

Fifth Generation Wireless Network Usage in Food Industry Operations: Barriers and Benefits

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ABSTRACT

The world is currently witnessing a new industrial revolution marked by the digitization and automation of industry through Information and Communication Technologies (ICTs). The food industry is one of the largest globally and contributes to the sustainability of human existence. The majority of the activities in this industry are characterized by their dynamism, decentralization, temporality, and the involvement of a large number of personnel, machinery, and supplies. Therefore, this study assessed the barriers to the use and the benefits of adopting Fifth Generation (5G) wireless networks in the food industry operations. The study adopted a systematic literature review approach in identifying the applications of 5G wireless network in the food industry operations. Findings from the study revealed that there are various barriers to the adoption of 5G wireless network in the food industry operations as well as benefits. The study concluded that the adoption of 5G wireless network in the operations of the food industry would promote the efficiency and effectiveness of the industry. The study expanded on previous research by promoting this wireless network to help the industry raise awareness about the various barriers and benefits of the 5G wireless network applications in the food industry's operations.

Keywords: 5G, Food industry, ICT, Wireless network

INTRODUCTION

With the growing rate of technical progress and improvement, new inventions are being introduced to the market regularly (Gruber and Verboven, 2001). Despite the fact that technological advances are regarded as a crucial driving force for economic progress, dissemination of innovation is required to capitalize on their potential (Rogers, 2003) fully. After watching many diffusion processes throughout the years, two similar traits have been recognized. These include the overall slowness with which new technologies are adopted and the significant variety in the acceptance of various technologies (Pisarov and Mester, 2020). These traits, the pace of adoption and acceptability of an invention, are affected by economic, social, cultural, and geographical variables (Pisarov and Mester, 2020). Technology adoption varies by sector

due to the magnitude of the elements that drive the dissemination of innovative processes (Oliveira and Fraga, 2011; MacVaugh and Schiavone, 2010). Most technology diffusion research focuses on innovative and more established businesses because they provide a more intriguing environment for the research (Liu, Madhavan and Sudharshan, 2005).

Humanity is on the precipice of a technological breakthrough, with 5G technology only around the horizon. Although new technology advances have been growing over the years, this acceleration is most noticeable in the telecommunications business (Chen, Reilly and Lynn, 2012). The fourth generation (4G) cellular network technology, now utilized worldwide, was initially presented in 2008 (Pisarov and Mester, 2020). As the world and its inhabitants become more interconnected, an infrastructure capable of meeting the demands of this connectedness is required. Current 4G and 4.5G technologies are insufficient to support new commercial applications like artificial intelligence (AI), the Internet of Things (IoT), smart buildings and cities, and Industry 4.0 (ITU-R, 2017). Companies may increase their value offering by incorporating these applications into their business structures. Unfortunately, because of the uncertainty surrounding the adoption process of an invention and the possible impact on current business models, determining value creation prospects before the diffusion process is achieved is challenging.

Fifth generation (5G) is the up-and-coming mobile network standard that will revolutionize the mobile telecommunication industry with enhanced mobile broadband services and the introduction of numerous new features and solutions. 5G will expand the mobile network to incorporate machines, devices, vehicles, and objects and enable industries to use its services for improved performance, efficiency, and cost. Artificial Intelligence, cloud, and robotics will redefine a broad range of social and industrial sectors, driven by 5G (Tahmid, 2020). This study, therefore, aims to assess the barriers and benefits to the adoption of Fifth Generation (5G) wireless networks in the operations of the food industry. This will be achieved by using a systematic literature review approach that involves retrieving published articles in the study area to compare and contrast the opinion of scholars.

BARRIERS TO THE APPLICATIONS OF 5G WIRELESS NETWORK IN THE FOOD INDUSTRY

Although there are numerous benefits to using a fifth-generation wireless network, there are also internal and external barriers to using 5G in the food industry. Expensive investment costs, system failures, malware assaults, and high professional costs per employee are all factors to consider (Mutesi and Kyakula, 2011). maintenance costs, organizational barriers such as lack of incentives, inadequate information and communication technology strategies, lack of training, inadequate support, cultural barriers. Moreover, technological barriers such as the difficulty in adopting new technologies, the inefficient use of software, and ill-defined processes and infrastructure problems; legal barriers such as liability risks, and organizational barriers such as lack of incentives; all lead to ill-defined processes and infrastructure

problems, the lack of information and communication technology strategies, a lack of training, inadequate support, cultural issues, a reluctance to change business processes, security of ICT transactions, and issues in handling electronic information and documentation are all issues (Zaching, 2017).

As 5G networks grow to be more and more dependent on international infrastructure networks and components, exposing devices and data (both personal and corporate) or even national security to risk, 5G also presents a huge potential risk. Amount of data being transmitted makes security monitoring difficult, making it difficult to detect severe security problems on networks. In addition to the speed, volume, and latency of data transfer depending on the frequency bands utilized and the context of network usage, there are still risks of connectivity interruptions and service disruptions (Medin & Louie, 2019).

Access to the 5G infrastructure is possible via peer operators, the Internet, and third-party technologies. Each of these covers a potential security vulnerability in the system, and since service providers use the same core infrastructure, if one provider is compromised, that would be a problem for the network as a whole (Sun, 2012). The greatest disadvantage of wireless networks is security. Because of the lack of security for wireless communications, many companies have avoided implementing it on a large basis (Diakite, 2008). According to a 2005 poll by Network Computing, just around half of business respondents felt that a lack of sufficient security technologies was a barrier to wireless network adoption in their company. Many organizations are hesitant to utilize wireless technology because of a variety of assaults on wireless networks, including denial of service attacks, password theft, message alteration, and other attacks (Due & Zhang, 2006). Despite the benefits of 5G technology, which include greater network speeds, lower latency, and 100 times faster internet than 4G, the complexity of the technology poses significant challenges. Two of them are difficult to penetrate building materials and the requirement for a massive number of tiny antennas and cell towers (Zhan, 2019). Nevertheless, the radio spectrum, which comprises two distinct frequencies, poses a difficulty for 5G technology. One of these frequencies is comparable to the existing Sub 6 GHz millimeter wave (mmw) bands, which are extremely high-frequency millimeter waves. However, the mmw band over 20 GHz requires an unobstructed and clear straight path (El-Shorbagy, 2020). Furthermore, buildings, mountains, trees, buildings, and even the human body block 5G signals to various degrees, especially in densely populated regions. Another drawback is that because these waves travel less than a kilometer, they can be absorbed by the air even without any physical barriers. As a result, they will require a large number of cellular base stations to be placed across short distances, which will have an impact on the aesthetic value of the urban environment. As a result, buildings must be fitted with cellular aids for dependable in-building coverage, and new, inventive, and scalable solutions must be sought (Tobin, 2018). Cameron and Green (2020); Lines, Sullivan, Smithwick, and Mischung (2015) argued that without understanding what change implicates for the individuals undergoing it, the organization will not be able to change. It

is therefore important to mention something about individual learning and competency. Berg (2009) describes learning in relation to knowledge in the profession as the process where the practitioner can do a specific task with less time consumption and better quality. Cameron and Green (2020) argue that learning is more than just merely acquisition of knowledge. The new knowledge needs to be applied to habits and behaviors, leading to new ways of doing things. The change of applying new knowledge to an individual's behavior is described by Cameron and Green (2020) as stress on the individual's psychological space, implicating that performance will initially drop as the individual need to focus time and cognitive abilities towards the change.

The identified barriers to the adoption of 5G wireless network are highlighted as shown in Table 1.

Table 1. Barriers to the usage of 5th generation wireless network in the operations of the food industry.

S/N	Barriers to 5G usage	Sources
1.	Security risk	Medin (2019); Sun (2020)
2.	Lack of awareness	Zachiang, (2017).
3.	Signal availability in densely populated regions	Tobin (2018).
4.	Training and education of employees	Cameron and Green (2020); Lines, Sullivan, Smithwick, and Mischung (2015)
5.	Expensive investment costs	Mutesi and Kyakula (2011).
6.	5G Technological complexities	El-Shorbagy (2020).
7.	Stakeholder's knowledge of the technology	Wiewiora, Smidt, & Chang (2019) Hartmann & Dorée (2015).
8.	Reluctance to changes in business processes	Zachiang, (2017).

BENEFITS OF 5G WIRELESS NETWORK USAGE IN THE FOOD INDUSTRY

5G is the next generation of mobile network technology that aims to supplement or re-place all previous network technologies. Unlike 4G, Third Generation (3G), and any other network technologies, 5G is unique. It aims to take a much larger role and introduce numerous new features and services as well as improve the existing technologies (Tahmid, 2020). 5G allows Advanced algorithms and artificial intelligence that help interpret data rather than just analyse it, allowing for improved process management and optimisation (Al-Ali, Zualkernan, Rashid, Gupta, & Alikarar, 2017). amount of collected data would improve monitoring and analysis, resulting in heightened accountability, transparency, and accountability (Sun, 2012).

Garcia et al. (2014) established a relationship between inefficiency and poor time management and a congested pipeline of paper records. on-site communication's traditional methods lead to a delay in receiving information "just-in-time", which can lead to a "information deficit" and a "neglect of situations that need immediate attention. The only way to improve efficiency is to remove the information bottleneck. As a result, time-consuming, labour-intensive, and error-prone manual processes are often responsible for

inefficiencies and poor time management. (Garcia et al., 2014). engineers and project managers working on major projects are disillusioned with “the impracticality of paper documentation and associated processes” (Bringardner & Dasher, 2011). Avram, (2014) concluded that companies using 5G will benefit a huge return on investment since there is cost and time saving due to efficiency that comes with the wireless network.

The process benefits resulting from 5th generation wireless network applications, according to this study, are not confined to advances in communication and information exchange. 5G applications will enable the use of technology to support improvements to the work process by sharing information and learning. Because of the mobility of smart devices, which provides access to shared information at any time and from any location, wireless network applications have the “potential” to enhance material tracking, safety management, defect management, and progress monitoring, according to Khorov et al. (2018). It also provides a platform for training and learning, increased collaboration, enhanced workforce safety and security, improved food processing factory management, and real-time visualisation, sensing, and tracking. It is widely acknowledged that, when the desire and expertise exist, using technology to automate on-site data gathering saves data collection time, enables for the use of real-time data, reduces reaction time when corrective measures are necessary, and lowers the costs associated with late responses.

As a result, detecting faults early in the food production process is important for quality assurance. 5G through drone technology can reduce human interference and improve project monitoring and quality control efficiency (Elazhary, 2018). Furthermore, drone technology allows for improved administration and faster, more informed decision-making, as well as accurate high-resolution archival recordings for diverse places (Al-Ali et al., 2017). The advantages of WPMS according to Sun (2012) also include improved communication among workers in the factory, shortened production delays, an increased awareness among all workers about the production, and ease of accessing and retrieving production information. The identified benefits to the adoption of 5G wireless network are highlighted as shown in Table 2.

Table 2. Benefits of 5th generation wireless network usage in the operations of the food industry.

S/N	Barriers to 5G usage	Sources
1.	Reduced production delays	Avram (2014), Aichouni et al. (2014)
2.	Increased productivity	Al-Ali et al. (2017)
3.	Improved material tracking	Khorov et al. (2018)
4.	Improved safety on production sites	Chen et al. (2012); Khorov et al. (2018)
5.	Improved progress monitoring	Mutesi and Kyakula (2011)
6.	Improved communication among production team	Sun (2012)
7.	Improved quality control using drone for inspection	Mutesi and Kyakula (2011)
8.	improved project administration	Al-Ali et al. (2017)
9.	Faster and more informed decision-making	Khorov et al. (2018)
10.	Simplified working methods	Mutesi and Kyakula (2011)
11.	Improved process management	Al-Ali et al. (2017)

CONCLUSION

The literature reviewed revealed that the perceived barriers to the usage of 5G in the food production are expensive investment costs, security risks, among others. The literature reviewed also revealed that the benefit of using 5G in the food production operations are improved safety on production sites, improved process management, increased productivity, among others. Based on the findings, the following conclusions were made:

- i. 5G wireless network is a significant technological spotlight that can help increase the effectiveness of communication and data sharing during the production operation in a typical food processing factory.
- ii. Communication has prospects to be the backbone of the food industry and therefore, there is a significant need to understand and address the barriers in 5G usage to foresee a future where 5G will be embedded as a ubiquitous tool to support the operations in the food industry.
- iii. Although there are barriers to the usage of 5th generation network in the food industry as identified on literature, there are numerous benefits to the usage of the 5G wireless network.

Therefore, the following are recommended:

- i. The food industry can employ approaches that can reinforce 5G use in the industry.
- ii. Research and academia should develop appropriate tools to evaluate the benefits of using innovations in the food industry. This will explore the uncertainty of return on investment.

Training should be done to build workers' confidence in the use of the 5G wireless network.

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