Will India Lead Fourth Industrial Revolution?

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Abstract— This paper explores India's potential to lead the 4th Industrial Revolution, driven by advanced technologies like AI, IoT, and automation.

Background:

- India previously missed opportunities to lead past industrial revolutions due to colonial rule and lack of technological advancement.
- The 3rd Industrial Revolution (digital) saw India's emergence as a significant player.

4th Industrial Revolution:

- Characterized by fusion of advanced technologies (AI, IoT, robotics, blockchain, 3D printing, quantum computing).
- Potential impact: transforming societies, industries, and healthcare.
- Challenges: job displacement, privacy concerns, ethical considerations.

India's Advantages:

- Large, young population with diverse skills and potential for innovation.
- Growing entrepreneurial culture and government initiatives supporting startups.
- Robust digital infrastructure development (Aadhaar, DBT, UPI, PM Gati Shakti).

Challenges:

- Limited investment in research and development (compared to global leaders).
- Need for improved higher education aligning with emerging technology demands.
- Addressing ethical concerns, privacy issues, and ensuring equitable access.

India has the potential to be a major player in the 4th Industrial Revolution. Overcoming challenges through strategic efforts and responsible adoption of new technologies can propel India towards a transformative future.

Keywords: 4th Industrial Revolution, India, Artificial Intelligence, Internet of Things, automation, digital infrastructure, challenges, opportunities.

I. INTRODUCTION

About 250 years back 1st industrial revolution took place. In those days the economy was mainly agrarian people use to make profits from the trade of agricultural goods. With this aim Portuguese came to India they used to sell spices to India if we believe historians Portuguese were making 60 times profit from their exports seeing this profit Britishers also came to India and they also started doing trade. A turning point came during 18th century which completely transformed human history this turning point was Industrial Revolution which revolutionized production, distribution and consumption. Taking the advantage of Industrial revolution the development process of western countries started growing like rocket. India again missed the opportunity to be part of this industrial revolution also as India was under the colonial rule. So India missed to be part of both the Industrial revolutions. Both these revolutions were powered by coal, steam, electricity and oil. The result of these revolutions was that all the countries of the world marched ahead of India. Then came the 3rd Industrial Revolution which was computer driven. India became a significant part of this revolution and with the help of this revolution. Due to this industrial

revolution Indian economy made tremendous progress and India started marching with the rest of the world. This revolution gave birth to a new service sector. Despite this due to lack of technological advancement, lack of skilled work force and lack of Infrastructure India could not reach its true potential. Now the world is under 4th Industrial revolution. This industrial revolution has brought a new glimpse of hope for India. This Industrial revolution will transform the world with the technologies of Artificial Intelligence, Internet of things etc. but the question arises, will India be a significant part of this revolution or this time also India will have to face disappointment. The answer is yes slowly India is becoming a major super power and definitely India will be a significant part of this revolution. But the story is not so easy the big question is will India simply be a part of this revolution as in case of 3rd industrial Revolution or will lead this industrial revolution as Britain lead the 1st Industrial Revolution can India generate opportunities with this industrial revolution.

II. RESEARCH METHOD

This research is Descriptive study and data is collected from the secondary sources of articles published in the journals, books on the themes of 4th Industrial revolution and its allied areas, websites, census surveys. Reports relating to 4th Industrial revolution that come on the newspaper and are published on Internet are also taken into consideration.

III. OBJECTIVE OF STUDY

To know, what is 4th Industrial revolution?

To know why India could not lead earlier industrial revolutions?

To know the impact of fourth industrial revolution on societies and industry.

To know how can India lead this industrial revolution.

To know the challenges of 4th Industrial Revolution.

IV. FORTH INDUSTRIAL REVOLUTION IS THE FUSION BETWEEN ADVANCED TECHNOLOGIES

Forth Industrial revolution is the fusion between advanced technologies this fusion intends to end the difference between physical, digital and biological world. This 4th industrial revolution will combine technologies such as Artificial Intelligence, Internet of Things, Block chain, 3D Printing, Quantum Computing and other ground breaking innovations. This industrial revolution is not merely related to automation of tasks but it has the power to transform the complete system and industries. Its relation is with connectivity, data driven decision making, inclusivity, sustainability, technology's use to increase the efficiency. According to experts this industrial revolution will mainly be mainly driven by six technologies."

   a. The first one is artificial Intelligence which helps the machines learn, reason, decision making and mimic the human intelligence. Artificial Intelligence's integral component as machine learning can revolutionize health care and financial industries.
   b. The second technology is Internet of things this means such type of interconnected devices which can communicate and share the data. This network of devices can provide valuable data to increase efficiency, safety and convenience in different sectors.
   c. The third technology is Robotics. Advance robotics provides such capabilities to machines that they can perform task autonomously with considerable accuracy. Robots are being used from manufacturing to Healthcare to increase precision and accuracy.
   d. The fourth technology is Block Chain technology which is an effective decentralized and secure way of recording transactions. Block chain technology are be used in crypto-currency, supply chain and digital identity verification.
   e. The fifth technology is 3D Printing which is also called additive manufacturing; this creates three dimensional objects by printing layer by layer. This technology has immense potential in prototyping, infrastructure, Aerospace, Organ Printing etc. For example in August 2023 in Bengaluru India's first 3D-printed post office which was built in 43 days was inaugurated (Indian express).
   f. The last technology is quantum computing. Quantum computers harness the power of quantum bits to generate exponentially greater computing power than classical computers. In all the fields where calculations are done by classical computers or super computers quantum computing can bring in revolution.

This industrial revolution will have tremendous impact on societies and industry. Because of automation some jobs may require displacement but along with this creativity, critical thinking and emotional Intelligence, the qualities in which humans excel will create new roles for humans. Artificial Intelligence can transform diagnostics and telemedicine and bring revolution in health care field. In countries like India where easy and affordable health care is a big challenge AI can act as a game changer. For example, Government of India provides telemedicine service in the shape of eSanjeevaniOPD. Fourth Industrial revolution offers sustainable solutions from smart energy grids to efficient waste management system usage; it tries to reduce ecological foot prints. Data analytics and Internet of things help in urban planning, smart city development, traffic management and public services. Technology driven education transforms the way of gaining knowledge and skill

Challenges to be faced by 4th Industrial revolution: Seeing the nature of this industrial revolution it may face challenges in Privacy, Data Security, job displacement, biasness because of AI. Amidst of such ethical challenges one would require careful adoption of such Industrial revolution.

India already has some benefits to lead and dominate this industrial revolution.

V. BENEFITS THAT MAKE INDIA ONE OF THE TOP CONTENDERS IN THE RACE FOR THE FOURTH INDUSTRIAL REVOLUTION

V.I. ENTREPRENEURIAL CULTURE

India's growing entrepreneurial culture will also play a major role in the success of the Fourth Industrial Revolution. Tremendous growth of Indian economy has provided entrepreneurs tremendous opportunities. But how this will lead fourth Industrial revolution is a big question. Let us see Global Entrepreneurship monitor (GEM) this provides data for entrepreneurial landscape. According to GEM India 2021-22 report there has been an increase in entrepreneurship activity in India in 2021. In year 2021 the persons from age group 18-64, 14.4% have started new business in 2020 this percentage was only 5.3%. Surge of entrepreneurial activity was because of COVID 19 pandemic, increasing demand and many other factors. But the main role was played by Government initiatives.

V.II. GOVERNMENT INITIATIVES

Government tries to provide financial assistance and seed capital to the startups by various schemes.

    a. In January 2016 startup India action plan was revealed. In this action plan to support startups 19 action items were mentioned. The aim was to build up startup ecosystem by providing schemes, support and incentives.

    b. The second initiative was Fund of Funds for startups scheme. To meet the capital needs of startups government started this scheme. The total budget was 10,000 crore rupees the monitoring agency was DPIIT (Department for Promotion of Industry and Internal Trade) and operating agency is SIDBI (Small Industries Development Bank of India). This scheme not only made capital available to startups at the growth stage but also helped in raising domestic capital because of this dependence on foreign capital has reduced and new venture capital funds are being encouraged.

    c. The third scheme is Credit Guarantee Scheme for Start Up. The aim of this scheme is to provide credit guarantee to startups recognized by DPIIT.

    d. After 2016 government has implemented over 50 regulatory reforms to improve parameters such as ease of doing business and ease of raising capital.

The above reasons have helped to improve entrepreneurship culture in India.

V.III. LARGE POPULATION SIZE AND LARGE CONSUMER MARKET

Because of large population country has abundant talent pool that offers a diverse range of skills, ideas and perspectives. For innovation and creativity a well educated population and skilled work force is required. India can cultivate this large population into skilled work force which can meet technology and industrial emerging demands for the future. Second important point is demographic composition. A large portion of India's population is below 35 years of age. According to a report by CNBC approximately 33% of the country's population is estimated to be between 20 and 33 years old. This young population can promote and fuel up economic growth by actively participating in this industrial revolution. Indian population also encourages diversity, creativity and innovative thinking. Different cultures, languages and perspectives help in creating vibrant eco system for ideas, which is essential for success of 4th Industrial revolution. A large population generates a vast amount of data, which is the biggest source of analytics. After analyzing this data decision making can be done in various

sectors, because this data reveals pattern and trends. For example by analyzing this data desired changes can be introduced in the product and then the product can be introduced in the market. Large population also represents a large market potential. Because of crores of domestic consumers Indian businesses can scale up their innovative products and services. According to CNBC report, India's domestic market will become 3rd largest consumer market because large number of families will be shifting from middle income to high income. Currently India is 5th largest consumer market. Fitch Ratings have predicted that in the coming years household spending will increase by 29% which will render India as 3rd largest consumer market. In this report it is predicted that India's household income will increase by 14.6% annually until 2027. By 2027 it is projected that 25.8% of Indian households will reach $ 10,000 in annual disposable income. This means that total spending of Indian households will exceed 3 million dollars. From this it can be assumed that large and youthful population of India is an asset for the country. If the population of India can be used for its advantage then India will become leader of fourth Industrial revolution.

VI. CHALLENGES THAT INDIA WILL FACE IN ORDER TO BECOME LEADER IN FOURTH INDUSTRIAL REVOLUTION

The road to lead fourth Industrial revolution will not be easy some challenges will have to be faced by India:

VI.I. PRESENCE OF ROBUST DIGITAL INFRASTRUCTURE

To be leader there must be presence of robust digital Infrastructure. India already has developed the eco system of Digital Public Infrastructure (DPI) and digital technology. In-fact digital Infrastructure is being considered as core element of 4th Industrial Revolution. India's first DPI was Adhar was launched in 2009 this provided citizens with biometric secured digital network ID's. It was designed in such a way that other services could be linked with this. Adhar is managed by Unique Identification authority of India and till now 1.35 million Adhar numbers have been generated. About 96% population has got Adhar number. After this DBT i.e. Direct Benefit Transfer Scheme was launched in 2013 so that in the process of transferring funds, leakages and delays can be reduced. Currently DBT is used by 53 ministries to disperse 310 schemes of GOI. From the time DBT scheme has been launches till date it has transferred more than 27 lakh crore of money. This has reduced the leakages of funds on massive scale. This DBT has transferred funds of PM Kisan Scheme, Mahatama Gandhi National Rural Employment Scheme, National Health mission(N HM), National Rural Livelihood mission (NRLM), Prime minister Vandana Yojana(PMVY) and Scholarship Schemes. Another master stroke regarding Digital Infrastructure Development was Unified Payment Interface (UPI). UPI was developed and launched by National Payment Corporation of India in 2016 for instant real time payments. Today it is India's most popular method for digital payments. There are several reasons like Smart phone penetration, increased Merchant transaction Limits, Removable of Payment service Provider fees Zero merchant Discount Rate (MDR) for making UPI successful. According to National Payment Corporation of India in 2022 through UPI had done more than 7.8 thousand crore transactions and the amount exceeded than Rs 125 lakh crore . Similarly in October 2021 PM Gati Shakti National master plan was Launched so that logistics costs could be saved by creating an integrated and planned infrastructure. On 75th Independence Day Prime Minister launched Gati Shakti scheme. It is a huge Rs 100 lakh crore project. The main objective of this project is that time needed for Infrastructure Development should decrease and competitiveness of India in the market should increase. In PM Gati Shakti mission there is a centralized portal which unites 16 central ministries and departmental Infrastructure. UDAN, Expansion of Railway network, Bharat-mala, Sagar-mala, Inland Waterways and Bharat Net all this will be executed under Gati Shakti master plan. This master plan will generate a large number of employment opportunities.

India's educational sector has also become part of India's digital journey. In 2017 Digital infrastructure for Knowledge Sharing (DIKSHA) was launched which is a national platform for school education. This platform is built on open source technology it provides various solutions like text books, learning tools for all and availability of all time digital content. According to latest metric this platform has delivered 5.17 billion learning sessions. In India the future of Digital Public Infrastructure (DPI) seems very bright. In the past decade India has deployed many digital public infrastructures on population scale. Now India in future is building on other digital advancement which will focus on E-commerce and health sectors for example government has launched open Network for Digital Commerce the aim is to provide a common platform for listing of goods and services to the enterprises. Unified health Interface which is the foundation layer of Ayushman Bharat digital Mission it is improving the access to health services. All these efforts by government which are backed by digital Infrastructure have led to the development of a plane ground for India for making Industrial revolution 4.0 successful. Along with this government is focusing on innovations so that Digital infrastructure could be linked to other technologies as Artificial Intelligence. For this,

the government from the development of its portal of artificial Intelligence to ensuring of Global partnership in the field of AI and joining the private players in this initiative has taken number of such steps. Though the digital transformation story of India has remained incredible yet a number of challenges will have to be faced in the coming years because in order to use these services the basic requirement is a stable internet connection. According to the data of Telecom Regulatory Authority of India of October 2022; in the country of 1.4 billion there are 820 million broadband users. With the advancement of time broadband users are declining due to the introduction of technologies like 4G and 5G. Loksabha session of December 2022 minister of state for communication and Information technology said that out of 644,131 villages 38,901 villages do not have mobile connectivity. If we have to increase the use of digital technologies India must improve on better connectivity.

VI.II. RESEARCH AND DEVELOPMENT

India will have to increase its Investment in Research and Development only after that those new technologies and Innovations could be introduced in industry. Currently, India spends only 0.7 % of its GDP on research and development. In comparison to this USA, China, Israel, Japan, South Korea spend 2% to 5% of their GDP. To address this problem government has recently introduced Anusandhan National Research Foundation Bill in Parliament. National Research Foundation aims at including Colleges and Universities also in the ecosystem of Research and development.

VI.III. ENTREPRENEURIAL CULTURE

Similarly, a better environment should be provided to the startups so that entrepreneurial culture develops in India. The government will have to focus on ease of doing business and make India further better on this parameter. Although in the past years India has shown a remarkable improvement in this parameter but still there is plenty of scope in this area.

VI.IV. HIGHER EDUCATION

The government should make effort to improve higher education so that youth of the country can get education as per the market demand so that the coming generation can learn the latest technologies and do innovations.

VI.V. SAFETY AND ETHICAL CONCERNS

Apart from this there are many critical concerns like safety, ethics and socio-economic impact, which have not been answered yet. For example, there are a lot of studies which point out that in facial recognition technologies have high tendency to misidentify African and Asian people.

VI.VI. PRIVACY OF PERSONAL DATA

A number of challenges related with privacy may be seen in the near future because in all these technologies there is lot of use of personal data. In case of normal sharing or data preach, there can be a negative impact on people's privacy.

After overcoming all these challenges only India can be ready to lead fourth Industrial Revolution.

Conclusion: India's journey to industrial revolution has been topsy-turvy. In the first Industrial revolution which was based on agrarian economy India could not become a part of this. On the other hand in the third industrial revolution of digital world India because of its resilience India emerged as a significant player. Now when the world is progressing towards fourth Industrial revolution which would be driven by Artificial Intelligence, Internet of Things and advance automation India is standing on the door of transformation where it can use its strength and change its and the future of global economy. Fourth Industrial revolution is expected to bring number of possibilities if this revolution is embraced and navigate with responsibly this can create a future which will help the entire humanity. But this all depends on how we adapt this revolution and evolve.

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