within AI framework.
- **Data Privacy and Security**: This is the main factor that contributes the development of AI in the industrial sector. So, there is no security of data security. We have data but there is galaxy of users around the world. There are so many companies, that already doing work with qualified data but may be this data will no longer work for other companies at the same time.
- **The Bias Problem:** The possibility of gaining score of AI system mainly depends upon the amount of data they trained on. In some situation, the data that have already collected by organization is poor and have no significance of its own in the wave of implementation. Thus, the change can be done effectively by way of introducing some algorithms that can track these problems systematically.
- **Data Security:** This is very important challenge among the other because there are so many companies like Google, Face book etc., that extracting user data from the different perspective. Thus, these companies may face problem from developing world level application with the help of local. Data security is very important element for using AI whenever we use its application with respect to any specific area in the economy.

Besides, (Singha, 2020) [9] has also outlined the following challenges in the presence of AI in the industrial sector of India.

1. Lack of data about AI- many companies and enterprises struggled to alien there AI strategies to the business context due to lack of proper information and knowledge. Lack of in-depth knowledge and existing possible solutions is becoming a huddle for the successful mapping of used case.
2. Shortage of skilled personal and expertise- many companies are handling the shortage of skilled AI talents and difficulty in haring the specified roles
3. Implementation is expensive and lack of funds- many companies deals with cost insensitive implementation of AI and lacks funds.
4. Issues in Data Management- many companies deals with data management issues in term of knowledge governance, acquisition, bias data.
5. Infrastructure limitation- For the successful adoption of AI in industrial sector, it essentially requires software, hardware, and technological infrastructure. If a producing business fails to successfully use anybody (or more) of those requirements, the corporate can expect unforeseen hurdles and deadlocks on its AI transformation journey.
6. Security-many widespread use of AI system are raises variety of ethical, moral and legal issues that are yet to be addressed.
7. Not realizing the requirement- the event of a thinking AI system are currently too difficult to realize in practice. Many Company culture still not recognized the necessity of AI.

- **Risks of Industrial 4.0 Centric Approach in the Industrial Sector of India**

AI contributes to development in numerous ways create a hub of hope and optimism views in India. There are predictable risks that can be associated to AI-Centric approach as well as can affect the socio-economic status of India.

- **Displacing workers**

As we know AI is machine learning and can affect directly on the workers placement in the companies. India's IT industry is already seen a wave of

automation and it is suggesting that this wave of technology can hit the population in the coming years.

- **Reinforce Social Discrimination:** In India, the caste system is a historical root and directly affecting on wages, employment, and access to credit from banks. Thus, with the growing intensity of AI, it has become a serious issue that data-driven algorithms that may be used to access applications for job seekers.
- **Amplifying Gender Inequality:** It can be examined that AI can increase gender inequality especially in rural areas where number of internet users and the number of mobile internet users are more in case of men than women. Moreover, India's software industry also facing gender inequality and this imbalance can create unpredictable long-term results.

Current Status of Industry 4.0 in India

Globally, the 4.0 market is expected to reach INR 13,90,647 crore by 2023.1 Countries such as the U.S., China, Japan and European nations like U.K., Ireland, Sweden, and Austria all have started adopting 4.0. In India, the sixth-largest manufacturing country, the manufacturing sector forms an integral part of the country's long-term vision as seen by the government's strong focus on the 'Make in India' campaign. The government aims to augment the share of manufacturing in GDP to 25 per cent from the current 17 per cent, by 2022. A number of initiatives and policy reforms, such as implementation of the GST (Goods and Services Tax) and easing FDI policy have been taken by the government.

At present, India lags its global peers in 4.0 adoption. A significant portion of the Indian manufacturing sector is still in the post-electrification phase with use of technology limited to systems that function independently of each other. The integration of physical systems on cyber platforms, the basic premise of 4.0, is still at its infancy. Furthermore, the Micro, Small & Medium Enterprises (MSME) segment has very little access to automation technology due to the high cost barrier.

The current scenario of 4.0 implications in India can be summoned by following way:

1. Non-awareness of the technology
2. Systematic approach towards modernization.
3. Non-Willingness to adopt the new technologies
4. Availability of Cheap labor initiates reluctance to adopt automation
5. Volume of products is not very high so as to adopt the automation increases ROI for the investments.
6. Non availability of skill set to adopt the Automation

Future scope for Industrial Sector with AI in India

Although India is lagging behind the new wave of technology, but it is surely said that, India will be placed among the AI nations over the next few years. The AI is being employed in manufacturing sector of India because it is a prime sector of industrial area and India will find itself in the new technology along with the risk associated to technology in the manufacturing sector of India. So, the future approach should be effective, reliable and riskless and more affordable with respect to AI application in the manufacturing sector of India.

Conclusion

In India, no doubt there is scope for Artificial Intelligence with respect available technology like machine learning and automotive in the manufacturing sector. But the nation as a whole not able to adopt such type of technology in the industrial sector because there are so many barriers and risks are concerned. Today, India is also placing among the nations that are being using the application of AI. But in India, there is lack of data security, data management and data security etc., leading to lag in the wave of technology among the nations.

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