International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 12 | December - 2023 SJIF Rating: 8.176 ISSN: 2582-3930

# Case Study of the Impact of 5G on the Evolution of Intelligent Automation and Industry Digitization

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***Abstract*** *—*
The mobile industry has came a long way in overall development to deploy the fifth-generation(5G) network. The expansion of IoT and other intelligent automation applications is being significantly fueled by the advancing 5G networks, which are becoming more widely accessible. The main feature of 5G that its lightning fast connection and low latency are needed and useful for the Internet of Things (IoT), Artificial Intelligence (AI), driverless cars, digital reality, block chain, and future breakthroughs and developments we haven't even thought of yet. 5G is more than just a new generation of wireless technology. It is a revolution that will change the way we live, work, and play. 5G's faster speeds, lower latency, and increased capacity will enable new and innovative applications in every industry, from healthcare to manufacturing to transportation. The main aim of this paper is to review studies of the 5G network based upon other researchers' work, also to carry out our research and survey. Based upon both the observations and studies that we find out, we can establish a strong review about 5G and how it can be applicable to automation and other techniques in a wide variety of fields. This paper examines the evolution of mobile wireless technology, with a focus on 5G. It discusses the key enabling technologies of 5G, the trends and challenges that 5G faces, and the applications of 5G in different manufacturing industries. The paper concludes by highlighting the role of 5G in shaping the age of unlimited connectivity, intelligent automation, and industry digitization. Detailed studies can be done further with extensive surveys in both rural as well as urban areas of a region and how 5G is affecting the overall life of people.

***Keywords*** *— fifth-generation, IoT, Artificial Intelligence, latency, connectivity and Automation, applications*

## I. INTRODUCTION

The development of new technologies like artificial intelligence (AI) and the Internet of Things (IoT) has significantly accelerated the progress of intelligent automation and industry digitization in recent years. The 5G network is the most recent innovation that promises to significantly alter these industries. The fifth generation of mobile networks, or 5G, is expected to offer stronger connectivity, reduced latency, higher bandwidth, and quicker internet speeds than its forerunners. The development of intelligent automation and the digitization of industries are predicted to be significantly impacted by this technology.

## II. LITERATURE REVIEW

The three main technology pillars that are anticipated to be used in the architecture of future 5G mobile networks are network function virtualization (NFV), mobile edge computing (MEC), and software-defined networking (SDN). These pillars are discussed in the paper "Technology pillars in the architecture of future 5G mobile networks: NFV, MEC and SDN" by Blanco et al. (2017). Network functions can be virtualized and operate on affordable hardware thanks to the network function virtualization (NFV) approach to network architecture. This could lower the cost of network infrastructure and increase its scalability and flexibility.[1] MEC is a cloud-based platform that moves storage and computational capabilities closer to the network's edge. Applications that are latency-sensitive, like augmented reality and virtual reality, can function better as a result.[1] The control plane and the data plane are decoupled in the networking architecture known as SDN. This makes network administration more adaptable and effective.Promising technologies like NFV, MEC, and SDN have the potential to enhance the functionality, adaptability, and scalability of 5G mobile networks. Before these technologies can be completely implemented, a number of issues must be resolved because they are still in the early stages of development. But these technologies have a lot of potential advantages, and they'll probably have a big impact on mobile networks in the future.[1]

The paper "Health solutions using 5G networks and M2M communications" by De Matos and Gondim (2016) discusses the potential of 5G networks and M2M communications to improve healthcare. Remote patient monitoring: Patients' vital signs and other health information can be remotely monitored via 5G networks and M2M communications. This may lower healthcare costs while also enhancing care quality.[2]

Telemedicine: Patients can consult with doctors remotely via telemedicine services, which are made possible by 5G

networks and M2M communications. For those who live in remote places or have transportation issues, this can increase access to healthcare.

Wearable technology: Smart watches, fitness trackers, and other wearable gadgets can be connected using 5G networks and M2M communications. This can assist in tracking patient health information and giving them health-related feedback. Medical supply logistics can be enhanced with the use of 5G networks and M2M communications. By doing this, it may be possible to guarantee that patients have access to the supplies they require when they require them.[2]

The air interface that will be utilised in 5G networks is called new radio (NR). Millimetre waves are one of the several frequencies that NR supports and can be used to produce very high data speeds.Multiple antennas are used in the massive MIMO technology to send and receive data from numerous devices.[5] This can help 5G networks run better, especially in congested locations.Network slicing is a method that lets administrators build several virtual networks on top of a single physical network.This can be used to support a variety of application kinds, each with unique needs. Software-defined networking (SDN): The control plane and the data plane are separated in this networking architecture. This makes network administration more adaptable and effective.[5]. Higher data rates: Compared to 4G networks, 5G networks will deliver much higher data speeds, opening up new and creative application possibilities.[4]

Less latency: Compared to 4G networks, 5G networks will have a lower latency, which is crucial for applications that demand real-time communication.

Greater capacity: Compared to 4G networks, 5G networks will be able to support more simultaneous connections of devices due to their higher capacity.[4].

Productivity growth: 5G can boost productivity across a range of sectors, including manufacturing, healthcare, and transportation. By connecting equipment and gadgets in factories, for instance, 5G can increase productivity and save costs.[10]

New revenue opportunities: 5G may open up new revenue streams for companies in the mobile gaming, streaming video, and augmented reality/virtual reality industries, for example.For instance, 5G can be used to send high-definition video material to mobile devices, opening up new income prospects for companies.Job creation: The deployment of networks, the production of devices, and the development of applications are all predicted to see an increase in employment due to 5G. For instance, 5G networks will demand more antennas and towers, which will lead to the creation of new jobs in the construction sector.[10].

Connected vehicles: 5G can be used to connect vehicles to infrastructure and to each other, enhancing efficiency and safety. To prevent accidents, for instance, 5G can be utilised to enable vehicle-to-vehicle (V2V) communication.[9]

The technology of autonomous driving, which has the potential to completely change the automotive sector, can be supported by 5G. For instance, 5G can be used to give autonomous vehicles real-time data so they can make judgements that are both safe and effective.[9]

Streaming video and gaming are two examples of the high-quality entertainment that 5G can provide to passengers in cars. 5G, for instance, can be utilised to give passengers a more immersive and interesting experience.

The economic impact of 5G on the automotive industry is predicted to reach $2.4 trillion by 2035, according to the paper's conclusion. This has the following advantages: Added security: $1.2 trillion

Efficiency gain: $0.7 trillion

New prospects for revenue: $0.5 trillion[9]

IoT devices can be used for remote patient monitoring, which involves keeping an eye on patients' vital signs and other health information. This may lower healthcare costs while also enhancing care quality.[6]

Patients can wear wearable IoT devices like smart watches and fitness trackers. This can assist in tracking patient health information and giving them health-related feedback.[6]

Medical logistics: The tracking of medical equipment and supplies is possible with IoT devices. By doing this, it may be possible to guarantee that patients have access to the supplies they require when they require them.[6].

The hurdles that must be overcome in order to realise the full potential of the IoT healthcare sector are also covered in the study. These difficulties include:

Security: Security attacks on IoT devices have the potential to expose patient privacy and data.[6]

Interoperability: Since various IoT devices frequently adhere to various standards and protocols, it can be challenging to incorporate them into a unified healthcare system.

Regulation: The deployment of IoT devices in a worldwide market may be challenging due to the fact that healthcare rules differ from country to country.[6]

.Performance: Compared to 4G networks, 5G networks should deliver much higher data rates, lower latency, and more capacity.

Use cases: A variety of novel use cases, including augmented reality, virtual reality, and the Internet of Things, are anticipated to be made possible by 5G[3].

Technology: 5G will make use of a number of novel technologies, including network slicing, massive MIMO, and millimetre waves.

5G is anticipated to be introduced in phases, with the first phase beginning in 2019 and the last phase being finished in 2025.[3]

In order to overcome the issues and realise the full potential of this new technology, the study calls for more investigation into 5G.

Increased data collection: Compared to earlier generations of networks, 5G and 6G networks will gather more information on users. The movements, pursuits, and interests of users may be followed using this information.[14]

New attack vectors: The introduction of new attack vectors by 5G and 6G networks will make it possible to breach user security and privacy. Attackers might utilise millimetre waves, for instance, to monitor user activity or take advantage of holes in the network infrastructure.

Complexity: Compared to earlier generations of networks, 5G and 6G networks will be more challenging to secure. This might make people more susceptible to cyberattacks[14].

## • III.METHODOLOGY/BRIEF-CASING

### 1. THE EVOLUTION OF CELLULAR WIRELESS NETWORKS:-

The development of mobile communications has been significantly influenced by the creation of cellular wireless networks. It can be broken down into numerous generations, each of which brings about a considerable advance in terms of capacity, speed, and coverage.

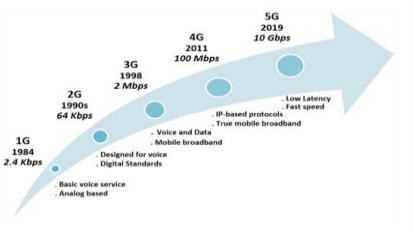
First-generation (1G) networks, which allowed for only analogue voice transmission, were initially implemented in the 1980s. Simple phone calls were the only communication option available due to the technology's lack of data or internet capabilities.

2G or second-generation networks were introduced in the 1990s and introduced digital voice communication, along with basic data services like text messaging. The introduction of digital technology enabled the use of encryption, which improved security and privacy.

3G or third-generation networks were introduced in the early 2000s and brought faster data speeds and improved voice quality. This enabled more advanced data services like mobile internet and video calling. 3G also allowed for better multimedia capabilities, including better image and video quality.

4G or fourth-generation networks were introduced in the 2010s and brought even faster data speeds, improved coverage, and better network reliability. This enabled more advanced applications like mobile video streaming and cloud-based services. 4G also introduced support for voice over LTE (VoLTE), which improved the quality of voice calls and enabled faster call setup times.

The 5G era, which will provide substantially faster download and upload speeds, lower latency, higher bandwidth, more capacity, and better coverage, is now upon us[3]. It will change the game for many industries since it will make it possible to develop new technologies and applications that were not before possible. By enabling the development of cutting-edge technology like driverless vehicles, remote surgery, and smart factories, 5G is predicted to revolutionise a number of industries, including healthcare, transportation, and manufacturing.




Fig(1): Timeline of Network

### 2. KEY FEATURES OF 5G NETWORKS

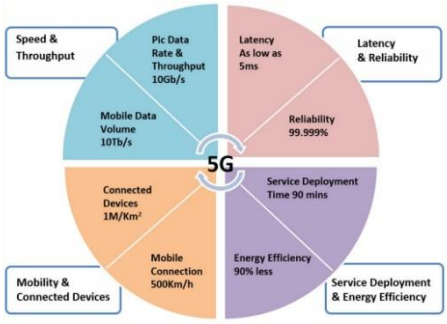
Speed: Compared to its predecessors, 5G promises to offer substantially quicker download and upload speeds. 100 times faster than 4G[1], 5G networks can attain peak rates of up to 20 gigabits per second (Gbps).

Latency: Compared to older networks, 5G networks have substantially lower latency. The amount of time it takes data to move between devices is known as latency. One millisecond of latency is possible with 5G, which is ten times faster than 4G.

Bandwidth: Compared to earlier networks, 5G provides substantially higher bandwidth. The amount of data that can be sent over a network at any given time is referred to as bandwidth. More devices can connect to the network at once with 5G, and more data can be transferred more quickly.

Capacity: The capacity of 5G networks is significantly greater than that of earlier networks. The quantity of devices that can be simultaneously linked to the network is referred to as capacity. With 5G, more devices can connect to the network without the performance of the network being slowed down.

Coverage: Compared to earlier networks, 5G networks have better coverage. With the use of a mix of high-band, mid-band, and low-band frequencies, 5G may now offer coverage in previously inaccessible places like remote areas. With significantly faster speeds, lower latency, higher bandwidth, more capacity, and better coverage than prior networks, 5G represents a substantial upgrade over them overall. It will change the game for many industries because these advancements make it possible to create new technologies and applications that weren't previously possible.




Fig(2): 5G -Network Capabilities

### 3. INTELLIGENT AUTOMATION AND ECONOMIC CONTRIBUTIONS OF 5G NETWORKS:

Manufacturing industries have adopted digitalization for a number of reasons, including boosting demand, outpacing the competition, increasing revenue by providing better customer service, cutting costs by improving productivity and efficiency, and lowering risk by enhancing safety and

security. The main obstacles and needs in the digitization of industries have recently been identified.
Ultra-reliable, flexible, instantaneous connectivity for millions of devices is just one of these criteria.
Cheap gadgets with longer battery lives.
Asset tracking along the constantly shifting supply chains.
Carrying out distant medical operations.
Improving the shopping experiences with AR/VR.
Applying AI to improve operations across the board or in several departments.

The rapid digitization of industries will depend heavily on the high-speed, secure, and reliable internet experience that 5G offers[3]. The networks and platforms needed to power Industry 4.0's digitalization and automation will be made available by it. It will facilitate the widespread adoption of crucial communications services as well as the enormous deployment of intelligent IoT.

Companies can use intelligent automation technologies like predictive maintenance, autonomous equipment, and predictive analytics to increase production, decrease costs, and improve efficiency with the advent of 5G networks. For instance, 5G networks can facilitate the deployment of intelligent automation solutions like collaborative robots (cobots) that can work alongside human workers in the industrial sector. This would increase production and efficiency while lowering the danger of workplace accidents.

The adoption of intelligent automation technologies is just one aspect of how 5G networks contribute to the economy. As they make it possible to develop new technologies and applications that were not previously possible, 5G networks are also anticipated to contribute to economic growth and the creation of new jobs. The widespread use of 5G networks is anticipated to lead to the emergence of new markets and employment opportunities.

## 4. 5G FOR THE INTERNET OF THINGS (IOT)

The Internet of Things (IoT) is predicted to be able to achieve its full potential through in large part to 5G networks. In order to create a network of interconnected "things" that can share data and carry out activities, the Internet of Things (IoT) requires connecting a wide variety of devices and sensors, from smartphones and smart household appliances to industrial equipment and autonomous cars, to the internet and each other.

The capacity of 5G networks to handle enormous volumes of data with extremely low latency is one of their main advantages for the IoT. This enables real-time data transmission between devices, allowing for prompt feedback and action. For applications like driverless vehicles, where millisecond choices can mean the difference between life and death, this is very crucial.

The fact that 5G can accommodate a significantly greater number of devices than earlier wireless technologies is another benefit for the Internet of Things. This is essential for the IoT, which will likely soon comprise billions of connected devices.

Additionally, increased security and dependability provided by 5G networks are crucial for IoT. The system provides redundancy and failover features to assure ongoing operation even in the case of network failures while also using cutting-edge encryption and authentication procedures to protect data carried over the network.

Furthermore, 5G networks support advanced network slicing features that let operators divide the network into various virtual networks that adapt to different use cases. This enables improved network resource modifying to meet the particular requirements of IoT applications.

In general, 5G networks provide the IoT with substantial benefits, such as extremely low latency, support for a large number of devices, better dependability and security, and advanced network slicing capabilities. The next wave of IoT applications, including connected health, autonomous transportation, smart cities, and industrial automation, are anticipated to be made possible by these characteristics.

## 5. 5G FOR AUTOMOTIVE INDUSTRY AND SMART CARS

5G technology is set to revolutionize the automotive industry by enabling the development of smart cars that can communicate with each other and the surrounding environment in real-time. With 5G networks, vehicles will be able to exchange information with other vehicles, road infrastructure, and the cloud, enabling a range of new applications and services.

One of the key advantages of 5G for the automotive industry is its ability to support ultra-low latency communication, which is essential for autonomous driving. With 5G networks, vehicles will be able to share sensor data and make split-second decisions, enabling safe and reliable autonomous driving.

5G networks also offer higher bandwidth and increased reliability, which are essential for a range of connected car applications, including entertainment, navigation, and safety features like automatic emergency braking and collision avoidance.

In addition, 5G networks can support vehicle-to-everything (V2X) communication, which enables vehicles to communicate with other vehicles, pedestrians, and infrastructure like traffic lights and road signs. This technology can improve road safety and traffic flow, reduce congestion, and enhance the overall driving experience.

Overall, 5G technology offers significant advantages for the automotive industry, including ultra-low latency, high bandwidth, increased reliability, and support for V2X communication. These capabilities are expected to enable the development of smart cars and advanced autonomous driving systems, paving the way for a safer, more efficient, and more connected future on the roads.

### 6. 5G for manufacturing sector and smart factory

5G technology is set to revolutionize the manufacturing industry by enabling the development of smart factories that are more connected, efficient, and flexible than ever before. One of the key advantages of 5G for the manufacturing industry is its ability to support ultra-reliable, low-latency communication. This means that devices in a smart factory can communicate with each other and with the cloud in real-time, enabling rapid decision-making and optimization.

5G networks also offer higher bandwidth, which is essential for streaming large amounts of data from sensors, cameras, and other devices in a smart factory. This data can be used to monitor and optimize production processes, identify potential issues, and make data-driven decisions[5].

In addition, 5G networks can support the development of advanced robotics and autonomous systems, which can improve efficiency and safety in manufacturing operations[4]. These systems can be used for a range of tasks, including assembly, quality control, and material handling.

Overall, 5G technology offers significant advantages for the manufacturing industry, including ultra-reliable, low-latency communication, high bandwidth, and support for advanced technologies like IoT, AI, and robotics. These capabilities are expected to enable the development of smart factories that are more efficient, flexible, and connected than ever before, paving the way for a more productive and sustainable future for manufacturing.

### 7. 5G FOR THE HEALTHCARE INDUSTRY

By enabling a variety of cutting-edge applications and services, 5G technology has the potential to completely change the healthcare sector. The development of new healthcare and remote patient monitoring technologies, as well as an increase in the effectiveness and efficiency of healthcare delivery, can all be supported by 5G's high bandwidth, low latency, and dependable connectivity[2].

Real-time, high-quality video and audio transmission is one of 5G's primary advantages for the healthcare sector. By enabling patients to receive care from the convenience of their homes and decreasing the need for in-person visits, this can be use for remote consultations, virtual diagnosis, and telemedicine treatments.

New applications and services that require high-bandwidth, low-latency connectivity may be made possible by 5G. For instance, hospitals can utilize 5G-enabled IoT devices to monitor patient health in real-time and provide more individualized treatment, while surgeons can employ augmented reality systems driven by 5G to execute complex surgeries with more accuracy and efficiency[2].

Additionally, 5G may help in the creation of connected, more effective healthcare systems, facilitating seamless collaboration and communication between patients and healthcare professionals. By revolutionizing healthcare delivery and enhancing patient outcomes, 5G has the potential to open the way for a more effective, efficient, and patient-centered healthcare system.

## • IV. RESULTS AND DISCUSSION

New degrees of automation and digitization in many industries are possible thanks to 5G. For instance, 5G can be used to link and manage industrial robots, track and improve industrial processes, and provide real-time data to decision-makers.

The effectiveness, productivity, and safety of operations can all be enhanced with 5G. Robots that are 5G equipped, for instance, can be used in hazardous locations where it is unsafe for people to work and can accomplish jobs more rapidly and precisely than human workers.

New business models and revenue potential may be aided by 5G. For instance, 5G-enabled manufacturers may provide clients with remote monitoring and control services, and they can gather and analyse data to enhance their processes.

A number of issues need to be resolved in order to properly utilise 5G's promise for intelligent automation and industry digitization, according to the case study. These difficulties include:

the requirement for new protocols and standards. Since 5G is a new technology, there aren't any established standards or guidelines for using it in industrial settings today. As a result, integrating 5G-capable systems and devices with current infrastructure may be challenging.

solutions for privacy and security are required. Large volumes of data will be collected and sent by 5G networks, making them susceptible to cyberattacks. The creation of security and privacy solutions that can safeguard this data is crucial.

The demand for qualified personnel. Automation and digitization solutions powered by 5G will need qualified individuals that are knowledgeable about the technology. It is crucial to provide training programmes that can aid in the development of this workforce.

In short we saw, how 5G has evolved with the help of previous generations of network and how it has evolved the life and technology around it. Just lets see in how many fields the 5G has been integrated and we see a massive development. Be it healthcare, automation, construction, sports etc. The 5G has helped to bring development in each field and along with generate a high revenue and overall

develop the technology. Overall, the case study found that 5G has the potential to revolutionize intelligent automation and industry digitization. However, there are a number of challenges that need to be addressed in order to fully realize this potential.

## V. CONCLUSION

.Over the following few years, 5G networks and services will be introduced in stages to create a foundation for the growth of new digital services and business models. 5G will usher in a new era in communications by offering super-fast connectivity to billions of devices. It will make it possible for devices to communicate in an IoT setting that can power an almost infinite number of services. The rapid expansion of the Internet of Things and the exponential growth of IoT use cases are made possible by 5G networks, which will also significantly benefit businesses and consumers. In addition to revolutionizing transportation, 5G networks will stably link patients and physicians worldwide, improving access to medical care.

By providing high speed, greater dependability, extreme bandwidth capacity, and low latency, 5G cellular technology will enable this next shift as digital transformation shifts user experience away from text, image, and video towards immersive VR and AR.

## VI. Acknowledgments

We would love to explicit our gratitude to Prof. Pankaj Kunekar for presenting us with the chance to carry out this case study. Also by helping and guiding us at every step of our research, testing. Whether it's helping our greater studies or giving us guidelines at every critical step. Secondly, we would love to thank everyone in the group who made this research and case-study possible. Without the entire group, we wouldn't have had the ability to finish our case-study under time constraints.

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