

INDUSTRIAL REVOLUTION 5.0: THE TRANSFORMATION OF THE MODERN MANUFACTURING PROCESS TO ENABLE MAN AND MACHINE TO WORK HAND IN HAND

Dr. A. SHAJI GEORGE ¹, A. S. HOVAN GEORGE ²

1, Independent Writer and Researcher, Masters IT Solutions, Chennai -600 057, Tamil Nadu, India

2, Masters IT Solutions, Chennai -600 057, Tamil Nadu, India

E-mail: [1drashajigeorge@gmail.com](mailto:¹drashajigeorge@gmail.com)

ABSTRACT

The Fifth Industrial Revolution (IR5.0) will see the transformation of the manufacturing sector that can ignite the industrial revolution. IR 5.0 should ideally be the evolution of the modern manufacturing process in order to allow man and machine to perform work hand-in-hand, combining the unique, cognitive abilities of workers and the accurate, technical expertise of robots to bring in an innovative culture into the workforce. The fifth-generation industry brings customer satisfaction and opens a new market. IR 5.0 is going to be distinguished by the collaboration between machines and human beings, with the ultimate objective to provide additional value to production, by creating customized products able to satisfy consumers' requirements. And in IR 5.0 the advent of an experience-driven manufacturing economy is focused on providing satisfying customer experiences. This article presents the idea of Industry 5.0, where robots are interconnected with the human brain as well as work as partners rather than competitors. This research paper also defines a number of important features and concerns that each and every manufacturer might have concerning Industry 5.0. Additionally, it represents several advancements achieved by researchers for usage in the IR 5.0 applications as well as environments. The following research paper aims at defining the way the alterations in the manufacturing Industry can be progressively explained and to assess the impact of the implementation of IR 5.0 on the Manufacturing industry. This paper summarizes several significant features of IR 5.0 and the history which led to the 5th IR. Moreover, the study also assesses its impact on the Manufacturing production sector and the new employment market of IR 5.0. Ultimately, the effect of IR 5.0 on the manufacturing industry and the overall economy is being discussed from an economic and productivity perspective.

Keywords: Fifth Industrial Revolution, Artificial Intelligence, Internet of Things(IOT), Manufacturing Industry, Employment Market, Robotic, Cobots, Collaborative Robot, Industry 5.0.

INTRODUCTION

IR 5.0 is going to continue to concentrate more on an innovative human-machine interface as well as not replacing human workers. It brings together the best aspects of both worlds, humans, and machines working alongside each other for increased productivity. IR 5.0 is going to re-introduce the human aspect of manufacturing. As IR 4.0 is primarily focused on technology, robots as well as interconnected systems, IR 5.0 looks at people who are working together with factory systems. Human intelligence will work together with cognitive computing to generate more value-added goods. Industry 5.0 will enable customers the opportunity to personalize their order. A straightforward example is how clients will be able to choose precisely the kind of shoes or clothing they desire. Which includes selecting their very own colors, style, or material prior to when it even reaches production. IR 5.0 will merge the accuracy and pace of Industrial Automation through the critical thinking of human workers. Hence, technology is not a replacement for the people but instead improves their role in manufacturing. IR 5.0 examines how humans and robots will be able to complement each other's unique strengths. In Industry 5.0 collaborative systems (Cobots) will be held accountable for routine tasks like drilling or data mining whilst employees will take on higher-level tasks. They are going to administer and supervise such systems and then make real-time decisions searching for opportunities to improve quality and manufacturing processes. IR 5.0 will bring back the human factor into manufacturing, which means advanced technologies will provide clients the sort of value-added, human-created products that they want. Hence, employees are going to get more significant, useful, and rewarding jobs as a result. IR 5.0 must ideally be the transformation of the modern manufacturing process in order to enable man and machine to carry out work hand-in-hand, merging the unique, cognitive abilities of employees and the exact, technical skill of robots to bring about an innovative culture in the workforce. In such a context, the research paper has tried to discuss IR 5.0 and its impact on the manufacturing sector and how humans and robots will be working together. Furthermore, Legal, psychological, regulatory, and social factors are among the main issues. Whilst shifting the role of human resources as well as information technology

departments, various personal choices toward working together with robots, kinds of robots selected to work with, to learn how to work with robots, competing or collaborating with robots. Ultimately, one thing is very evident that the Industrial revolution 5.0 is going to be very technology intensive.

OBJECTIVES OF THE STUDY:

In recent times, technological innovations and technological development plays a significant role in every organization. Nonetheless, the advancement in digital transformation and increasing mutual connections represent new challenges to the organizations since the Industrial revolution drastically changes products and manufacturing systems regarding the design, operations, processes, as well as services. The main objective of the research paper is to talk about IR 5.0 and the anticipated changes in the manufacturing Industry due to Industry Revolution 5.0. The fifth industrial revolution is going to re-shape the world's economy. It will be based on the amalgamation of a wide range of technologies. This study aims to discover the information communicated in preliminary media and publication coverage of Industry 5.0. The ongoing research will be based on the following objectives.

- To brief about the Industrial revolution 5.0.
- To study how IR 5.0 Refocuses to humanity and modifies our working approach.
- To Analyse why IR 5.0 will not lead to the replacement of workers in automation.
- To Visualize the employment opportunities for creative thinkers and AI specialists.
- To find out the new roles in manufacturing companies because of IR 5.0.
- To assess how IR 5.0 brings customer satisfaction and opens a new market.
- To point out the major Environmental benefits of IR 5.0.
- To envisage the advantages of IR 5.0 such as cost optimization, customization, and Innovation.
- To Analyse how IR 5.0 will make companies adaptable, sustainable, and competitive.
- Visualize the advent of an experience-driven manufacturing economy focused on providing satisfying customer experiences.
- To study the foundation for future-focused traffic concepts in smart cities for autonomous vehicles in IR 5.0.

- To assess the emergence of robotics department and the shifting role of the IT department due to IR 5.0
- To visualize how the rise of industry 5.0 will rename Human Resources Department (HRD) as Worker Resources Department (WRD)
- To analyze the need for defining the legal framework of laws and regulations pertaining to autonomous robots (cobots)

METHODOLOGY:

This research paper mainly uses secondary data. The relevant information that is used for the study was solely based on secondary sources from various publications. The appropriate sources of information gathered are from published sources like books, reports, journals, magazines, publications, as well as the website of several online journals, etc. The majority of articles assessed for this research have been collected utilizing Online Newspapers, Blog databases, and Articles. The key terms used to search for suitable articles included “Industry 5.0” in the headline and “Industrial Revolution” in every text.

HISTORY OF INDUSTRIAL REVOLUTION

For many centuries, goods such as clothing, food, houses, and weapons were produced either manually or with the assistance of work animals. By the start of the 18th century, the production process started to change significantly through the introduction of IR1.0, and the operations quickly developed from that point. The following is an overview of that evolution.

First Industrial Revolution (IR1.0): Mechanical production

The IR1.0 started in the 18th century by the use of steam power as well as mechanization of production. Whatever manufactured threads on straightforward spinning wheels, the mechanized version attained eight-times the quantity in the same period. Steam-power was already well known. The usage of it for industrial use was the biggest breakthrough for improving human productivity. Rather than weaving looms driven by muscle, steam-engines can be used for electricity. Advancements like the steamship or the steam-powered locomotive brought about

additional huge changes due to the fact that humans and goods can move long distances in fewer hours.

Second Industrial Revolution (IR2.0): Mass production

By the start of the 19th century, electricity had become the main source of power. It was a lot easier to use than water as well as steam and allowed businesses to focus power supply to specific machines. Ultimately machines were conceived with their very own power sources, which made them more transportable. This time period additionally witnessed the growth of many management programs which made it possible to improve the performance and efficiency of the production facilities. Division of labor, where every worker performs a part of the overall job, increasing productivity. Mass manufacturing of goods utilizing assembly lines had become common. Frederick Taylor, an American mechanical engineer pioneered methods of studying jobs to further optimize workers as well as workplace methods. Finally, quick and lean production principles additionally polished the manner in which manufacturing companies can enhance their quality as well as output.

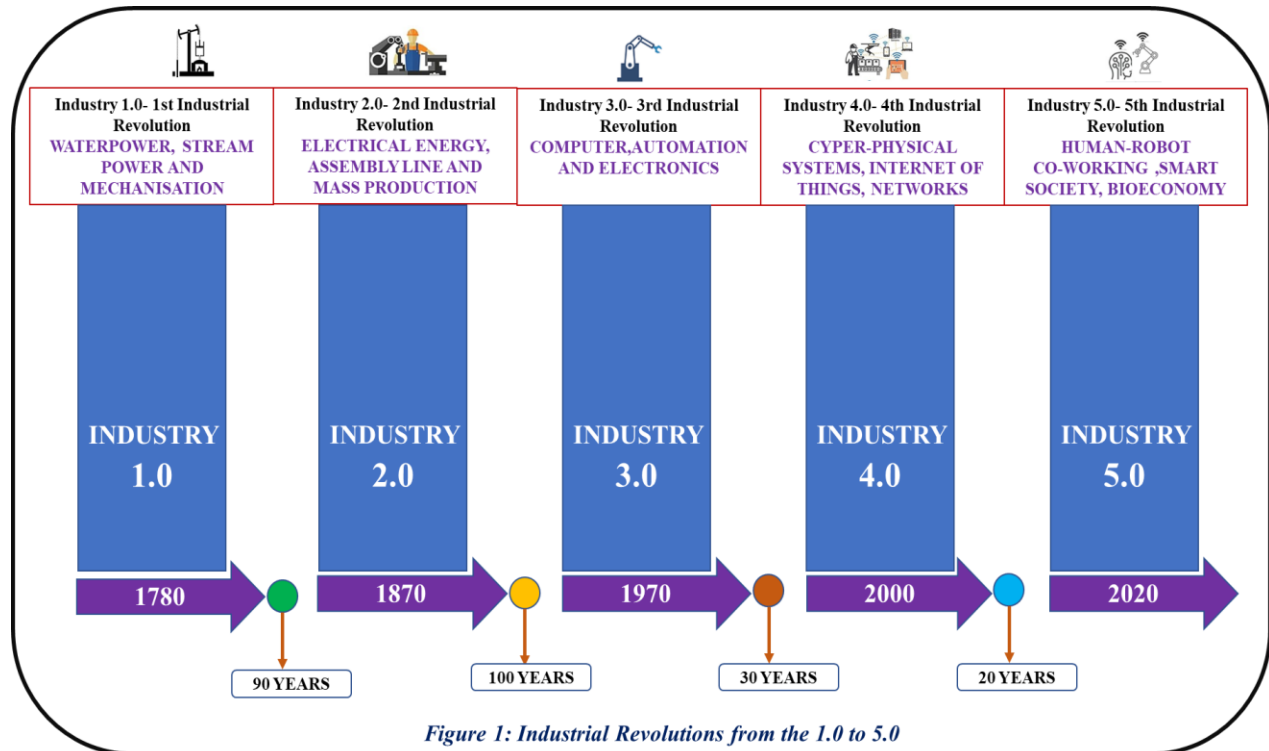
Third Industrial Revolution (IR3.0): Automated production

IR3.0 had taken place in the midst of the 20th century owing to the introduction of electronics as well as computer technologies. They permitted the implementation of manufacturing automation in factories as well. Such technologies are substitution and relief for employees in the most challenging tasks. During this time period, robotics as well as mass production had also been introduced.

Fourth Industrial Revolution (IR4.0): Digital Transformation

IR4.0 is distinguished through the application of information and communications technology to industries and is also known as "IR 4.0". It is based on the advancements of IR 3.0. Manufacturing systems that already have computer technology are being expanded by network connectivity and are equipped with a digital twin over the internet so to say. This will allow communication with other facilities as well as the output of information regarding themselves. The networking of all the systems is leading to cyber-physical production systems. Therefore, smart factories, where production systems, components, and individuals communicate through a network and manufacturing is almost independent.

INDUSTRIAL REVOLUTIONS FROM 1.0 TO 5.0



Fifth Industrial Revolution (IR5.0):

While the previous revolution highlights the transformation of manufacturing plants into IoT-enabled smart facilities that use cognitive computing and interconnect through cloud servers, IR 5.0 will be set to concentrate on the return of human hands as well as minds incorporated in the industrial framework. IR 5.0 is a revolution where man and machine reunite and discover ways to work together in order to enhance the resources and effectiveness of production.

INTRODUCTION TO INDUSTRIAL REVOLUTION 5.0

Industry Revolution 5.0 is concentrated on the interaction between humans and machines. We are already beginning to view this as humans working together with machines and are linked to intelligent manufacturing plants through devices, the IR 5.0 is expected to resume the push toward more technologically advanced human-machine interfaces. This is going to improve

integration, thus enabling faster, superior automation coupled with the power of human intelligence. It also means that robots will not take over manufacturing plants at some point soon. Furthermore, the transition from IR 4.0 to IR 5.0 involves greater focus on human manufacturers. Additionally, this shift which brings together the best of both the human as well as machine domains, will probably also result in improved efficiency.

IR 5.0 implies people working together with robots and intelligent machines. It is about robots assisting humans work better and more quickly by utilizing advanced technologies such as the internet of Things (IoT) as well as big data. It will add a human touch in accordance with the IR 4.0 pillars of automation and productivity. In production environments, robots have historically worked dangerous, repetitive or physically laborious work, like welding and painting in automobile manufacturing plants and loading or unloading heavy materials in the warehouses. Since machines at the workplace come to be more intelligent and much more connected, IR 5.0 is targeted at combining those cognitive computing abilities with human cleverness and ingenuity in collaborative processes.

In IR 5.0, industrial robots that will be working safely and efficiently alongside humans. While industrial robots have been traditionally operated independently from employees and behind safety cages. The collaboration of human and machine workers opens the door for numerous opportunities in the manufacturing industry. Since the used cases of IR 5.0 are currently still in its relative formative years, manufacturers must be actively organizing ways to incorporate human and machine workers with a view to maximizing the unique advantages that can be gained as this movement continues to develop.

THE LAUNCH OF COLLABORATIVE ROBOTS (COBOTS) IN IR 5.0

The official definition of a cobot is a robot designed to physically interact with people in a shared workplace. Cobots are distinct from industrial robots which are designed to operate independently and with no human involvement. Cobots are equipped with integrated sensors with advanced features and make it possible to automate sensitive product assemblies. Working together with human coworkers greatly improves processes and efficiency, assisting them to finish their work. Not just that, cobots improve human-based workmanship by improving

accuracy, speed, precision, and output. Finely crafted goods along with human collaboration certainly attract attention and cobots will be able to assist in making that happen much more quickly and in larger quantities. Despite the fact that industrial robots may cause serious injuries to humans, cobots are specifically designed with safety in mind. If sudden contact is made with a person, cobots may be able to reduce their speed generating less energy to such an extent that helps prevent injury.

INDUSTRIAL REVOLUTION 5.0: A REVOLUTION WITH A HUMAN TOUCH

The notion of humans and machines working together can be possible once we divide the manufacturing production line into two sections: a) Utilizing humans for customization and creative thinking. b) Using robots for monotonous and laborious work.

Japan describes Industry 5.0 as '**SOCIETY 5.0**', a **HUMAN TOUCH** revolution: A human-centered society which balance out economic development with the resolution of social issues through a system that highly incorporates cyberspace as well as physical space. A phenomenon that envisions a forward-looking society as well as without any information stagnation. Hence, digitalization will not make humans in industrial manufacturing obsolete. On the Other Hand, it will integrate smart automation, systems, and devices in the workplace to promote co-operation and collaboration among people and machines. It would contribute highly skilled employees to help guide smart machines as well as robots to function better and faster along with collaborative bots or cobots.

Industry 5.0 will solve the need for personalization as well as mass customization of products for clients. It would encourage and then apply human intelligence and thinking processes in computers in a process called cognitive computing. The cobots of the smart factories will also be intelligent enough to comprehend the human operator's demands, determine whether they want assistance, and assist them appropriately. Additionally, it would be beneficial for the workforce in two different ways: a) upskilling and b) offering value-added assignments in production. It will also bring together intelligent systems to the current workflows in order to improve leverage human ingenuity and brainpower and enhance operational effectiveness. Consequently, the

emphasis on the factories is going to be less on mass production, automation, and digitalization, which have been the core components of Industry 4.0.

IR 5.0 REFOCUSES TO HUMANITY AND MODIFIES OUR WORKING APPROACH

The Fifth industrial revolution (Industry 5.0 or 5IR) places more importance on human intelligence than yet before. Although Industrial Revolution 5.0 is going to take away dull and tedious tasks, it opens the way for curiosity, empathy, creativity, as well as judgment guaranteeing a balance among humans and technology. It alters the approach to work, nearly all of us no longer wish to work at 8-5 jobs. The manner in which we work is radically changing. Since our inclinations in the job, as well as timings, change, companies are compelled to change as well. Certainly, the Industrial Revolution 5.0 will alter this much further. New workers will no longer need to read a stack of papers or sit through meetings to obtain all the current and precise information. This is going to mean that you will be able to involve them quite easily without needing to invest a great deal in education and training. Industrial Revolution 5.0 is going to help companies get the most out of the available resources assisting management teams to concentrate on more strategic assignments. The 5IR is Exactly What We Need, In Industrial Revolution 5.0, technology is going to serve humanity, marked by innovation and a common objective. Industrial Revolution 5.0 will empower us with the opportunity to close up the historic gap and build a new socio-economic period.

THE IR 5.0 WILL NOT LEAD TO THE REPLACEMENT OF WORKERS IN AUTOMATON

Production workers may rest reassured, automated systems will not substitute them. At least for the time being. The most apparent result is that IR5.0 provides cooperation between workers as well as automation, there will be no substitution of workers. It is regarding applying technologies in order to speed up the human performance, that will free up the worker to devote more time on high-value assignments like strategic planning. Companies will value innovation, creativity, as well as insight for logical components over the procedure and routine for the mechanical components. Professionals with critical thinking abilities are going to be in demand.

The main concept of this trend of industrial evolution is using technologies in order to not replace humans but to hasten their performance. Although with the enormous technological up growth, there remains a risk combining these limits between logical as well as mechanical components, due to the fact that AI will be very intelligent. As a supplement to the mechanical one, it is always prepared to take on the human logical part performing under the cover of greater productivity as well as quality. To accomplish cooperation in the workspace, IR 5.0 is utilizing cobots (collaborative robots). Working in together with humans, cobots can be fitted with connective sensor technology like Artificial Intelligence, lidar/radar, and GPS to execute sophisticated but repetitive tasks, giving the complex, sensitive tasks to the human workers. In the case of safety, working in a similar workspace with humans, cobots may also be a literal right hand while at the same time ensuring process safety.

INDUSTRY 5.0: AN EMPLOYMENT OPPORTUNITY FOR CREATIVE THINKERS AND AI SPECIALISTS

IR 5.0 is being advertised as taking it one step further and enhancing the collaboration between humans and machines. We shall see greater cooperation between the two, the superfast accuracy of automated technology works in conjunction with a person's critical thinking abilities and creativity. The concept is that IR 5.0 produces even greater-value employment than IR 4.0, due to the fact that humans have been taking back planning responsibility, or the work which involves creative thinking. However, it was never taken away, Artificial Intelligence simulates human intelligence, that is handled by machines and mainly computer systems. The technology is primarily used for managing the more conventional, monotonous tasks, although that is changing, with machines that are able to make suggestions that humans are able to trust. The truth is that, creativity is difficult to automate, AI is able to assist humans in such a way as to accelerate their creativity, however, that makes Artificial Intelligence a tool instead of a collaborator in the sense that IR 5.0 indicates.

THE INDUSTRIAL REVOLUTION 5.0 WILL CREATE A NEW ROLE IN MANUFACTURING COMPANIES

By this emphasis coming back to humans, IR 5.0 might also need a new manufacturing position, the **Chief Robotics Officer (CRO)**. Such a position is going to require an expert that specializes

in human-machine connectivity and will be responsible for all things related to technology, beginning with decision-making on which machines or appliances are to be added to the factory floor to improve approaches for enhancing the production line. These changes depend on how the individual is ready to embrace IR 5.0 and how fast they choose to adopt and apply the technologies required to bring the next Industrial Revolution to the factory floor.

THE EMERGENCE OF ROBOTICS DEPARTMENT AND THE SHIFTING ROLE OF IT DEPARTMENT DUE TO IR 5.0

As the usage of technology is increasingly becoming unavoidable for companies, the significance of information technology (IT) departments will rise. To achieve the dream of human-robot collaborating organizations will have to find a way to obtain and sustain the robots. At the start, this job is going to be likely allocated to its departments. Later, companies can create robotics departments accountable for acquiring and maintaining the robots within an organization. When robots take up vital responsibilities, robot maintenances and enhancements should be carried out in a safe and secure way. The information assurance of robots will be vital. Getting information acquired by robots is going to be a challenge and even more complex than securing existing organizational IT infrastructures. Humans and robots collaborating will most likely make it more difficult for ensuring information as well as safeguarding confidentiality at work. This will be a significant research topic for information security researchers.

THE RISE OF INDUSTRY 5.0 WILL RENAME HUMAN RESOURCES DEPARTMENT (HRD) AS WORKER RESOURCES DEPARTMENT (WRD)

Organizing work assessments, creating job descriptions, as well as filling the jobs with people that have the correct credentials are amongst the essential duties of human resources departments. Excluding industries using industrial robots, an overwhelming majority of organizations presently employ humans for the job. When robots come to be a part of organizations, HRD will have to face new challenges. Additionally, along with their existing responsibilities, they shall also have to identify the positions to be processed by robots. They are going to decide the jobs to provide to robots. The significance and responsibilities of HRD will rise. Ultimately, HRD will develop and they might even be named as Worker Resources

Department (WRD). Presently, there are businesses and companies marketing themselves as green. They say they are sensitive to the natural environment. The green companies and organizations attempt to behave responsibly toward the environment even if these initiatives increase costs. In the foreseeable future, there might be companies that claim to be human. Such organizations will only employ humans even if being a human organization increases costs on the assumption that employing robots turn out to be a less expensive option. Such human organizations will argue that they are acting socially accountable toward human beings and they are creating jobs for humans. HRD will be required to repeat most of the work they have done taking into account robots prior to incorporating robots into their respective organizations. In the future, the collaboration of robots and humans will lead to the renaming of the human resources department(HRD) to the worker resources department(WRD).

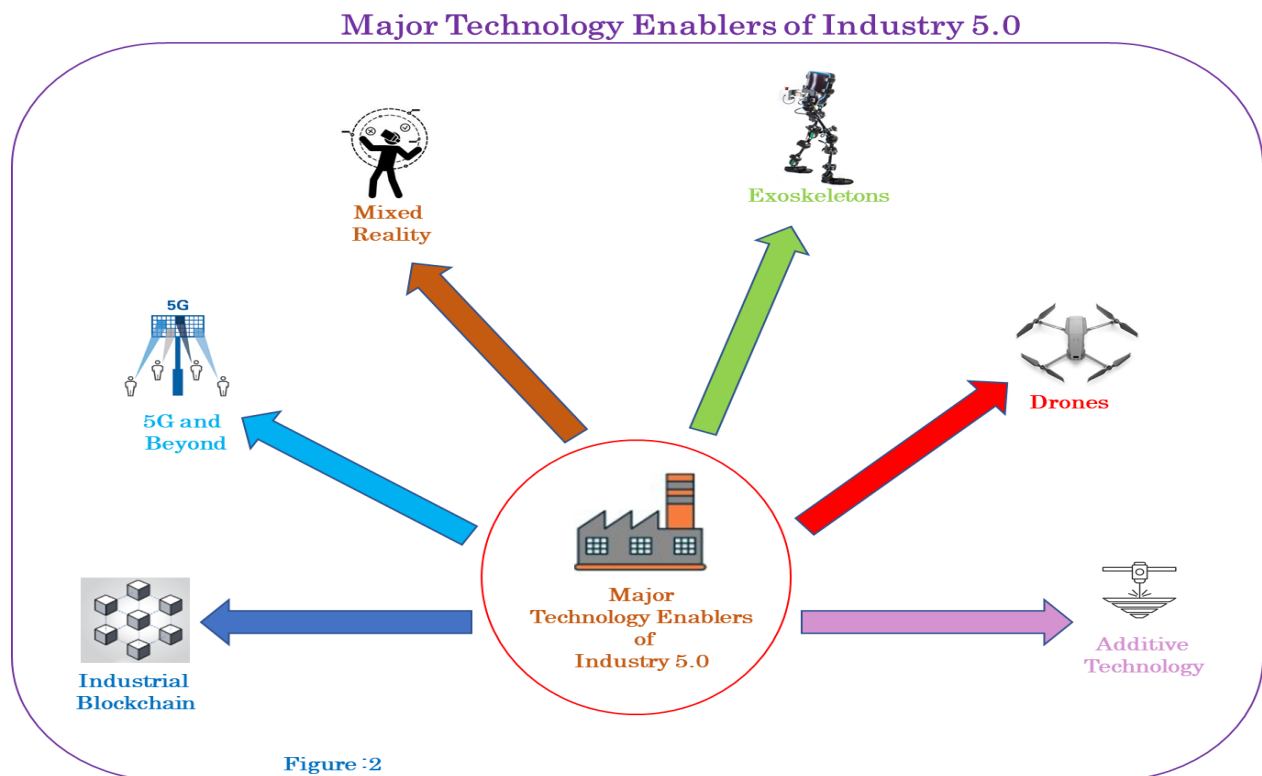
THE FIFTH GENERATION INDUSTRY BRINGS CUSTOMER SATISFACTION AND OPENS NEWMARKET

Industrial Revolution 5.0 will combine the innovation and creativity of the human intellect with sophisticated, digitized, and modern industrial processes. The present market situation, via the feedback system, indicates that human creativity will not be able to be removed, on the other hand, it is necessary to restrict the human factor in order to reduce the possibility of incidence of unnecessary mistakes and losses. A mutual entity, that will bring together the human mind as well as the highest standard of the digital process, shall represent industrial revolution 5.0. Industry 5.0 will bring about a higher level of personalization to the end products, which makes the end client feel more satisfied. Consumer satisfaction, as one of the key factors of industry growth, ensures the positioning of products, and opens up new markets for product positioning.

IR5.0: THE ADVENT OF AN EXPERIENCE DRIVEN MANUFACTURING ECONOMY FOCUSED ON PROVIDING SATISFYING CUSTOMER EXPERIENCES.

Industrial Revolution 5.0 that will bring back empowered humans to the forefront. At the core of this idea are new business situations facilitated by advanced technology themes, concentrating on providing individually customized customer experiences. The individual description of products, solutions, and services is going to merge into one and produce Industry 5.0 which is

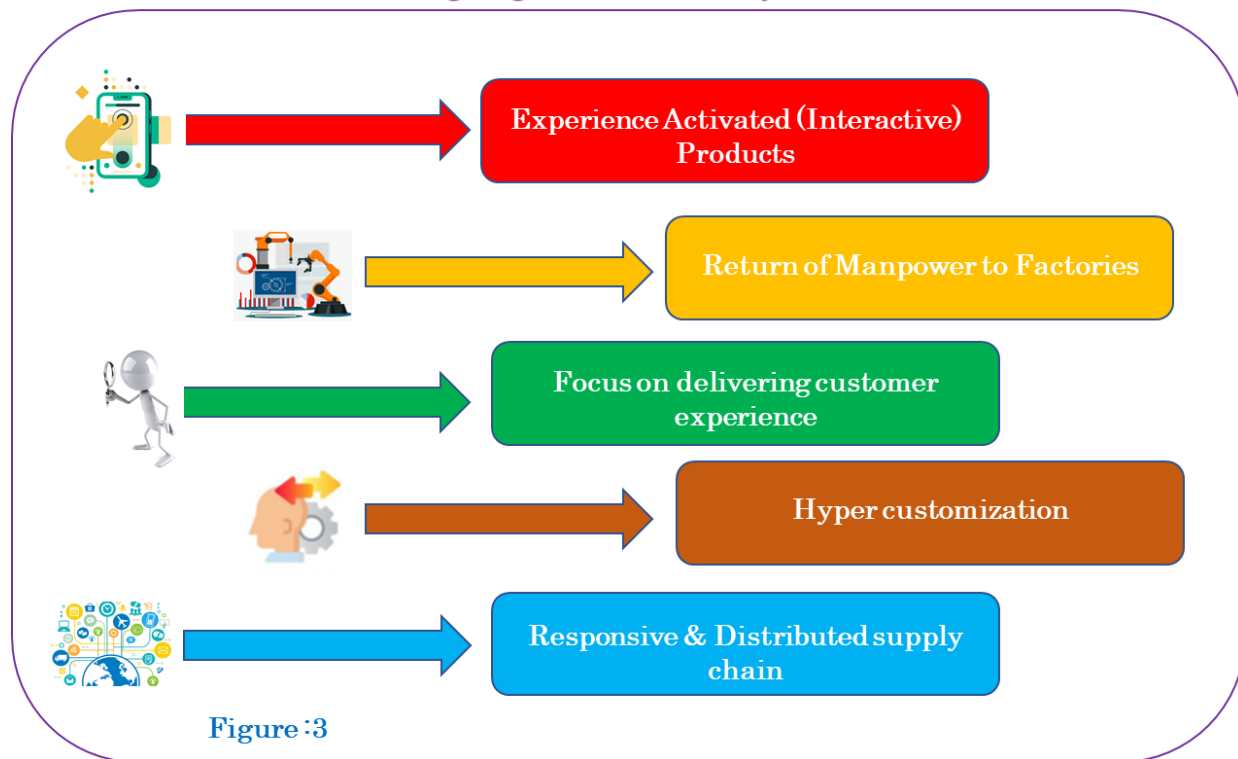
the era of experience. In IR 5.0, client aspirations are going to drive the market interests in the direction of hyper customization. Every single product is going to be specific to its planned customer and manufactured appropriately. To cater to the trend of batch size one, producers will have big, robotic intelligent factories placed throughout the world to produce the fundamental design of the particular product in large quantities. The fundamental, semi completed material will subsequently be sent to the local factories, in which the final phase of the product will be finished using manual labour.



This manner of allocated distribution chain combined with the gig economy is going to modify the existing nature of jobs, as well as industries will be able to experience it directly. Moreover, the flood of data is going to create new employment opportunities that are linked to data monitoring and management, employment roles on the factory floor are going to develop and incorporate multiple ability sets into one. Responsibilities such as machine maintenance and quality-assurance will combine into plant operations and turn into one job. This is going to require workers to be taught in various and varied job roles.

Furthermore, IR 5.0 will allow daily products in order to understand and react to the end user's needs through edge intelligence. In IR 4.0, products have been enabled simply to gather usage data, track usage patterns as well as communicate it to the observer although given limited actionable intelligence constructed into them. Backed by quick connectivity, IR 5.0 products are able to enhance their effectiveness and deliver the highest efficiency available in the whole lifetime of the product.

Highlights of Industry 5.0



IR 5.0 is a template of the next stage of industrialization exemplified by the comeback of manpower to factories, intelligent supply chains, distributed manufacturing, as well as hyper customization, everything designed to provide a customized customer experience time and time again.

INDUSTRY 5.0 IS THE FOUNDATION FOR FUTURE-FOCUSED TRAFFIC CONCEPTS IN SMART CITIES FOR AUTONOMOUS VEHICLES

Urban developers, citizen initiatives, Environmental researchers, and several local legislators, agree that traffic in and around towns need to change. Changing traffic patterns remains the only way, the crumbling of the city's infrastructure must be prevented if our cities continue to be worth residing in. For a long period, the subject of city traffic jams had been kept flat or yet accepted. However, the latest developments demonstrate that a change is urgently required.

INDUSTRY 5.0 : FUTURE-FOCUSED TRAFFIC CONCEPTS IN SMART CITIES FOR AUTONOMOUS VEHICLES

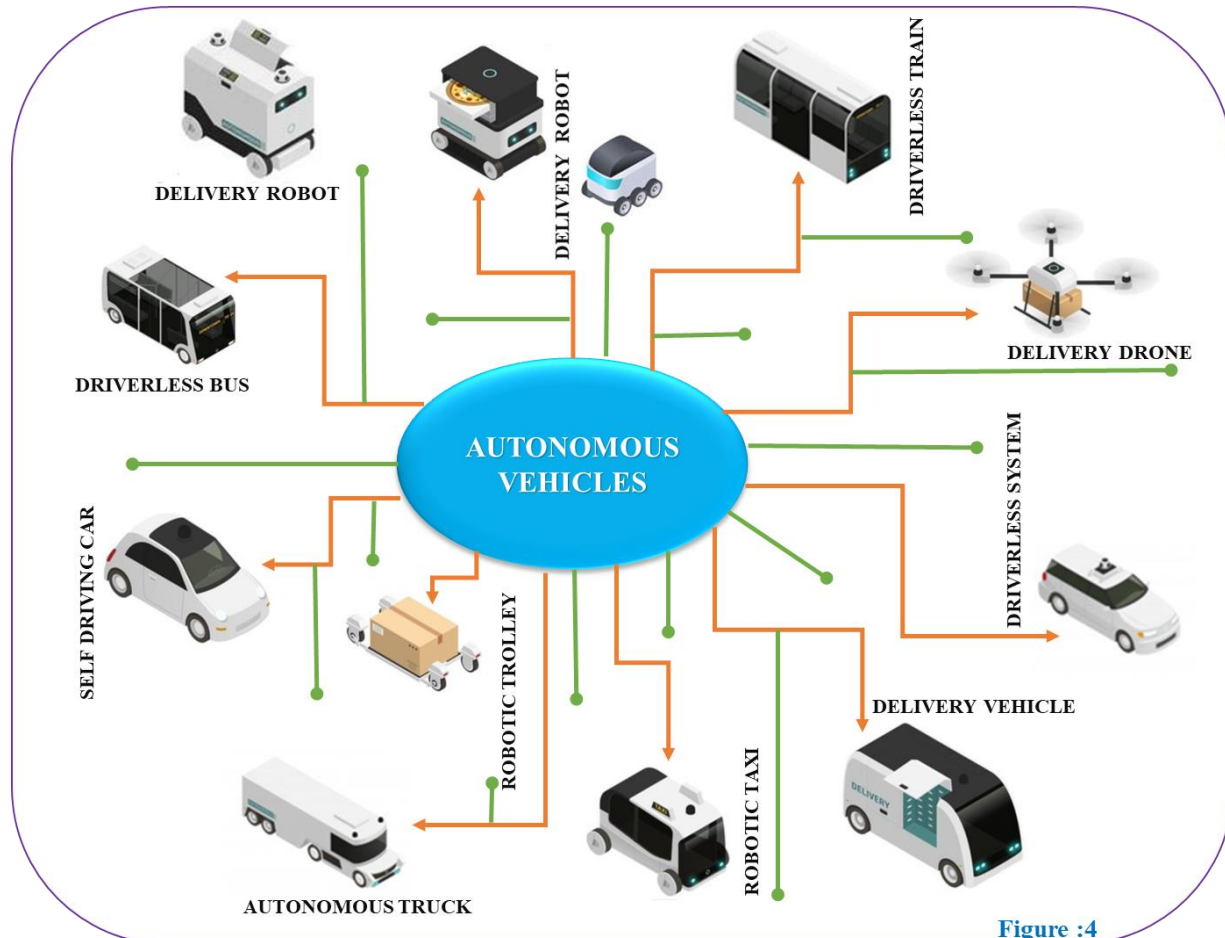


Figure :4

Various forms of transportation and mobility need to be combined to allow for comfortable and traffic congestion-free progress whilst benefiting the environment. Embedded computing is an important engine for every application that modern traffic needs. Comprehensive solutions allow intelligent data transmission between different vehicle types. At the same moment, they facilitate road traffic planning and control. Additional building block for future-focused traffic concepts is wireless communication, as the (5G)mobile communications standard. IR5.0 is going to help to

combine different capabilities to generate smart solutions. Specialists agree that only the mix of different components is going to help to satisfy the requirements of future traffic.

Study into technologies that allow an infrastructure through which traffic has been optimized in smart towns and cities is well underway worldwide. Under these circumstances, the phrase industry 5.0 is appearing ever more frequently. Still, there is no universally accepted definition of the term. Nevertheless, it is clear that bundling the skills of people, machines, and software is vital and pledges new opportunities towards the development of autonomous vehicles. This combination of several technology methods like Advanced Internet of Things, Software Defined Trains, Deep Learning, Mobility as a Service, Big Data, and a lot more will also contribute. The growth of Autonomous Vehicles has currently picked up speed. Almost all major auto manufacturers around the world are working on solutions. Furthermore, there remain prototypes that can also be used in regional public transport, the so called Robocabs.

INDUSTRY 5.0 WILL MAKE COMPANIES ADAPTABLE, SUSTAINABLE AND COMPETITIVE

The modifications set up by IR 5.0 remain permanent. This process gives companies the skills of progressively more powerful machines in tandem with skilled experts to develop an efficient, viable, safe, and secure production. IR 5.0 is not considered to be a trend, It is instead a new method of identifying manufacturing that has productive, financial, and commercial repercussions. Hence, companies that do not adapt their manufacturing to the Industry 5.0 model will quickly become outdated, not being able to benefit from the competitive benefits that it can offer. Not just that, the pace of technological acceleration is becoming faster and demonstrates that the advent of new models never ends. So, adapting the processes of every company and turning them into the idea of the digital industry will be essential in ensuring that organizations stay competitive.

MAJOR BENEFITS OF INDUSTRY 5.0 ARE ENVIRONMENTAL FRIENDLINESS (GREENER SOLUTIONS), COST OPTIMIZATION, CUSTOMIZATION AND INNOVATION

ENVIRONMENTAL FRIENDLINESS: Industrial transformations have not concentrated on the conservation of the environment as a top priority. With IR 5.0, new corporate technology, sensitivities are altering this trend. This has resulted in the advent of environmental policies where, for instance, a negligible production of waste material and its management become indispensable, cross-cutting processes, additionally making the organization more efficient. This transition is consistent with what international institutions, governmental regulations, and customers have been increasingly asking.

COST OPTIMIZATION: IR 5.0 uses previous enhancements that, since the initial Industrial Revolution, have produced more effective processes. The quest for business models that use the minimum resources to achieve the highest incomes, discover in Industry 5.0 the maximum level of perfection to the present day because man and machine are working together to make the best financial choices for a company.

CUSTOMIZATION AND INNOVATION: Technical innovation does Permit for a degree of personalization that satisfies the demand of the consumers. The personnel which is part of IR 5.0 are going to influence the possibilities of technology, although will also discover space to add their own thoughts that will lead to a product that is developed with customization in mind. Moreover, the automation attained during IR 4.0 allows employees to set free themselves from specific monotonous tasks, concentrating on creating more effective strategies or applying their creativity.

THE NEED FOR DEFINING THE LEGAL FRAMEWORK OF LAWS AND REGULATIONS PERTAINING TO AUTONOMOUS ROBOTS (COBOTS)

Without the required rules and guidelines, humans and robots co-working is going to create numerous problems. First, we will have to officially define what a robot is. Although there are scientific definitions used for robots, only a legal definition of a robot will be binding for companies and organizations. There are many kinds of automated machines. Robots are also an automated machine. There exist automation levels specified for machines. The difference between an automated machine as well as a robot must be clear in a law governing humans and robots co-working. Additionally, there are closely linked entities like drones and cobots. The rules and regulations must also include the differences of robots from drones as well as cobots.

Additionally, to a precise definition, the law and other relevant regulations must at the very least include the kinds of robots which can be used in workplaces, functions, and responsibilities of robots, the kinds of choices that robots are permitted to make concerning humans, the kinds of robot failures and who's responsible in a robot malfunction, the division of duties in robot malfunctions, whether or not the robot software is followed by certain hard-coded rules or is permitted to learn and develop, the certifications robots need, the certification bodies and their duties. There will be numerous discussions concerning the regulations for robot advancement, production, and certifications. Presently, several countries have failed in controlling the air space used for drone use. We will have to be at the forefront of such a quick deployment of autonomous robots. Necessary legal and regulatory concerns that surround the use of AI, Robots, Drones, and Cobots are going to be the focal point of several research studies.

CONCLUSION:

Technological innovations and revolutions are taking place much more quickly, and that is why a business requires clear visions for business developments and a clear mindset for such a transformation. The company has to acknowledge that success will come to the ones that are more innovative and responsive to changes in the market to offer high-quality products as well as service on client requests. IR 5.0 emphasizes an obvious transition from mass automation to the process of improving the abilities of human workers in order to achieve personalization by means of product customization at a higher level. The Implementation of IR 5.0 will accomplish those objectives, particular activities, primarily related to innovation and technology, will be carried out and implemented on four subjects, Human resources, Investments, Products, and Infrastructure. Four main areas for measures to be taken in this new IR have also been identified, namely Research and Innovation, Education, Work, and Training, as well as Infrastructure Development. Additionally, greater attention is paid to manufacturing sectors, Finally, from the technical aspect, a greater prioritization of Big Data or Analytics, 3D Printing, Artificial Intelligence, Advanced Robotics, and Internet of things technologies could also be observed.

To achieve the task of Implementation of IR 5.0 much attention should be given to the study, innovation, technology, and workforce qualification. This must be anticipated as the next step

towards this new IR, as technologies are becoming more affordable and are grasped by nearly all organizations. In conclusion, striking a balance between the requirements for an expert workforce, advanced technologies, greater productivity, tighter integration with clients, higher quality products and quicker time-to-market of products is not an easy task. There exists an underlying need for improving management practices linked to these aspects. IR 5.0 will increase interaction between humans and machines which will empower people to express themselves in the form of customized products as well as services. IR 5.0 will provide clients with more personalized products as well as services than ever before and this could only be feasible with the increasing engagement of humans when designing goods and services. It is considered that, because of increased human and machine collaboration and a greater focus on human and user-centered products. This customization and improved human and machine cooperation in IR 5.0 have made current innovation structures unsuitable for IR 5.0.

It doesn't matter if IR 5.0 is going to be about co-working between humans and robots or not, humans and robots co-working will continue to be a major change for organizations. Moreover, robots throughout our lives will most likely be a major change for mankind. We are attempting to build a technology that is similar to humans in numerous aspects. Some people will find this groundbreaking and interesting. Other people will find it shocking, infuriating, and even a danger to mankind. This pessimistic stance towards robots is supported by the media. We need to be aware of the current generation's differences and begin building a robotic society where humans take advantage of this technology to its highest extent and try to reduce the consequences. We can conclude that IR 5.0 in addition to the previous industrial revolutions, has the ability to increase the global income levels and to enhance the quality of human life. IR 5.0 is different from the previous industrial revolutions, as it will contribute to a radical transformation of society, to the quality of life, and of the economy.

This research will discuss the possible problems that might arise from humans and robots co-working. Legal, social, regulatory, ethical concerns are among the most important issues. Furthermore, changing the role of human resources (HR) and IT departments, various personal preferences toward working together with robots. All the problems that are discussed are topics for additional discussion, research, investigation, in summary for a wide range of studies. We

need to gather data as they are made available for collection. At the moment, we are able to only survey the expectation and vision. Still, the research we carry out might not be conclusive until human-robot co-working conditions really exist.

REFERENCES:

- [1] Columbus- Role of Humans in Industry 5.0- Arivarasu Selvaraj 10 Oct 2019
<https://www.columbusglobal.com/>
- [2] CADCAM Group- Industry 5.0 on the horizon <https://www.cadcam-group.eu/>
- [3] Fingent- How the 5th Industrial Revolution is Advancing Humanity at Workplace - Feb 21,2020- by Tony Joseph
- [4] IOT Practitioner – The Good, the Bad, and the Inevitable about the Industrial Revolution Oct 21,2019
- [5] FROST AND SULLIVAN- Industry 5.0 – bringing Empowered Humans Back to the shop floor-An excerpt from an SPS 2019 presentation to be delivered 26 November 2019, CET, Forum, Hall 3 by Aroop Zutshi, Global President & Managing Partner, Frost & Sullivan. <https://ww2.frost.com/>
- [6] ESSENTRA COMPONENTS-Is Industry 5.0 really all that different from Industry 4.0- 24 Oct 2019
<https://www.essentracomponents.com/>
- [7] Kontron- Autonomous Vehicles and Industry 5.0 are the basis for future oriented traffic concepts in smart cities- by Valentin Scinteie | 19. Jun 2019 <https://www.kontron.com/>
- [8] Industry 5.0: the new revolution Digital transformation - Nexus Integra / April 6th, 2020
- [9] “Birth of Industry 5.0: Making Sense of Big Data with Artificial Intelligence, the Internet of Things, and Next-Generation Technology Policy,” by Ozdmir V. and Hekim N., U.S. National Library of Medicine, National Institutes of Health.
- [10] Industry 5.0: Top 3 Things You Need to Know 30 July 2020 By James Jardine, Staff Writer, MasterControl.
- [11] “Artificial Intelligence and Robotics: Inevitable and Full of Opportunities,” EESC, March 16, 2018.
- [12] Tweet by Elon Musk, April 13, 2018.
- [13] INTESENS- The Connected Maintenance – From industry 1.0 to industry 4.0 three centuries of transformation June 27,2019
- [14] SCM Now Magazine- Industry 1.0 to 4.0: The Evolution of smart factories – Richard E. Crandall – September/October 2017
- [15] <https://supplychaingamechanger.com/the-industrial-revolution-from-industry-1-0-to-industry-5-0/>
- [16] PRV Engineering-Manufacturing 5.0: The Future Is Now- July 6, 2018

[17] Sheridan, Thomas B., and William L. Verplank (1978) “Human and Computer Control of Undersea Teleoperators.” Man-Machine Systems Laboratory Report, MIT, Cambridge, USA, 1978.

[18] Bekey, George A. (2005) “Autonomous robots: From Biological Inspiration to Implementation and Control” Cambridge, USA, MIT Press

About Author: **A. SHAJI GEORGE** M.A, M.B.A, MCA, MSc IT, MPhil, PhD.

Shaji George is a recognized technical expert in IT Infrastructure Systems, Network & Telecommunication, having worked in almost every aspect of the IT Industry. His research interests include Wireless, Networking, Cloud Computing, Big Data, Data Mining, Automation systems, Microeconomics, Gig Economy and Labour Economics.

About Author: **A.S. HOVAN GEORGE**

Hovan George is a student. His research interests include Neurology, Virology, European History and Literature.