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Evolution of the Fifth Industrial Revolution: A forecast

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Forecast

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Evolution of the Fifth Industrial Revolution: A Forecast

Abstract

Technological advancement has changed the outlook of almost everything, business, life and even our thinking pattern. Wherein one hand it brings social change, on the other it revolutionizes the processes like manufacturing, management practices like operations, and technological tools. This study examines the underlying principles of earlier industrial revolutions, the current post-COVID-19 scenario, and attempts to ponder on how the next industrial revolution might develop as a whole, with ongoing technological development in wireless communication, potentially playing a primary role, and other upcoming technological concepts, potentially serving important supporting roles. With the recognition of the coexistence of Industrial Revolution 4.0 and 5.0, we have developed five questions to organize our arguments, and we made an effort to be objective in our choice of information sources and in our discussions of the major problems. This study may serve as a catalyst for further discussion and on upcoming Industrial Revolution 5.0.

Track: Organisational Transformation Change and Development Track

Word Count: 7000

Keywords: Industrial revolution, Operational innovation, 5G, Algorithmic management, Gig economy, Blockchain, Metaverse

Introduction

The first industrial revolution (IR 1.0) started with the advent of steam engine (Deane, 1979) as well as mechanization of production followed by the management concepts of labor specialization (Glaser and Rahman, 2012), and parts standardization (Crawford, 1948). The usage of steam engine revolutionized the manufacturing sector and steam ship locomotive made huge changes in transporting goods, it reduced the time greatly while improved the operational efficiency in logistics in multi-fold (George and George, 2020b). This was the transition period from craftsmanship at home to using machines for manufacturing, from making one product at a time to replicating identical products on mass level. Although the development of factories and managing the setup was at an initial development phase, its social impact started to appear when labor specialization came into existence and managerial hierarchy developed over the time to monitor division of labor. Other management concepts of IR 1.0 including scientific management (Gulzar, 2015), motion and time study (Jacobs et al., 2004), process analysis (Judd and Kenny, 1981), and queuing theory (Kendall, 1951) evolved into a part of it over time and even extended to the second Industrial Revolution (IR 2.0).

The IR 2.0 began in the late 1800s with the invention of electricity. With this invention, many other technologies were discovered during this time period, where one of the breakthroughs was moving assembly line. Manufacturing of new machine tools started, and power generation using steam as well as iron ore production processes emerged. Techniques for analyzing occupations to better manage both employees and workplace practices were invented (Atkeson and Kehoe, 2001). Concepts like lean management, statistical sampling and linear programming enhanced the productivity in IR 2.0 era (Muthiah and Huang, 2006). The major developments during the IR 1.0 and IR 2.0 were consisted of steel and chemicals manufacturing, advancement in transportation, agriculture, and food engineering (Koyande et al., 2021).

The Industrial Revolution 3.0 (IR 3.0) began in late 1900s with spread of automation and digitization, through the use of electronics and computers and a major breakthrough of the internet. Other supporting technologies that aided IR 3.0 were Radio Frequency Identities (RFIDs), Enterprise Resource planning (ERP) systems and International Quality Standards. The determinatives feature of this era includes biogenetic, synthetic materials, microelectronic technology, fiber optics, biotechnology, laser technology, nuclear energy, computer technology,

and telecommunication (Taşkan et al., 2020). The majority of production, logistic, and related services had been digitalized in IR 3.0 to increase productivity. Yeong et al. (2022) also explained that in IR3.0, technologies were only able to replace human labor in tasks that could be documented and were repetitive in nature. With the beginning of industrialization and large manufacturing, the need to look at institution performance arose. In parallel, IR 3.0 had a significant impact on how businesses were managed and produced. We may claim that the IR 3.0 saw the most advancements in enterprise performance measurement techniques, and this was also the time when management effects peaked (Taşkan et al., 2020), the socio-economic transition from an agrarian society to an industrial society was witnessed (Yeong et al., 2022), and an alteration of macro structures like social stratification and micro level variables like personal values were observed (Inglehart and Baker, 2000). The Industrial Revolution 4.0 (IR 4.0), is mainly the process of automation, digitization with the widespread use of Information and Communications Technology (ICT) operating under the network of Internet of Things (IoT), integrated with cyber-physical systems (CPS) technologies and with all the related information contained to cloud computed intelligent systems. IR 4.0 technologies help in improving the decision-making processes, execution and operations. Likewise, IR 4.0 has also influenced the operational framework of almost every industry progress detection, and data acquisition technologies for more efficient outcomes (Qureshi et al., 2020). The integral components of IR 4.0 consist of IoT, artificial intelligence (AI), advanced robots, autonomous vehicles, cloud computing, big data, augmented/simulated reality, 3D printing, nano material, and digital twins (Rymarczyk, 2020). Meanwhile, this led to advancements and more focus on sustainability (Alaloul et al., 2020). IR 4.0 brought many changes in industry and the workforce due to the widespread adoption of advanced technologies such as AI, automation, and the IOT in manufacturing and other industries for example increased productivity and efficiency, improved quality of products and services, and new job opportunities in fields such as data analytics, cyber security and AI. The IR 4.0 has a significant and far-reaching effect on society. It changed the way we communicate, access information, and conduct business. It increased opportunities for telecommuting and remote work and education, and the ability to connect with people all over the world. However, there are also potential negative impacts, such as job displacement (Alaloul et al., 2020), increased inequality, and the need for retraining and up skilling of workers (Fair and Modafferi, 2022). In addition, it has resulted in shifts in the labor

market, with the rise of the gig economy, digital divide, and the automation of numerous jobs. Figure 1.0 shows stages of Industrial Revolution.

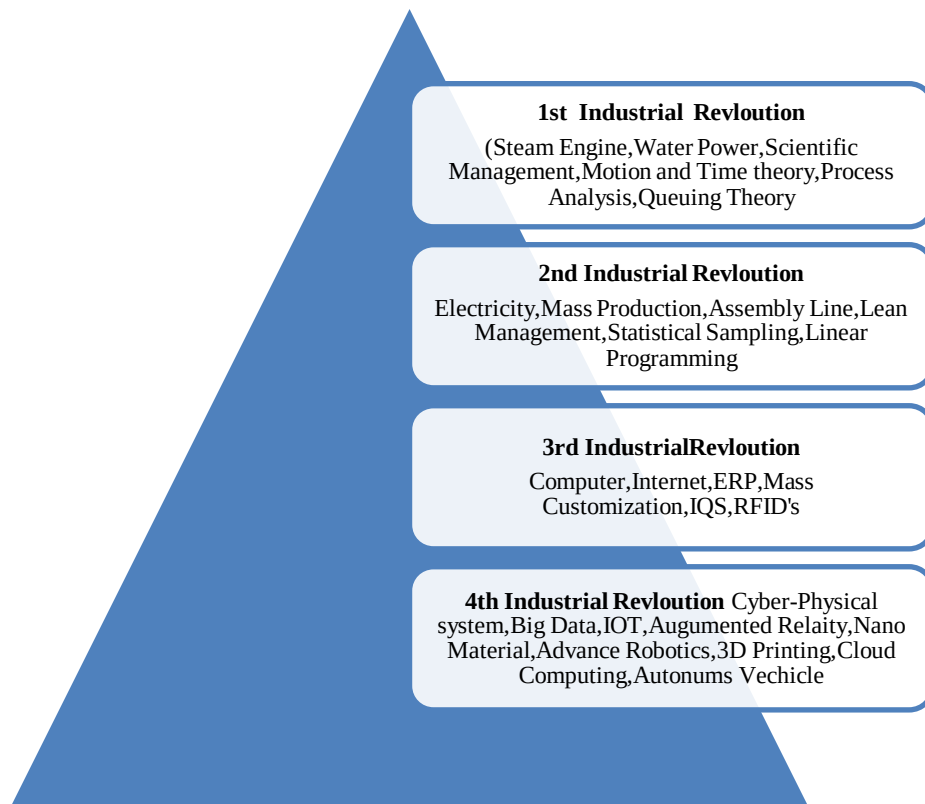


Figure 1: The Four Stages of Industrial Revolutions

Over the time technological development has been witnessed and other supporting technologies have been evolved merging into every industry. Figure 1.0 show the different stages of IR.

This paper aims to identify the foundation of IR 5.0 and forecast its integral pillars. It proposes potential inhibitors and subsequent enablers of disruptive innovation. The key area focused in this paper includes framework, comprehensive knowledge, distinct features and applications of IR 5.0 and the opportunities and challenges faced by IR5.0. This paper would aid researchers and industry practitioners to better understand the role and importance of IR 5.0 in the future. This paper suggests blockchain, the gig economy, algorithmic management, and 5G/6G to be the main dimensions of the next industrial revolution however, the next revolution will stand on the bases of currently evolving 4th industrial revolution.

This paper is further organized as below: Section II covers the extensive literature review of IR 5.0. Section III describes the framework and its integral pillars whereas Section IV presents the challenges of IR 5.0 and Section V consists of challenges that are addressed through management practices, different roles and trainings. Section VI focuses on social impact of IR 5.0. Section VII and VIII cover discussion and conclusion, respectively.

Literature on four generations of industrial revolution offers many takeaways. It enlightens us with the observation that the so-called revolution itself is an evolutionary process that starts with a disruptive concept however evolves, being accompanied by other supporting technologies and concepts, into a package. It impacts the management practices, organizational structures, other technologies, and ultimately brings different changes and challenges in society. With this recognition, this study attempts to explore on (i) How the next industrial revolution may look like? (ii) What technological advancements are potential candidates for primary/disruptive concepts? (iii) Which concepts may play the supportive role? (iv) How it may impact the society? And (v) What are the challenges the decision makers should be ready for?

2. Literature Review

Numerous academics are currently discussing about IR 5.0, and its impact on modern era that includes operations, industrial processes, management practices and the post covid scenario. The post-pandemic vision of Industry 4.0, in which human-centricity has been recovered or improved, is increasingly incorporating newly developed solutions, industry recovery strategies that address the COVID-19 and climate change crises (Golovianko et al., 2023). Many authors believe that IR 5.0 would be widely known as Age of Augmentation because human and machines would work in symbiosis. Another noticeable contribution in this regard is made by George and George (2020b) and Humayun (2021) who focus on the previous revolution and highlight the transformation of manufacturing plants into IOT enabled smart facilities that uses cognitive computing which are integrated through cloud server. Many authors including Leng et al. (2022) and Golovianko et al. (2023) emphasis that IR 5.0 would be focused on the return of human hands as well as minds incorporated in the industrial framework (Golovianko et al., 2023). Further explained that an integral core value of IR 5.0 would include resilience; "self-resilience" and

"system-resilience", whereas Sustainability in terms of utilizing renewable energy sources and reduction in carbon emission to ensure the ecology of the planet.

The major enablers of IR5.0 would include Blockchain, 5G and beyond, Mixed reality, exoskeleton, drones and additive technology (George and George, 2020b). Other authors including Ivanov (2022) and Xu et al. (2021) mention that the major enabling technologies of IR5.0 would include PI-Mind Clones, collective intelligence, bio-inspired technologies, digital twins, AI, Data transmission, Metaverse, storage and analysis, technologies that are able to handle data and interoperability Golovianko et al. (2023), states that the idea of Industry 5.0 is complementing and extending the hallmark features of Industry 4.0 and it suggests that they are to be considered side-by-side, i.e., the hybrid of technology-driven Industry 4.0 and value-driven IR 5.0.

According to George and George (2020b), AI will be able to assist to accelerate creativity, and it will be used as tool instead of a collaborator in the IR 5.0 era and responsibilities such as machine maintenance and quality-assurance would come under a single job as plant operations. A new role of chief robotics officer (CRO) would be included in management hierarchy of the organizations handling 6G networks, AI-powered mobile Edge Computing (EC) and smart mobility where 6G networks are anticipated to meet the requirements of an intelligent information society for Industry 5.0 applications, which may give ultrahigh data speeds, ultra-low latency, ultra-high reliability, high energy efficiency, traffic capacity, and more (Maddikunta et al., 2022). The author further emphasis on key technology of IR 5.0 i.e. Blockchain which has some unique features such as transparency, secure peer to peer communication, smart contract (Maddikunta et al., 2022). Many authors have laid their focus on an upcoming essential pillar of IR5.0 which is Metaverse; it is currently a milestone for cyberspace. Metaverse is the idea of a fully immersive virtual environment where people congregate to socialize, engage in activities, and work (Laeq, 2022). The Metaverse is supported by Blockchain and the crypto currency through which trading would take place in the Metaverse would be known as Non Fungible Token (NFT) Laeq (2022). In Metaverse individual will be able to buy digital property, cars, apparels etc. It is evident through recent literature that Metaverse, Blockchain, AI enabled devices and other supporting technologies would shape up the next IR 5.0.

Industry 5.0, which incorporates elements from Industry 4.0, aspires to broaden and reframe the use of digital and smart technologies beyond the production of goods and services for profit and

concentrating on achieving real prosperity, which demands achieving social and environmental advancements (Romero and Stahre, 2021).

The literature can be divided into two parts few authors agrees that first four industrial revolutions began with disruption and evolved over time and diffused into one another. Technology has once again experienced growth and change as a result of Industry 4.0. The primary focus of Industry 4.0 is development, information sharing between businesses, machines, and people (Sarfraz et al., 2021). But the post covid scenario have changed the modern era. The fifth society, which would be extremely advanced, is about to be accepted by the globe. The inclusion of Society 5.0 and COVID-19 might have a favorable effect on community development initiatives. The COVID-19 pandemic's unexpected upside is the chance to test out cross-border technological collaborations that promote a more inclusive, secure, and sustainable future. Many authors believe that society 5.0 would be a hybrid of IR4.0 but also incorporating new novel features of IR 5.0 (Golovianko et al., 2023).

We have proposed a new framework in our research to indicate the novel features of IR5.0 which has not been discussed before in the literature.

3. Framework for IR 5.0

The IR 5.0 would stand on the foundation of technological advancements of IR4.0. Literature propels that IR 5.0 would bring in human factor as integral part along with the COBOT and other technologies to produce seamless customized products. We will further look into our framework shown in figure 2.0 created and its integral pillars that could form the future of IR 5.0 which is as followed, gig economy, algorithmic control, blockchain technology, and 5G technologies and Metaverse. According to some authors IR 5.0 would be a template of the upcoming stage of industrialization simplified 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 (George and George, 2020b).

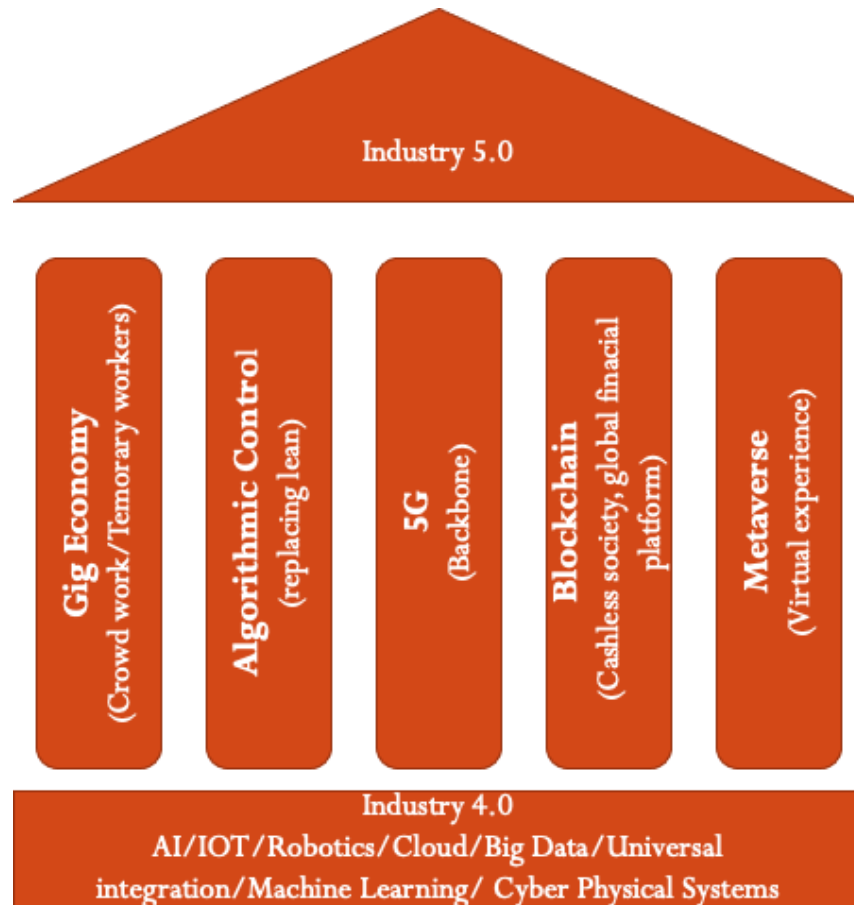


Figure 2.0: Proposed Pillars for the next IR5.0

Gig Economy

The first and foremost integral pillar of our proposed framework in the next IR 5.0 would consist of gig economy which is now considered an integral dimension. The gig economy refers to labor markets that are characterized by independent contracting that happens on digital platforms. The nature of job offered is often temporary, casual and non-permanent work. It has variable hours, little to no job security, it involves payment or remuneration on assigned work basis, and it lacks options for career development. (Graham et al., 2017).

Gig economy lately gained popularity during the pandemic, when physically going to work was not possible and a new way of working emerged as “Work from Home”. New platforms like up-

work gave an opportunity to employees to work from remote setting for various companies and many organizations quickly shifted to online to continue their business activities.

A report by payoneer (2020), confirms that there was a surge in Pakistan freelance economy. Local Pakistani government took huge initiatives as educational institutes shut down due to Covid-19 this led to development of online education system. As a part of this initiative government program such as E-rozgar expanded its services throughout the country gave additional opportunities to improve the freelancing skill set of people. Another report by digital payment platform Payoneer (payoneer, 2020) confirms that Pakistan gig economy has one of the fastest growth rate as shown in figure 3.0.

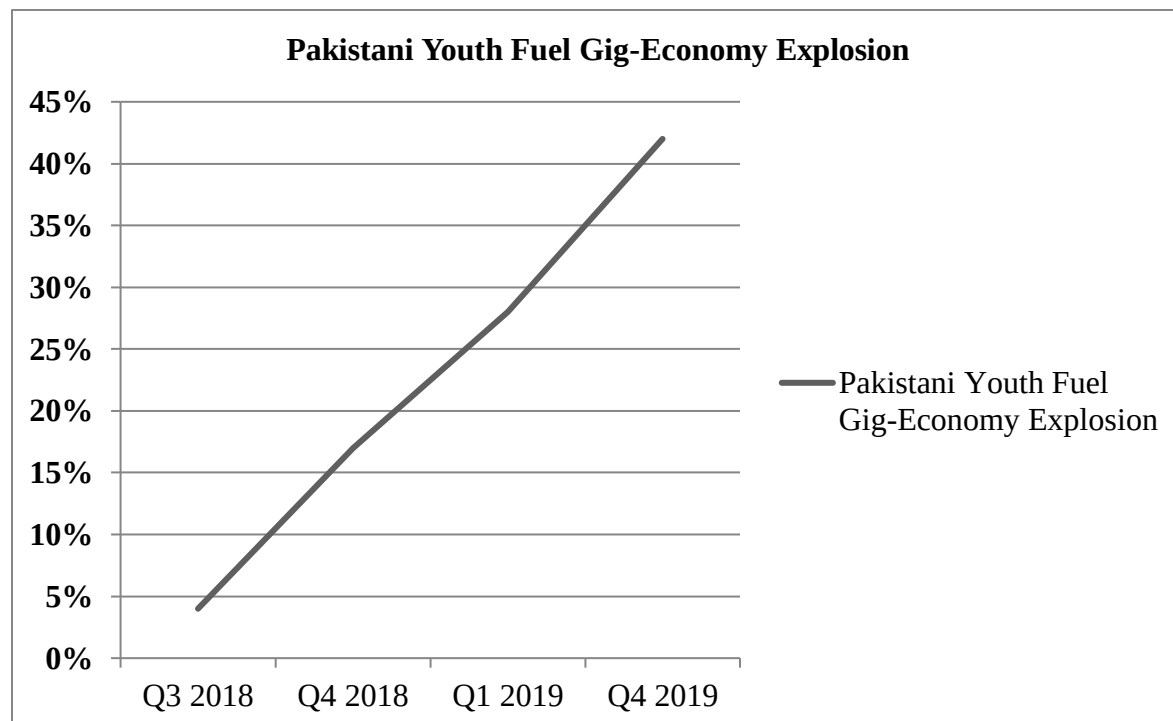


FIGURE 3.0 Expansion in gig economy of Pakistan (Payoneer 2020)

After the pandemic, the gig economy is likely to expand as more workers choose to work in flexible and independent environment. On the organization side, the benefits of gig workers includes, cost effectiveness ,innovation, high level of productivity and specialized skill. The proposed blend of permanent and gig employees pushes the gig economy to be integral pillar of

next industrial revolution. The gig workers will be treated as “Employees as service” and every industry may have digital platforms to manage the workforce. But on the downside the gig worker would be socially isolated.

Algorithmic Control

The next integral pillar of our framework is related with post covid scenario. It is about Algorithmic Management (AM) which is a software aiding to automate organizational functions that were previously conducted by human managers in both platform work and conventional employment settings (Kellogg et al., 2020).

According to the empirical research that is currently available, algorithmic management primarily consists of automating direction (what needs to be done, in what order, for how long, and with varying degrees of accuracy) in order to reshape organizational control. evaluation of the worker activities to correct errors, evaluate performance, and identify underperformers); and discipline, which is the process of punishing and rewarding employees for their cooperation and compliance Wood (2021).

Algorithmic Management is relatively new concept of managing human resource. It facilitates, monitoring, goal setting, scheduling, compensation, and job termination. Secondly each AM function affects key job resources (e.g., job autonomy, job complexity) and key job demands (e.g., workload, physical demands); with each of these resources and demands being important drivers of worker motivation and their well-being. It makes it easier for organizations to monitor each and every employee performance hence making the job description, clear and concise. The unsatisfactory performance of employees may be tracked and reviewed through algorithmic management.

However, algorithmic control concept is bringing up challenges of labor-algorithmic interface (Abuarqoub et al., 2017). This creates the need of intensive research in the area of algorithmic control as it can play a crucial role in the next industrial revolution in light of pandemic or any other economic crisis in future. Algorithmic control has already been into the industry, for example at many places algorithms manage the attendance and payroll systems. Given that the gig economy

is there, the algorithmic control will replace/diffuse in to the lean operations of the industry (Jarrahi and Sutherland, 2019).

Blockchain

Our modern world is facing many issues of storage of big data. We have suggested the next integral pillar of IR 5.0 could be Blockchain. A key differentiating features between a database that is commonly used today and a Blockchain is how the data is structured. A blockchain collects information together in groups, known as blocks that hold sets of information. Blocks have a storage capacity and, when filled, are closed and linked to the previously filled block, forming a chain of data known as the Blockchain. All new information that follows that freshly added block is compiled into a newly formed block that will then also be added to the chain once filled (Andoni et al., 2019). The organization of the data is one significant distinction between a Blockchain and a normal database. In a blockchain, data is gathered in sets called blocks, each of which contains a set of data. Blocks have specific storage capabilities, and when filled, they are sealed and connected to the block that came before them to form the data chain known as the Blockchain. Every new piece of information that comes after that newly added block is compiled into a brand-new block, which is then added to the chain once it is complete (Andoni et al., 2019). There are several benefit of using Blockchain technology that includes transparency, decentralization, immutability, security. Other benefits includes real time information sharing, and visibility which enables the location and identity of the users (Aslam et al., 2021). Blockchain technology provides secured and real-time information sharing it has been getting attention as an emerging new tool to improve the organization's performance (Aslam et al., 2021).

Blockchain would play a pivotal role in forming IR5.0 pillars since it resolves many of the hurdles faced in the modern era. Blockchain is the technology which can provide us with the global financial platform and smart contracts. Many researchers are already talking about the implementation of Blockchain in supply chains (Aslam et al., 2021) (J. Aslam, Saleem, Khan, & Kim, 2021; Longo, Nicoletti, Padovano, d''Atri, & Forte, 2019), even in healthcare (Massaro, 2021), and many believe it to be part of industry 5.0 (Alvarez-Aros and Bernal-Torres, 2021); (George and George, 2020a). However, the argument of inclusion of blockchain is not only as a source of global financial platform it will also boost the implementation of internet of things (IoT) with the emergence of 5G (Dwivedi et al., 2023). Literature propels that

blockchain is going to be the strong pillar of industry 5.0 as it provides global financial platform, that is secure, transparent, traceable, and visible (Andoni et al., 2019).

5G and Beyond

The most crucial pillar of our framework is 5G and beyond, this pillar would be integral part and correlated with all other pillars. The First generation was launched in 1980 analogue based and it only provided with voice communication facility. While the second generation offered both phone and data services and it was digital based. Additionally, 3G enabled video conferences and other features as mobile wireless technology continued to progress. Due to rising demand, 4G was created and gave us access to ultra-broadband internet. We will be able to access amenities through 5G that have never been available before, the three main technologies of 5G would include, Nanotechnology, Cloud computing, and all flat IP platform (Bhandari et al., 2017).

There are three main latest technologies that provide higher network capacity in order to support user equipment (UE) i.e. (Smart phones and tablets). Firstly, high bandwidth is provided via mmWave communication, which operates in high frequency bands (i.e., 30 GHz to 300 GHz [19]). (i.e., at least 11 Gbps). Second, the deployment of tiny or small cells that enables UEs to communicate utilizing mmWave to lessen interference and transmission range. Thirdly, massive MIMO (multiple-input multiple-output) enables base stations (BSs) to employ a significant number of antennas (up to 16 antennas per sector), providing directional transmission (or beam forming) to minimize interference and enabling nearby nodes to interact simultaneously (Hassan et al., 2019).

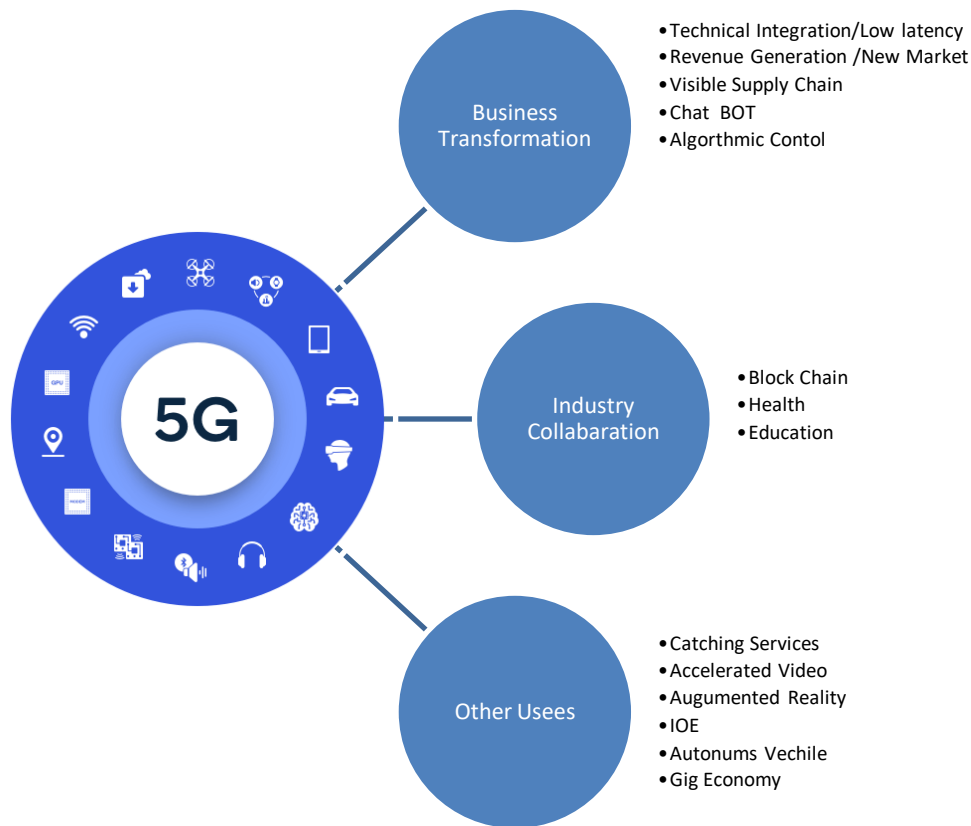


Figure 4.0 :The application of MEC Source:(Hu et al., 2015)

The market drivers of Mobile edge computing (MEC) are as followed it includes business transformation, technology integration and industry collaboration (Figure 4.0). All of these can be enabled by MEC and a wide variety of use cases can be supported for new and innovative markets, such as e-Health, connected vehicles, industry automation, augmented reality, gaming and IoT services (Hu et al., 2015).The Internet of Things (IoT)-centric concepts like augmented reality, high-resolution video streaming, self-driven cars, smart environment, e-health care, etc. have a ubiquitous presence now. These applications require higher data-rates, large bandwidth, increased capacity, low latency and high throughput. In light of these emerging concepts, IoT has revolutionized the world by providing seamless connectivity between heterogeneous networks (HetNets). The eventual aim of IoT is to introduce the plug and play technology providing the end-user, ease of operation, remotely access control and configurability (Shafique et al., 2020).

Metaverse

Metaverse is a relatively new concept that is being adopted by many social websites, i.e., Facebook. The metaverse is aimed at providing an open, shared and persistent virtual world that offers accesses to the three-dimensional (3D) virtual spaces, solutions, and environments created by users. On the other hand, various virtual technologies create the ways to access metaverse. For example, virtual reality (VR) is one of technologies to create 3D virtual environments with specifically functionalities.(Yang et al., 2022).

Metaverse has the potential to evolve many fields like educational e-learning, involving more of e-learning to another dimension and making it possible to develop meta-based application. Other fields like medicines could also use metaverse to promote tele-medicine, disease education, diagnosis and prevention. And even in tourism industry Metaverse can transform the experience. Moreover, gaming industry can also take advantage of metaverse. As firms start to sell virtual skins, virtual apparel, and even virtual estates with a high price. But on the contrary, this can also be a barrier to a number of players from joining the metaverse; people would prefer to turn to their virtual wardrobe to choose a digital outfit in the future. Therefore, it is vital to suggest specific governance methods with the assistance of multinational corporations. Furthermore, there is still a question about how to set up a digital currency system that facilitates financial exchange between the metaverse and the real world. Additionally, the amount and frequency of transactions in the metaverse will increase significantly more than they did in the physical world. Thus, a difficult issue in the future is how to sustain such high-volume and high-frequency transactions. This is where the Blockchain concepts come into play a vital role. There are many possible applications for blockchain technology in the fields of money, contracts, voting, and government. Among the possible applications for Blockchain in metaverse could be facilitating financial transactions easier and convenient in the metaverse and construct platforms for online voting that are safe, transparent.

4. Challenges Faced by IR 5.0

The challenges faced by disruptive technologies of IR 4.0 and IR5.0 would be similar in nature and are as followed. Figure5.0 shows potential benefits and challenges of IR5.0.

The disruptive technology creates challenges for the entire economy and overall organization. It creates shortage of skills among the existing workforce. This enforces the employers to either train,

the existing workforce or recruit the new skilled workforce. The situation creates a demand of newly skilled workers with higher qualification and skills required for new technology. The room for job polarization due to disruption of technology. This challenge also leads to a change in curriculum followed by academic institution. The boundaries of traditional teaching disciplines are blurring, and academic institutions which once taught traditional disciplines from ages are no longer able to follow the same practices. They have to radically change themselves to introduce the interdisciplinary as well as multi-disciplinary courses which suits to the current industrial era and make students not only capable to handle these technologies but also apply them in real industrial situations (Kumar et al., 2020).

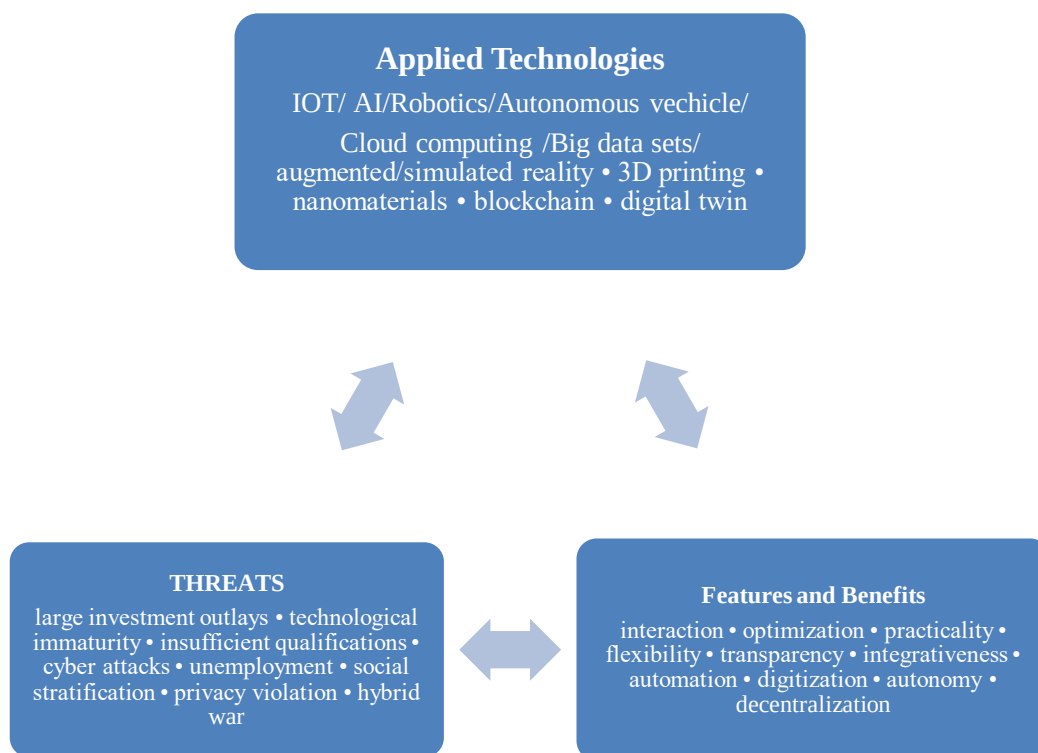


Figure 5.0 Challenges and Potential Benefits for IR5.0. Rymarczyk (2020)

The new/disruptive technology may bring challenges in terms of infrastructure , need of huge capital cost, Data security, manpower upgrading their skills in order to be compatible with new technologies, rules and regulation formation (Brkovic and Sorooshian, 2021). The organization's

business model and strategies must be adjusted and customized according to the requirement of IR 5.0. due to the greater degree of automations in the industries It is for a fact when technology advances many employees loses their role in the organizational structure. The organization structures often redesign in order to enhance productivity (Humayun, 2021).

5. Challenges are addressed through management practices, different roles, trainings

A substantial body of literature has elaborated on enabling disruptive innovation from the organization itself. The explanations categorized six aspects identified as;(1) Leadership; (2) Organizational Structure; (3) Organizational Culture; (4) New Product Development Process; (5) Employees; (6) Spin off or Ambidextrous Organization. The research so far has well addressed the management challenges of exploiting disruptive innovation within the organization (Dan and Chieh, 2008).Leadership has a vital role in implementing new technology and disruptive innovation. The article of Dan Dan and Chieh (2008) discuss that senior manager have limited current experience and are trained to manage well defined product line and middle managers are the ones that loses most when disruptive changes come in the organization more often technologies takes over their assigned task. Hence it is the responsibility of the senior manager to introduce new disruptive technology in order to be competitive in today's world. Organizational Structure is the number and size of business units which could facilitate development of disruptive innovation. Most large corporations keep the flexibility to have small business units; they can continue to have decision makers who can adapt about emerging opportunities, thus contributing to the emergence of disruptive innovation. The size of the firm and business units is often negatively related to disruptive innovation. When huge changes such as disruptive innovation are introduced in the firm, the organizational culture generates cultural inertia which is difficult to tackle it is a primary reason managers tend to introduce revolutionary change even when they know that it is the need of the hour. Hence, at the advent of potential disruptive innovation, it's important for incumbents to prepare for and instituting organizational change and unlearn its values and norms. Nevertheless, some integral parts of culture should be preserved and valued so as to capture the wave of disruptive innovation. For example, culture of a small business unit (SBU) must value entrepreneurship, risk taking, flexibility and creativity to develop disruptive innovations. Literature supports that resource allocation is process which evaluates emerging disruptive projects by the same criteria applied for existing businesses. And financial results in new product development process are a particularly a tool to manage disruption. The solution lies

in that there should be two distinct portfolio to manage the new product development projects separately from the operational projects such as cost reductions, line extensions and quality improvements. From employee's perspective the less formal organizational structure, allow managers to proceed intuitively rather than having to be backed up by careful research and analysis. Lack of Knowledge and creativity creates potential disruptive innovations (Dan and Chieh, 2008). New startups always have innovative and potential disruptive technology strengths, but they lack complementary assets that belong to the market leaders. Hence, different kinds of collaborations between starts up and market leader are essential.

6. Social Impact of Industry 5.0

Industry 5.0, also known as the Age of Augmentation (Lee et al., 2022), it is characterized by the integration of even more advanced technologies such as artificial intelligence, Blockchain, gig economy ,algorithmic control, Metaverse, and uninterrupted 5G and other technologies like quantum computing, in manufacturing and other industries. The social impact of Industry 5.0 is expected to be significant, and could include both positive and negative effects. Positive impacts may include an increased in productivity and efficiency of the product and services resulting in better quality of products and services with increased customization and personalization than before. There would be many new job opportunities in fields such as robotics department, algorithmic management, Blockchain, gig economy and Metaverse (Lee, 2018). However, it is also likely that there will be many negative impacts; due to prevalence of IR 5.0 it has the potential to disrupt the labor market structure and increased inequality, as highly skilled workers benefit more than others. There would be more complex and dynamic working conditions. And a greater dependency on technology with a need for more advanced skills and high cost of technological up-gradation for organizations especially in manufacturing sector (Dan and Chieh, 2008). According to the Sociotechnical Theory, social and technical factors are equally significant and shouldn't be considered separately while doing analysis. Hence, a sociotechnical perspective of Industry 5.0 and prosperity means that before investing in the collaborative robot, the return on investment (ROI) must be measured according to all of these aspects equally (people, resilience, sustainability, profit, society, etc.). The crucial thing to remember is that all of these factors are equally relevant when calculating ROI. At its core, it may be said that Industry 5.0 acknowledges that people, communities, businesses, cultures, technologies, and the planet can no longer afford a technology-first, profit-above-all mindset (Fair and Modafferi, 2022). It could also exacerbate

existing social issues, such as privacy concerns, and may raise new ethical dilemmas. It is important for policymakers and industry leaders to anticipate and plan for these potential impacts, through the implementation of policies such as retraining programs, up skilling opportunities, and social safety nets.

7. Discussion

Industry 5.0's guiding principles urge for both updating and creating new business model designs. A wide range of options exist to change the current business models and make them more robust, sustainable, and human-centric. These opportunities are represented by new organizational principles, managerial viewpoints, and digital technology. New business model designs would be enhanced by digital technologies. Literature propels that the main features of Industry 5.0 would include, human centricity, sustainability, and resilience. IR 5.0 would also be more inclined towards value creation rather than technology driven. Real time information would play an important role to enhance lean practice; the supply chain would be visible till the order has been completed. Industry 5.0, in contrast to Industry 4.0, boldly shifts the emphasis from discrete technologies to a methodical approach. With this strategy, the industry is given the ability to advance social objectives beyond economic development and job creation, and the welfare of industry employees is put at the forefront of the manufacturing process.

The framework pillars discussed above are interconnected to one another. And it does not come without challenges, Metaverse is a new concept, known as second birth of human. It requires huge amount of financial expenditure, network and computing requirements and dependence on uninterrupted internet speed, and to store huge amount of data retrieved by the users in real time. Another challenge a User would face will be cyber-syndrome which refers to the physical, social, and mental illnesses that humans experience as a result of excessive interaction with cyberspace. Companies operating in the metaverse will unavoidably amass vast amounts of user-provided personal private data in order to gain a comprehensive grasp of the user's thought and behavior patterns. This will eventually lead to privacy invasion and would require standardized governance rules and regulations to avoid cyber security issues.

The next pillar which has the potential to integrate with Metaverse is Blockchain, but currently the need of huge data processing may not be met by the existing Blockchain computing speed (only three to seven transactions per second). The blockchain's scalability, or network's processing

power, directly influences whether it can be integrated with the Metaverse. If the scalability is improved the number of blockchain nodes participating in the operation rises than scalability can be enhanced. Another challenge of Blockchain includes cost effectiveness, Blockchain requires huge amount of investment to reap benefits. Blockchain has other limitations like interoperability, flexibility and reliability. Control and maintenance could be made easier with a shared infrastructure that is safe, scalable, and usable by many enterprises. This will reduce expenses, though it is not yet apparent how this should be set up and governed.

The most crucial pillar of our framework is 5G technology and beyond. All other pillars require 5G technology in order to function smoothly. The fifth generation is created as a result of the rapid advancement of network technology. The features of (5G), includes low latency, high bandwidth (100 Mbps) and strong IP-based solutions, substantially greater data rates, than 4th generation, The 5G networking, will also support very high traffic volumes. But there are number of constraints for successful implementation of 5G technology.

As the signal bandwidth is directly related to carrier frequency it is recommended in the literature to increase the frequency by 5% in order to maximize the signal bandwidth in wireless communication. 5G technology will bring some challenges as the 5G technology uses beam forming technique to address the problem of slow data rate, from the base station to the end user, the beam moves like a laser beam giving an impression that the signals are moving along unseen wire. The beam formation aids in achieving a higher data rate using less power and reducing interference because the signals are directed other problems include antenna correlation, computation complexity that needs to be resolved before reaping the benefits of 5G technology.

5G networks requires major infrastructure up gradation including new base stations, antennas, and fiber-optic cable. This can be costly and time consuming process especially in rural areas with limited existing infrastructures.

Another constraint of 5G technology is spectral efficiency, due to high density of technologies operating in the frequency range below 5GHz, it requires access a large amount of spectrum, particularly in the high frequency bands, as they have shorter range and more prone to interference. Allocating new spectrum can be difficult and time consuming process. Interoperability as with any new technology there is constraint of incompatibility between 5G and devices. this can prove to

be a hurdle for businesses to implement and upgrade their current systems in order to gauge all the benefits from 5G technology but this too would require standard protocols to be followed and a setup for troubleshoot incase the device shows any error in performance.

As more devices are connected to one another through 5G. The data transmission and network security can't be overlooked. This would urge to develop advance cyber-security infrastructure and protocols. These regulations can vary from country to country creating challenges for global companies seeking to deploy 5g technology on a large scale. Blockchain can act as supporting role of providing security issues.

The next pillar is gig economy which is related to the post covid scenario the temporary worker, which are remotely available and managed online. The newly developed scenario created a workforce which is available round the clock without the limitation of location or time boundaries and it won't be incorrect to refer the employees as service providers as they sell their services remotely. But the challenges of gig economy include low job security, when the task ends the employee has to look for other projects, the gig economy gives autonomy to the worker to work from home or anywhere they like to but on the other hand strict bidding process on platforms like up work makes it very competitive for the workers to win the job available, often with very strict deadlines attached to the task. Another challenge for gig worker is the weak structural negotiating power which limits their ability to determine how much time they work and often have irregular timings and strict deadline to meet. Another limitation includes social isolation of the workers with few exceptions, the great majority of worker worked from home. Yet, there is a drawback to this independence, which is that working from home resulted in social isolation.

The last pillar is correlated with gig economy which is algorithmic control. The algorithmic control is managing the gig workers online, for instance, screenshots of the employee's screens and the frequency of their keyboard and mouse clicks were recorded but in contrast these can be easily manipulated. The algorithmic management made possible by platform-based rating and reputation systems which is an effective method of hiring gig worker but the downside is many potential workers do not get jobs due to lack of ratings. Although there are many potential workers remotely available without being judged on gender, race or religion but the downside is workers often complain that there is a huge pressure of tight deadline and increased work intensity. The lack of high speed internet and non-standardized payments methods is a barrier for many potential gig

workers to join the digital world. 5G for high speed internet, Blockchain for financial payments and Metaverse can bring in more immersive experience for the gig workers .

All the pillars are interconnected to one another but 5G would play the role of backbone to shape up the next industrial revolution as it is a mandatory feature to ensure the smooth functioning of all other features. Industrial Revolution 5.0 would change the society, the traditional practices of team work which were once an integral part of the management would be irrelevant and temporary or gig worker would replace team work. Social Interaction in person would be replaced by the Metaverse. The decision makers should be ready to update their manufacturing units to highly modernize facility and retrain their employees to sync with the new technology up gradation. This would require huge financial expenditure and many challenges to overcome.

If observed closely we can see that all the challenges in the adoption of any pillar are actually resolved by the other pillar of our framework. High speed internet (5G) will provide gig worker and algorithmic management to function smoothly payment methods and storage of data can be resolved by blockchain socially isolated people due to advancement of technology can reap benefit from metaverse. All the pillars described above if implemented all together can shape up the next industrial revolution or Society 5.0 the base line would be IR 4.0.

8. Conclusion

It is most likely that 5G/6G will allow very high speed communication, will integrate with the concepts of Industry 4.0 (Du et al., 2021) and start shaping the fifth industrial revolution (Yavari and Pilevari, 2020) as back bone and will ultimately play an important role to achieve with green circular economy (Fraga-Lamas et al., 2021) .However, the acceptance of the proposed model highly depends on the following questions; do we want to keep the mix of permanent and temporary gig based employees? Can the next revolution ignore that we are moving towards a cashless society? Is 5G/6G is disruptive technology which will clarify the blurred boundaries of transition from industry 4.0 to industry 5.0? Is algorithmic control the new lean concept of digitalized operations?

This may aid in illuminating why Industry 5.0 is seen as a distinct Industrial Revolution from all prior Industrial Revolutions. Our framework shed light to post covid scenario where gig economy would play an integral part along with algorithmic control to manage online gig worker and there

would be transparency within the horizontal integrative aspect that will also be aided by strategic data sharing, data management, and self-regulation of algorithm management. The uninterrupted 5G/6G technology which would support all other features like Blockchain and Metaverse.

Our study can be used by Policymakers and organizations that can use the conceptual framework to come up with policies and strategies that will help them overcome obstacles, speed up adoption, and generate value. Adoption is likely to be slow when the benefits of the new technology are unclear or poorly understood. At the organizational level, changes are required to accelerate adoption (for example, in governance mechanisms and business procedures); the technological level as well as the environmental level (including, but not limited to, further research and development of solutions for interoperability and scalability). The framework emphasizes the importance of comprehending the technological, organizational, and environmental factors that influence the adoption of blockchain applications, incorporating gig economy, 5G technology and algorithmic management practices and how this may generate value for ecosystem stakeholders.

As future study, authors are working on the validation of the proposed framework. Authors are collecting data from the experts from academia and industry to perform both quantitative and qualitative analysis. The quantitative analysis will be performed using machine learning based algorithm.

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