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The Effects of Industry 4.0 on India's Economy Industry: A Comprehensive Analysis

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Abstract: ***Countries like Germany, Japan, the USA, and Singapore have all embraced Industry 4.0 to increase their economic competitiveness. India has fallen behind its global rivals in its embrace of Industry 4.0. But it has started using these technologies in production, and that's led to a lot of good things happening. Since urbanization began, people have been preoccupied with improving their physical and mental prowess. At first, simple tools were made out of wood or stone, but as time went on, humans experimented with metals, plastics, and even glass for various purposes. Humans have developed a wide range of practical mechanical devices. The advent of new machinery prompted the first industrial revolution. Many people called it a revolution since it also brought about major changes in society and the economy. The new ideas formed during the French Revolution, such as equality, liberty, and fraternity, were infused into the first industrial revolution, which happened a few years after the revolution. This suggests that the global economy and our culture as a whole are profoundly impacted by industrial revolutions. In light of this, the purpose of this research was to demonstrate the potential effects of Industry 4.0 on India's manufacturing industry.***
Keywords: Industry 4.0, Producing, the Indian Economy, Growth, and Industrialization

I. INTRODUCTION

Ever before they began settling in cities, humans have been preoccupied with improving their physical prowess. At first, humans relied on simple wooden or stone implements, but as knowledge and technology advanced, they started to try their hand at more complex and effective tools. Machines are an artificial aid that humans have developed. Introducing more equipment into production led to the first industrial revolution (Mehta & Awasthi, 2019). In addition to the anticipated increase in productivity, it resulted in widespread social and economic transformations, thus the revolution label. During the 1790s French Revolution, novel ideas such as "Equality, Liberty, and Brotherhood" emerged; these ideas were assimilated into the first industrial revolution that happened a few years later. This finding demonstrates that the economic and social climates of the world are profoundly impacted by industrial revolutions (Javeed, 2023). It has been shown that progress in technology is essential to economic expansion. Manufacturing system shifts, technological developments, and the introduction of novel production systems all contribute to increased output. Worldwide, businesses of all sizes are investing in cutting-edge technology in order to keep up with consumer demand. Technology and data innovation are propelling businesses to the foundations of their manufacturing processes. We have lived through the first three industrial revolutions, and now the fourth is reaching every corner of the planet. As a result of this new technical development, the industrial industry is experiencing a dramatic transformation. Changes in the direction of development, as well as people's enthusiasm for getting jobs and forming friendships, were profoundly impacted by research and development's prodding of technical progress. Following the advent of "industry 4.0," enterprises and corporations will see a radical shift toward ICT. Included in this category are advancements in areas such as manufacturing processes, data tools and analytics based on the Internet of Things, 3D printing, product lifecycle management, cyber physical production systems, robots, etc (Mehta & Awasthi, 2019). The Fourth Industrial Revolution is approaching rapidly as a result of technological development. Recent technological advances, such as AI, IoT, Big Data, etc., will have far-reaching effects on the present business climate. Industry 4.0 will impact all aspect of human life, including our jobs, homes, thoughts, and relationships with one another. Artificial intelligence (AI) is crucial to the production processes of the fourth generation. This paves the door for intelligent, self-directed robots. Space companies anticipate a new age of exceptional development because to AI. In the not-too-distant future, robots will be sent into space instead of humans, and this will lead to fascinating new discoveries in space science (Naz, 2019). However, AI will have useful applications beyond only space exploration. Some of the many areas where AI will be used include security, counter-terrorism, surveillance, traffic management, and education. Artificial intelligence will have a profound impact on the banking sector, the airline industry, the medical field, and the classroom. Nanotechnology has also allowed for potentially life-saving treatments for cancer patients (Javeed, 2023).

In the future, students will benefit from smart classrooms rather than conventional ones. While the cost of this technology has increased recently, it is expected to decrease as innovation drives down production costs. In addition, artificial intelligence (AI) and machine learning (ML) courses will become mandatory for tomorrow's students because of their importance to the future of the world. The potential advantages of this technological progress are not free of negative side effects. The entry of robots into society is forecasted to reduce human productivity, according to research. Medical advancements mean individuals will live longer, but as they age, they will become less active and lazy. Those who make smart technological choices to maintain their health will do better in this future. Human life has tremendous value. Because of this, future armies may include robot fighters. This may have a devastating effect on economies like India's, where the military now employs over 20 lakh people.

II. THE FOURTH INDUSTRIAL REVOLUTION AND ITS PRACTICAL APPLICATIONS

A. Automation in India

1) It is believed that the impact of technology on jobs will be more in developing countries as
2) Compare to developed countries. The report says that the percentage of jobs in India and
3) China that have great risk with automation corresponds to 69% and 77% respectively for both
4) countries (Global Perspectives & Solutions, 2016) as compare to USA and OECD countries
5) that have risk of 47% and 57% jobs respectively. According to the report of World Bank, by
6) the end of 2025, working population of India will increase to 70% and could be in great threat
7) because of automation. The main sectors of jobs that will be affected include health care,
8) education, architecture, insurance, journalism, human resource, marketing and management

The "Internet of Things" (IOT) refers to another technical development that enables items to communicate with one another. Combining IoT with AI allows for the development of "smart" products, processes, environments, and infrastructures such as factories, cities, vehicles, and houses (Singh, 2021). If this happens, the quantity of labor needed from people will be reduced by about half. To a similar extent, big data analytics are crucial to Industry 4.0. Its primary goal was to help companies better understand their clientele and provide more personalized services. In today's digital age, information is of paramount importance. Think of the astounding changes that may be made with the right processing of this mountain of data. Due to the consistent quality of the provided services, we won't needlessly waste either time or money. Indeed, Big Data will have far-reaching effects on the organizational framework of governments. This will make things much easier to understand and use. Putting policies into action is difficult for governments. One solution proposed to this challenging issue is the integration of Big Data with AI. No one will be beyond the reach of government help, and everyone will be afforded the same protections under the law. This suggests that Big Data will ensure everyone's future social and economic progress (Mehta & Awasthi, 2019).

B. Data Security in the Age of Industry 4.0

The right to privacy is recognized as a universal human right by the United Nations. Can we guarantee confidentiality when implementing this kind of technology? Are our basic freedoms safe from the onslaught of Industry 4.0? In reality, we're talking about data sets that span millions of terabytes when we talk about Big Data. Personal information is somewhat unimportant in the face of such a massive data set. While this information might be useful, it can also be used to sway the public's opinion and undermine democratic processes. Unsecured, this information might spark civic unrest or even war. Therefore, this is going to be a significant obstacle down the road (Javeed, 2023). The global economy is profoundly affected by the industrial revolution, which fundamentally alters its structure. For instance, the agricultural economy was turned into the industrial economy during the first industrial revolution, the service-based economy was molded during the second industrial revolution, and the knowledge-based economy was established during the information technology revolution. But in this development, if one were to survive, he or she would have to acquire new abilities. For instance, when tractors and electric pumps were first used in agriculture, only the farmers who had adapted their methods to work with the new equipment fared well (Online, 2022).

C. Indian Attempts at Automation

It is expected that underdeveloped nations would be hit harder by technological changes that affect employment than will wealthy nations. The proportion of occupations in India and China at high danger of automation is 69% and 77%, respectively, according to the research, while in the United States and the OECD, those numbers are 47% and 57%, respectively. The World Bank predicts that by 2025, 70% of Indians will be working, putting that country's workforce at serious risk from automation.

Jobs in healthcare, teaching, architecture, insurance, media, human resources, marketing, and management will be most at risk. For automation to be successful, it must be paired with a labor force that is both educated and skilled (Online, 2022).

Technology Advances in Industry 4.0 and Their Monetary Impacts

The COVID phase will have ended, and India's economy will have completely recovered, thanks to the disruptive impacts of Industry 4.0 technology. This will occur by 2025. The use of AI in industry is going to be critical to India's economic revival after the current pandemic. Using cutting-edge technologies like block chain, big data analytics, Internet of Things (IoT), advanced manufacturing, quantum computing, and artificial intelligence, India will be able to carve out a unique niche for itself as an "International nucleus" in the not-too-distant future. There is hope that AI's "digital inclusion" applications in India would spur more growth and development in the country's economy. As early as 2025, AI is projected to add over $500 billion and about 20 million jobs to India's economy. By 2035, this number is projected to rise to $957 billion. The Indian government is also in the midst of building a complete legal framework controlling the nation's data, which will help to facilitate the development of a data-driven society and capitalize on the many benefits it can provide to citizens, communities, and businesses alike. India's AI plan, which combines a large AI workforce and a flourishing startup ecosystem, gives the country a great shot at being an AI industry leader.

III. EFFECTS ON WORKERS AND EMPLOYERS FROM INDUSTRY 4.0 TECHNOLOGIES

Concerning questions like "Will there be any job left for humans?" arise while thinking about the likelihood of constructing artificially intelligent robots. Occupations aren't going away, but they are evolving. While it's true that some jobs might be lost due to Industry 4.0, plenty of others are being created in fields like big data analytics, virtual reality design, blockchain auditing, social media reporting, drone flying, and space tourist guiding. The predictions are that the jobs at either end of the training spectrum will survive, but the middle jobs will be automated away. This phenomenon is known in the economics field as "job polarization." If they want to keep their existing jobs, they need to learn how to use new technologies effectively (How Is Fourth Industrial Revolution Changing Our Economy? 2022).

Researchers at Oxford University have shown that jobs that require manual dexterity, high levels of cognitive ability, and social skills are not readily automatable, indicating that individuals should put a premium on developing these talents. Eventually, AI technologies will replace physicians, but until then, nothing beats a human doctor with excellent interpersonal and caring skills. As a result, it's clear that competence and education will take on more significance in professional life. A builder has to know more than just how to frame a house if he or she wants to design and construct a "smart home" that takes use of automation and sensors (Singh, 2021). Hospitality, empathy, and politeness are all character strengths that may be developed via education (Online, 2022).

The "Gig" economy has been on the rise in recent decades all across the globe. The term "gig" indicates a discontinuity. Temporary, part-time, and freelance jobs, on the other hand, are predicted to grow, while permanent, full-time jobs are predicted to shrink. Without steady employment, it's impossible to get paid vacations or sick days, save for retirement, or secure a comfortable retirement income. It might lead to something like joblessness at first, but I think it will become the norm eventually. Consequently, the revolution's early phases will be difficult, and the world economy is expected to grind to a standstill for a while. Therefore, we must be ready for it. Lack of "reciprocity between technology and skill results in social inequality," as the saying goes. Those who are committed to lifelong learning will prosper in the Fourth Industrial Revolution, while those who are not will be put to the test. In actuality, it is up to you to choose whether or not Industry 4.0 will be beneficial.

IV. THE FUTURE OF INDIA'S ECONOMY: THE IMPACT OF INDUSTRY 4.0

India's economy has been dealing with persistent structural shifts for decades. The new economic policies have helped speed up the structural transformation process, which had been moving at a sluggish rate before. About seven decades ago, agriculture and rural sector dominated India's economy. The transition from an agricultural to an industrial economy has progressed far, although slowly. It has been noted that the new macroeconomic policies implemented in the Indian economy in the 1990s accelerated the pace of structural change and set the stage for the country's rapid economic expansion.

Businesses aren't the only ones embracing AI; whole economies are shifting their focus to developing AI capabilities as a means of spurring development; the developed world is already ahead in this regard, and India, a potential future powerhouse, is about to join them. India seems to be at the pinnacle of Industry 4.0, with its rapid adoption of AI-based technology. As a result, India might benefit from this transition in order to develop its AI capabilities despite the widening of the global digital divide (How Is Fourth Industrial Revolution Changing Our Economy? 2022). Experts predict that, like other technological revolutions (such as the Industrial Revolution and the Information Technology Revolution), AI will create more employment opportunities than it eliminates.

However, it is clear that emerging countries have challenges in the "initial adoption of technology" stage, where limited access to Industry 4.0 might increase wealth disparity (Online, 2022). Furthermore, the transformation stage of adoption is likely to eliminate employment before it creates new ones. Although AI has had a positive impact on GDP and productivity, research has shown that it has had a negative impact on employment. According to McKinsey Global Institute, by 2030, intelligent mechanisms and robots might replace as much as 30 percent of human work throughout the world. Although new technologies have shown to be valuable in the long run, the short-term failures cannot be justified, and the growth in unemployment might make this transition much more challenging. Despite its growing rates of entrepreneurship, powerful enterprises, and a talented pool, India is lagging behind on key measures of AI development. Therefore, a holistic strategy, creative regional responses, and centrally crafted policies should be proposed to improve crucial AI metrics. Directing AI to provide fair growth will also need a greater role for government and the private sector to play together. The "digital revolution" couldn't continue without sustained innovation and cooperation by Public-Private Participation (PPP) to bring down the price of contemporary technology that can assist more people. However, it is crucial for the Indian economy that India prioritizes the improvement of its "hardware sector" to assist address bottlenecks.

V. CONSTRUCTION 4.0: HOW THE INDUSTRY 4.0 FRAMEWORK AFFECTED ITS DEVELOPMENT

As long as construction's slow acceptance of technology and lack of innovative procedures persist, the chasm between the two industries will widen. Smarter resources are desperately needed in modern building, but the field of smart construction is just getting started. The construction industry must embrace digitalization if it is to be transformed and its productivity improved. One area where manufacturing has historically outpaced other industries in terms of productivity growth is in comparison to construction (Singh, 2021). However, the construction sector can be viewed as a sub-business of manufacturing due to the emerging concept of industrialization of construction (Naz, 2019). According to a study cited in, cyber-physical systems enable all stakeholders to collaborate along the entire value chain for the communication and functioning of humans and machines via the Internet of Things, and to control processes and make decentralized decisions through a virtual copy of the physical integrated smart factories. This is akin to the "smart factory" described by Hermann et al. Once BIM and IoT are combined, a cyber-physical system is produced. Information from cyber-physical systems can flow in both directions, allowing for real-time monitoring of asset performance and early warning of any potential issues in the physical environment, as well as the provision and sharing of internal and inter-organizational services across the full value chain. By combining components of Industry 4.0 with those of the construction industry, improvements can be made to the supply chain, the management of physical processes through the development of virtual models, and the decentralization of decision-making (Industry 4.0 and Its Consequences, 2019).

VI. ACCELERATING INDUSTRY 4.0 WITH GOVERNMENT PROGRAMS

To begin using AI for the economic transformation of the country, the Ministry of Commerce and Industry has formed an AI Taskforce. However, broad use of AI is in its early stages. Therefore, it is suggested that India establish an "Industry 4.0 Ministry" to supervise all technologically advanced policies and initiatives. The United Arab Emirates was the pioneer in creating a cabinet-level position dedicated to artificial intelligence in 2017. Governments throughout the globe are now taking action to join the AI-led digital economy, which is predicted to contribute more than $15.7 trillion to the global economy by 2030. Given the present state of affairs, India is poised to take advantage of a fantastic opportunity for economic development and rising living standards. It's possible that India's "inclusive economic growth" would make the nation a great place to pilot new technologies (Naz, 2019). In order to do this, the federal government should allocate a larger portion of its annual budget to research and development and push for the establishment of R&D centers at universities around the country. The effect of GPTs on a country's economy and society may be profound, and India may be able to have significant worldwide influence in this area (Industry 4.0 and Its Consequences, 2019).

VII. CONCLUSION

India has 1.32 billion people living in it, and its wealth is undeniably vast. The changing nature of India's environment, however, means the country must alter its traditional approach to problem solving. As we have discussed, the world is on the cusp of experiencing the fourth industrial revolution, which will undoubtedly bring forth several opportunities. Industry 4.0 gives them a leg up in production, and it allows them to set up mass customization. It is very difficult to cope with the practice, but if actors in the system implement the proper modifications, the effects will be amplified. So it's easy to say that businesses in the public and private sectors stand to gain the most from industry 4.0 initiatives. On the flip side, there are a plethora of benefits that industry 4.0 will bring to India, including development, effective globalization, optimal asset utilization, seamless human and robot interaction, efficient energy utilization, autonomous controlling, greater adaptability, and so on.

But the repercussions will be visible in things like labor market participation, the elimination of low-skilled occupations as a result of automation, the increased unemployment of the unskilled, and so on. Therefore, by adopting Industry 4.0, we will gain a significant economic advantage over our global rivals.

By 2030, India is projected to have the youngest population in the world, which would result in the nation providing roughly 30 percent of the world's workforce. Thus, AI in this context may significantly increase the productivity of the typical worker to the level of the best performers of today. In addition to thinking about the ethics and security of Industry 4.0, there is a need to foster a "scientific temperament" regarding modern technology among the citizens of the nation. In this light, the Indian government's "National strategy for AI" has proposed setting up ethics committees to address privacy, security, and ethical issues unique to certain industries. The Sustainable Development Goals (SDGs) are a major impetus for India's economy, and they may be attained with the support of Industry 4.0. With the advent of Industry 4.0, the Indian economy and society will undergo a dramatic transformation, bringing the country closer to its ambitious goal of being a $5 trillion economy by 2025.

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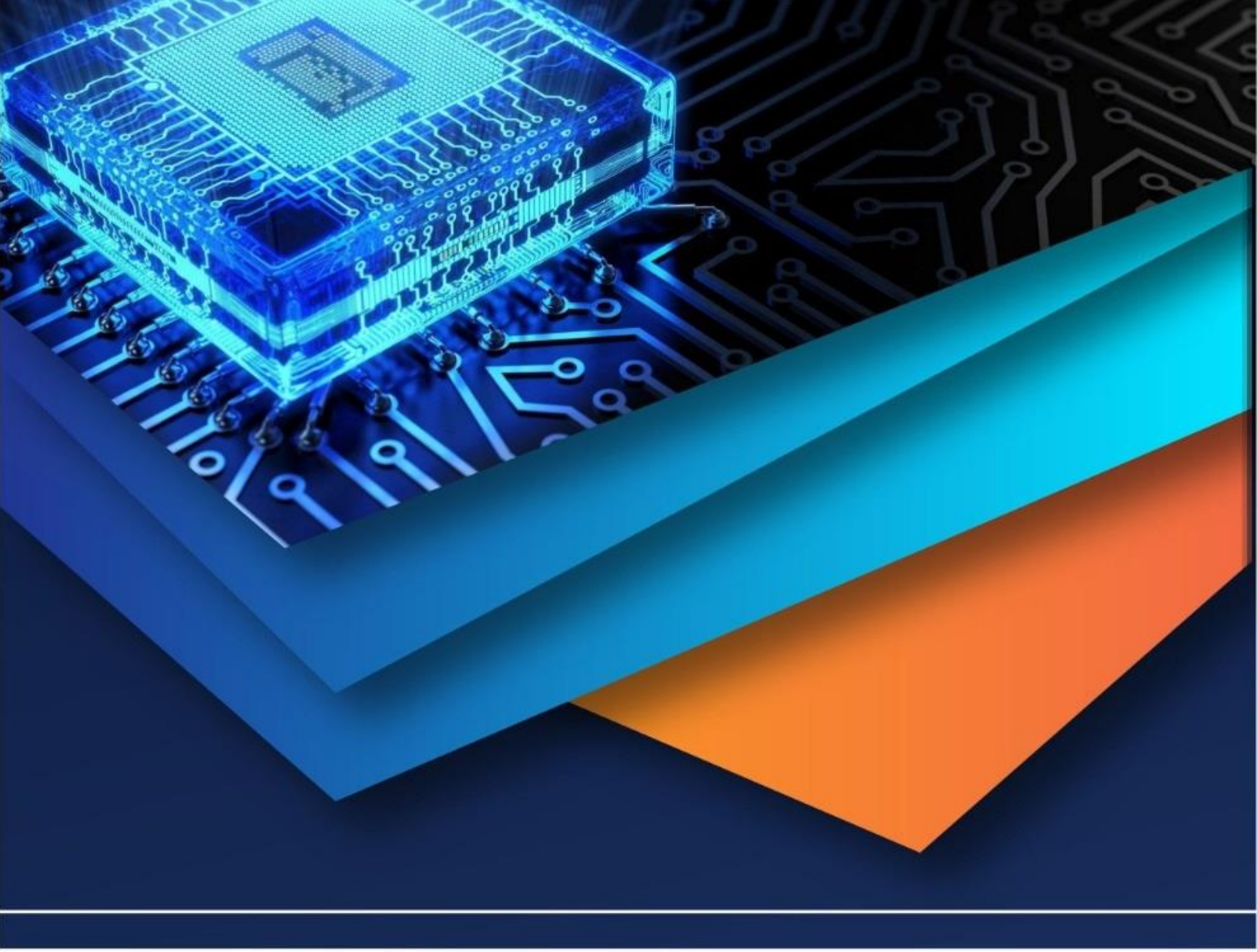

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