Enhancing Workforce Performance and Applications Toward Industry 5.0 with the 5G Conceptual Framework in Malaysia

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ARTICLE INFO	ABSTRACT
                   	As part of its "industry revolution plan," also known as "Industry4WRD," Malaysia has accepted and implemented contemporary technology, transforming Malaysia's diverse industrial sectors. We are currently well-established fourth Industrial Revolution of human history. The range and sophistication of digital instruments have increased significantly in recent years. Everything from robots to the Internet of Things (IoT) devices, communications infrastructure, data centres, and their power requirements. The manufacturing industry must develop innovative technologies, designs, structures, and concepts for communication and data storage to enhance the digital world's functioning and reduce the amount of energy necessary to operate it. Industry 5.0 is the next wave of industrial innovation, and industry experts eagerly anticipate its arrival. To increase industrial efficiency and flexibility, digitalisation and AI-driven technologies have supplanted the original goals of Industry 4.0, which included social fairness and sustainability. One interpretation of Industry 5.0 is that it is the return of the "human-centred" emphasis of Industry 4.0. By prioritising the well-being of people and the planet over pursuing financial gain, technological breakthroughs in industrial production would acquire a renewed sense of purpose and direction. A literature search was conducted to learn more about the first description of Industry 5.0. By utilising this strategy for systematic literature research, we could understand the concept and the most recent advancements in various published works. Following this, we used the software NVivo to develop a conceptual framework congruent with the study's objectives.

1. Introduction

In the current global economy [1], Fifth-generation (5G) mobile communication technology has become the new norm [2]. 5G, the latest wireless internet technology, promises to revolutionize our everyday lives and corporate practices. Its enhanced speed and ability to manage a growing number of connected devices and advancements will enable a tidal wave of novel software and hardware. The GSM Association anticipates that more than 1.7 billion people will have joined 5G networks

worldwide by 2025. The 5G network will handle around 212 billion sensors and 50 billion intelligent devices [3-4]. In addition, 5G will have a tenfold lower energy footprint, doubling the battery life of connected devices [5-8]. The technological breakthrough that allows us to travel at the speed of light has drastically altered our way of life [9]. It enables connectivity to many devices whose average traffic profile consists of occasional tiny amounts of data. The 5G and the Internet of Things (IoT) will transform several technological sectors. For example, 5G and IoT will send real-time data to corporate, operation, and facility systems [10].

More businesses are adopting a data-driven decision-making system, which is critical for forecasting future performance and optimizing operational efficiencies. To facilitate this change, exponentially higher data rates and low latency will produce a more responsive network and pave the path for more internet-enabled intelligent devices to be integrated along the corporate value chain. This will allow faster, safer, and more dependable procedures [11]. However, the 5G journey will ultimately depend on the desire and skills of the three ecosystem players: telecom carriers, businesses, and regulators [12]. Figure 1 illustrates the 5G Future International Mobile Telecommunications (IMT) map.
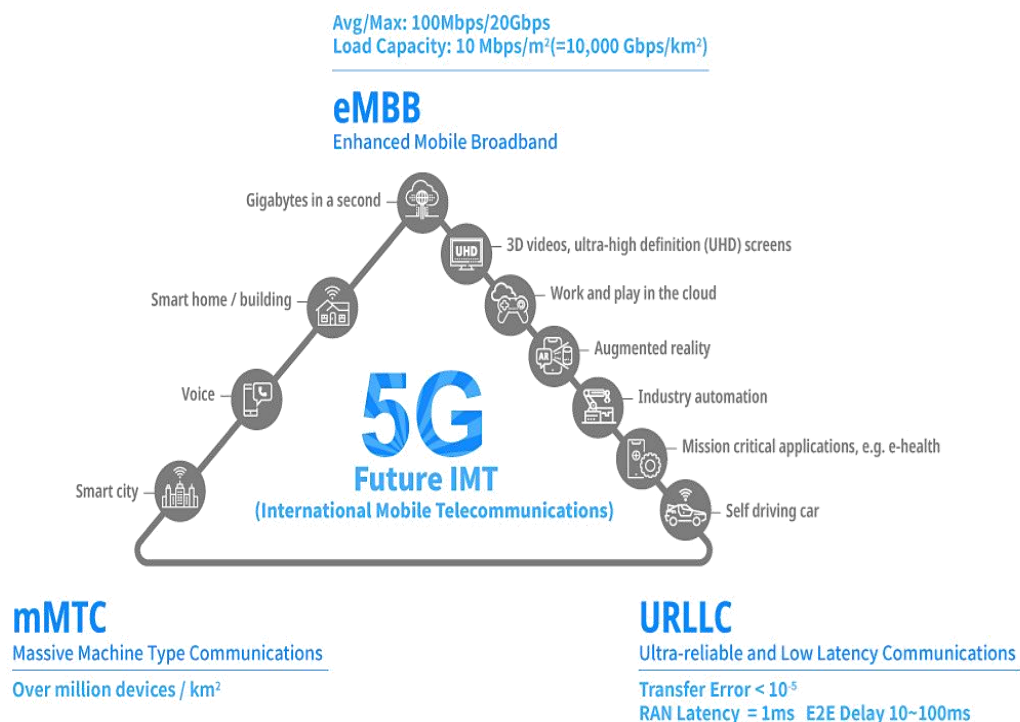

Fig. 1. 5G future IMT

1.1 5G Technologies as Catalyst for the Next Industrial Revolution

The advent of 5G technology will allow mobile to move beyond the realm of consumers and businesses and into the realm of industry, ushering in a new era of unparalleled connection between humans and their physical surroundings. Compared to previous generations, 5G has drastically different technical specifications and capabilities [13]. Many kinds of radios can be used in many final devices. The standard supports licensed and unlicensed bands, a common frequency range, and private and public networks. Because of its incredible flexibility, 5G can serve various industrial applications [14]. Mobile ecosystem players will need in-depth knowledge of the industries and use cases they are targeting to break into these markets successfully. In several of these fields, the

average lifespan of a device will be more than ten years. However, many would like a private network, a guaranteed chunk of the internet, and assured service. This variety of application domains and device types is a crucial factor in economic impact analysis. Furthermore, it clarifies why specific markets have a higher adoption rate than other fields [15]. As a result, the worldwide 5G connections broken down by use cases are shown in Figure 2.
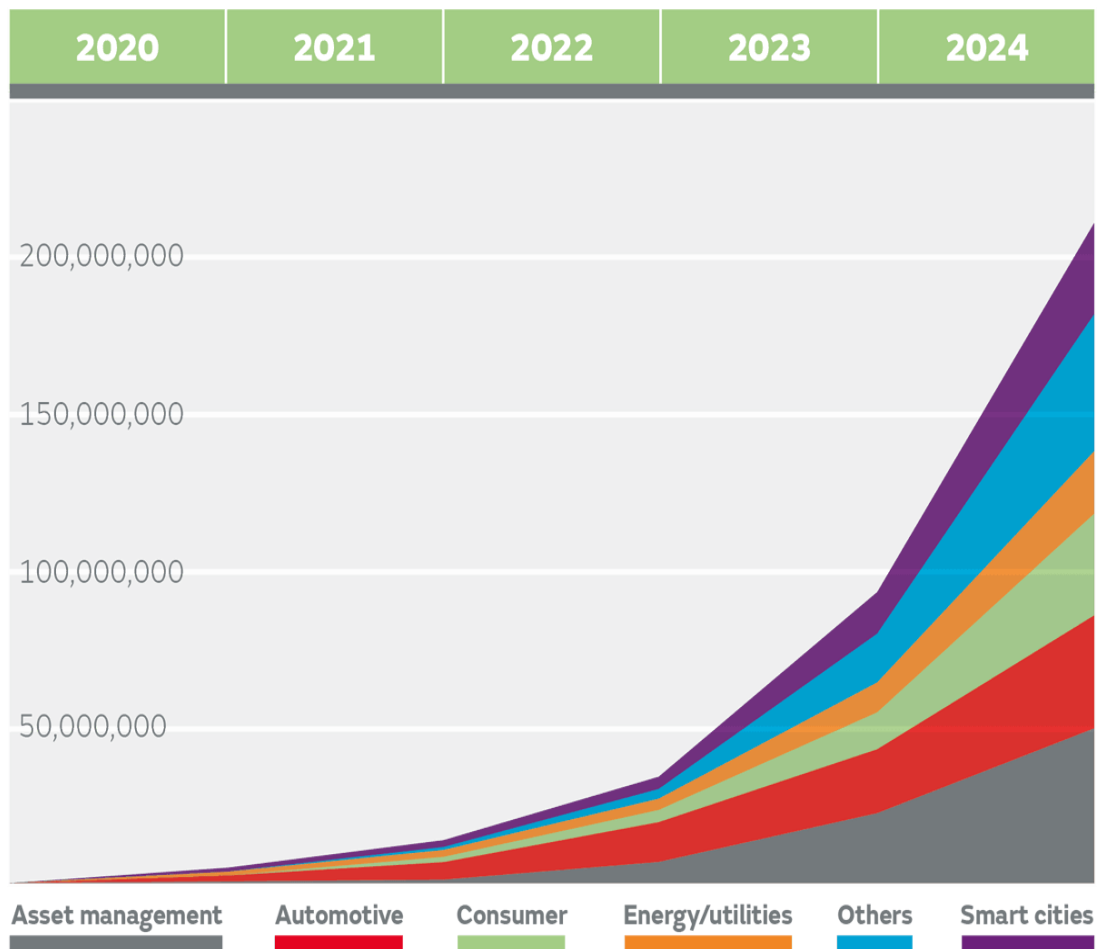

Fig. 2. Global 5G connections by applications (Source: Informa Tech)

1.2 The Impact of 5G Applications

The introduction of 5G networks will improve operations across virtually all sectors. The more widely adopted and used 5G is, the more it will help transform mobile technology into a GPT. However, the timeliness and widespread adoption of the new business models made possible by 5G will depend on each sector's economic and regulatory environments. For this report, IHS Markit used 2035 as the base year. IHS Markit predicts that 5G-enabled worldwide sales activity across various industries may reach $13.2 trillion by 2035 if the standards process, regulatory environment, and industry adoption develop, as indicated in this analysis. In 2035, this will amount to about 5% of the total world output [16]. Projected sales figures for 2035 are shown in Figure 3.

Sales enablement data should be used with caution. The sales enablement metric is not intended to substitute for measures of actual economic output anywhere in the world. The sales activity that will be enabled by 5G across the sixteen ISIC industrial sectors is instead measured by sales enablement. This includes sales to ultimate consumers and business purchases for use in the production process (i.e., final demand). As an illustration of a medium asset, consider the tires,

batteries, and other parts that a car maker must get from vendors before beginning assembly. When completed, the car is sold to a dealer (yet another middleman) before finally reaching the buyer (final demand). From the moment a vehicle is ordered until a client drives it off the lot, every transaction is recorded and analyzed to understand the sales enablement process better.

On the other hand, gross domestic product measures how much money people are willing to spend on products and services in a country. In this case, GDP would reflect just the final consumer purchases. Therefore, the sales enablement metric will have a far more enormous impact on the GDP.
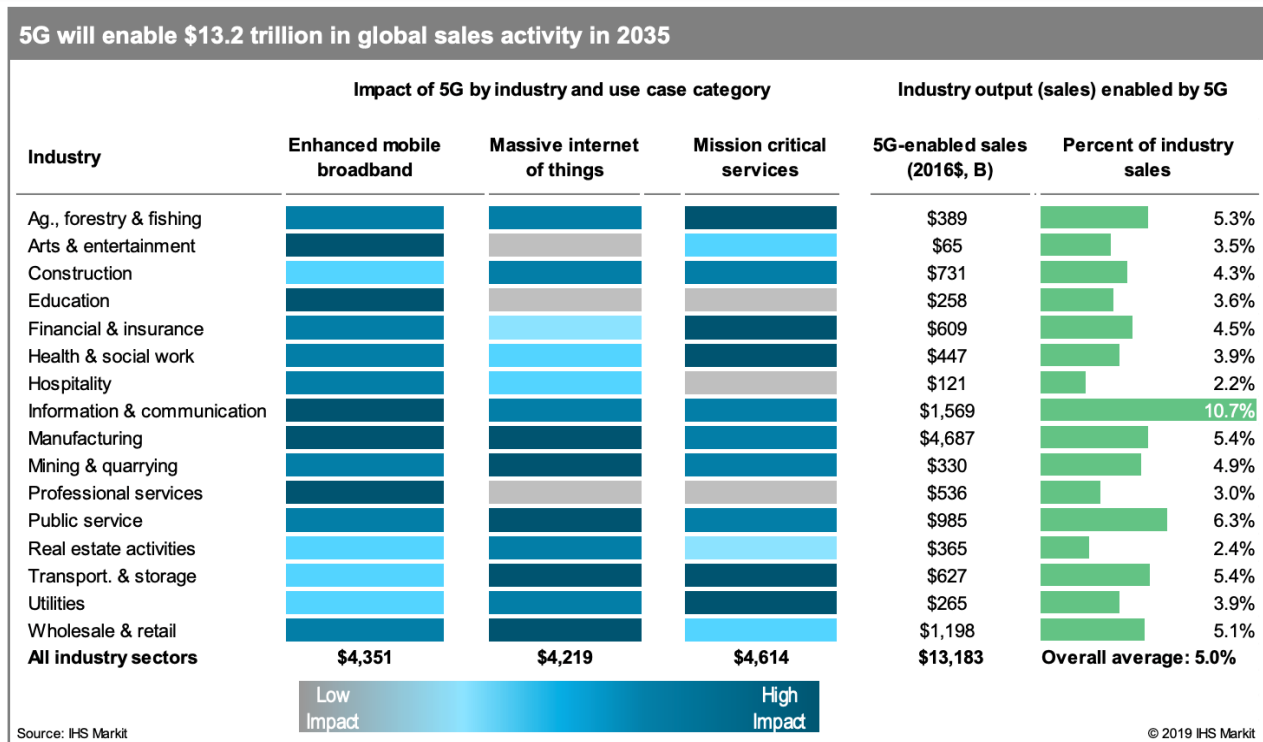

Fig. 3. 5G tentative global sales activity by 2033 (Source: HIS Markit)

1.3 The 5G Application in Malaysia

The primary objective of this study is to guarantee that Malaysia's workforce is prepared for the deployment of 5G networks by investigating and identifying the 5G network's competencies and abilities. Furthermore, with the involvement of 5G industry players, a strategic conceptual framework will be developed and analyzed. Finally, stakeholders will verify the conceptual framework to ensure the validity of the study output. Malaysia requires a framework to assist the development of an Industry4WRD professional workforce towards Industry 5.0 competitiveness along the whole value chain, including connectivity aspects (5G-related skills and competencies) [17]. The strategic framework is anticipated to facilitate establishing industry-wide 5G application competency programs. In addition, the verified framework may serve as a basis and guidance for future skilled workforce competence areas for 5G-related vertical businesses. Figure 4 depicts the work activities by vertical industries and the required customized resources.

The research objectives identified for this study are the following

    i.   RO1 - To determine the concept of competencies readiness for the enhancement of workforce performance in 5G applications

ii.   RO2 - To assess the group of competencies for the enhancement of 5G workforce performance in selected vertical industries; and

iii.   RO3 - To propose a concept of an implementation framework for a competencies development program for the enhancement of 5G workforce performance in selected vertical industries
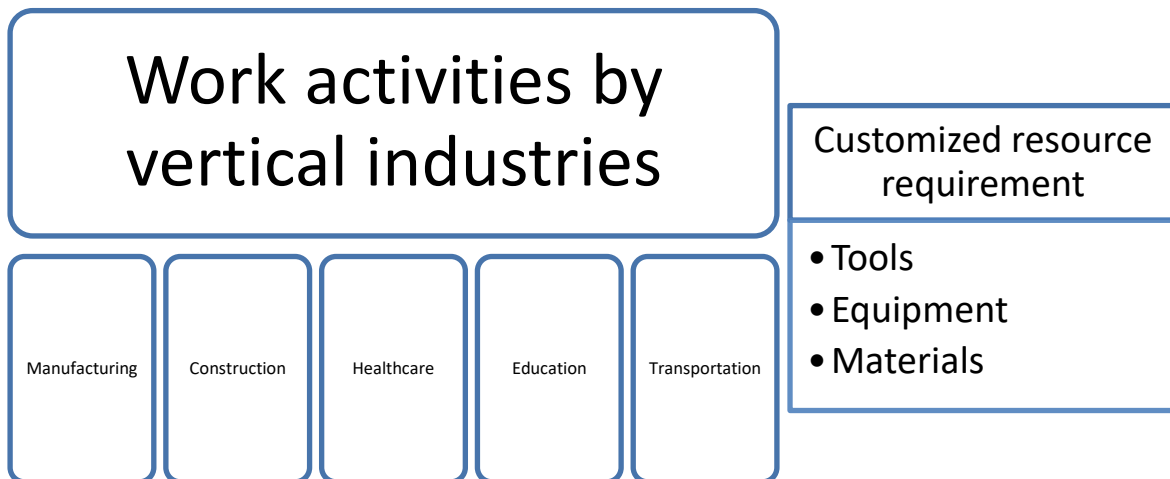
Work activities by vertical industries

| Manufacturing | Construction | Healthcare | Education | Transportation |

Customized resource requirement

- Tools
- Equipment
- Materials

Fig. 4. Work activities by vertical industries and required customized resources

The paper is organized as follows. Section 1 briefly discusses the importance and future requirements of 5G. It also discusses the technology trends around the world. Section 2 presents the methodology adopted for the study. Finally, section 3 contains a discussion on the conceptual framework developed; it also gives the conclusion and suggestions for future work.

2. Methodology

Industry 5.0 was first described to learn more, and a literature search was performed. Using this method, we could gain an in-depth comprehension of the idea and the most current advances discussed in several publications. The terms "Industry 5.0," "Industry 4.0," "5G competencies," "readiness", and "human-centric" (a synonym for "human-centered") were utilized to search for relevant publications in reputable scientific databases like Scopus® and Web of Science (WoS). To supplement the rationale for the investigation, a conceptual framework was created through a systematic literature review utilizing Nvivo software.

The telecommunications and system networks business in Malaysia employs various telecommunications systems. Multiple business sectors use wired, wireless, and satellite forms of communication. The 5G wireless communications system is the topic of this study since it is helping to increase the urgency of businesses adopting the concept of the industrial revolution. This research utilised the Industry4WRD profile to acquire information specific to the connection technology of the studied firms and literature.

3. Results

The data analysis findings and the systematic literature research indicate that cultivating talent capabilities is necessary for advancing shift factor connection technology. The staff needs to receive training on Industry 4.0, which limits their exposure to the technology and their knowledge and skills. Few companies invest in competency standards, training needs analysis or learning and development

programs for their employees about the four pillars of technology that comprise "Industry 4.0." It is reasonable to deduce that most employees need Industry 4.0 competency, given that the bulk of tasks is governed by employees' job requirements and required skill sets. Most executives currently holding positions were brought on board in 2019. Thus, they are still relatively new to their jobs. As a result, they tend to work in silos with little to no communication. Finding and employing people with the proper education, experience, and mindset for the I4.0 revolution has become more complicated in recent years.

Acquiring workforce candidates in Sarawak with the needed skills, knowledge, and hot mentality for the I4.0 transformation is becoming increasingly difficult. It is difficult for a corporation to hire or recruit persons for positions relating to design and fabrication because there are only a limited number of highly qualified and experienced professionals and graduates in these fields. Many businesses have pointed to the need for dedicated IT workers as one of the obstacles in their path to Industry 4.0 competency in personnel. It is necessary to find a solution to this issue that encourages the growth of appropriate competencies and skill sets to improve the application of 5G technology.

3.1 The Conceptual Competency Framework

As shown in Figure 5, a conceptual framework is provided to assist the organisation in establishing strategic competencies and skill sets for using 5G technology. The conceptual framework was built using the programme Nvivo to analyse the data gathered from the systematic literature review. Using this framework, the competencies are broken down into their most fundamental forms, which are organisational and technical. In addition, it divides the two basic levels into subgroups based on the complexity of the enterprise, the operations, and the facilities. On the other hand, job titles are directed to the subsets and the fundamental competencies.
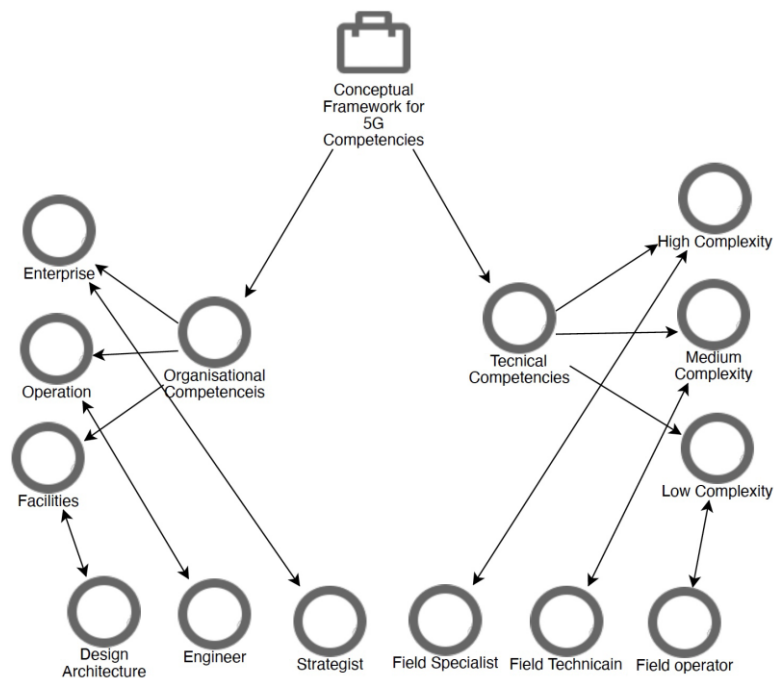

Fig. 5. Conceptual Framework developed using Nvivo Software

4. Conclusions

As part of this project, a conceptual competence framework for 5G technology applications was built using a thorough literature assessment. The framework's structure can help the corporation determine the critical requirements for the organisation's effective adoption of 5G technology. Instead of emphasising traditional administrative positions, the framework will strategically balance the technical competency unit's staff growth and acquisition objectives. The two basic competency levels serve as a starting point for organisations to customise their competency units and work activities to the needs of industrial revolution projects and programmes. This can improve the success of the second phase of the Industry4WRD intervention programme, particularly in competency development. In addition, the validated framework is used in industrial sectors and policy formation for the Malaysian human capital project, including strengthening the national skills standard and establishing the national skills standard.

Acknowledgement

References

[1] Iqbal, Muhammad Saqib, Zulhasni Abdul Rahim, and Syed Aamer Hussain. "Digital Disruption and COVID-19: A Review on the Paradigm Shift in Pakistan." *Journal of Advanced Research in Applied Sciences and Engineering Technology* 24, no. 1 (2021): 28-36. https://doi.org/10.37934/araset.24.1.2836

[2] Iqbal, Muhammad Saqib, Zulhasni Bin Abdul Rahim, Syed Aamer Hussain, Norulhusna Ahmad, Hazilah Mad Kaidi, Robiah Ahmad, and Rudzidatul Akmam Dziyauddin. "Mobile Communication (2G, 3G &4G) and Future Interest of 5G in Pakistan: A Review." *Indonesian Journal of Electrical Engineering and Computer Science* 15, no. 3 (2020). https://doi.org/10.11591/ijeecs.v22.i2.pp1061-1068

[3] O'Hara, John F., Sabit Ekin, Wooyeol Choi, and Ickhyun Song. "A perspective on terahertz next-generation wireless communications." *Technologies* 7, no. 2 (2019): 43. https://doi.org/10.3390/technologies7020043

[4] Rahman, Md Mijanur, Fatema Khatun, Sadia Islam Sami, and Ashik Uzzaman. "The evolving roles and impacts of 5G enabled technologies in healthcare: The world epidemic COVID-19 issues." *Array* (2022): 100178. https://doi.org/10.1016/j.array.2022.100178

[5] Monserrat, Jose F., Genevieve Mange, Volker Braun, Hugo Tullberg, Gerd Zimmermann, and Ömer Bulakci. "METIS research advances towards the 5G mobile and wireless system definition." *EURASIP Journal on Wireless Communications and Networking* 2015, no. 1 (2015): 1-16. https://doi.org/10.1186/s13638-015-0302-9

[6] Al-Falahy, Naser, and Omar Y. Alani. "Technologies for 5G networks: Challenges and opportunities." *It Professional* 19, no. 1 (2017): 12-20. https://doi.org/10.1109/MITP.2017.9

[7] Klaine, Paulo Valente, Muhammad Ali Imran, Oluwakayode Onireti, and Richard Demo Souza. "A survey of machine learning techniques applied to self-organizing cellular networks." *IEEE Communications Surveys & Tutorials* 19, no. 4 (2017): 2392-2431. https://doi.org/10.1109/COMST.2017.2727878

[8] Fourati, Hasna, Rihab Maaloul, and Lamia Chaari. "A survey of 5G network systems: challenges and machine learning approaches." *International Journal of Machine Learning and Cybernetics* 12 (2021): 385-431. https://doi.org/10.1007/s13042-020-01178-4

[9] Iqbal, Muhammad Saqib, Z. Abdul Rahim, and Syed Aamer Hussain. "Industry 4.0 revolution and challenges in developing countries: a case study on Pakistan." *Journal of Advanced Research in Business and Management Studies* 21, no. 1 (2020): 40-52.

[10] Remmert, H. "What Is 5G Network Architecture." *Digi International* (2021).

[11] DHL, "5G: Five Things It Means for Logistics," https://lot.dhl.com/5g-five-things-it-means-for-logistics. 2019.

[12] Menon, Naveen. "5G in ASEAN: Investments, challenges and growth scenarios," in *Linkedin Newsletter* vol. 2022, ed: LinkenIn, 2019.

[13] Attaran, Mohsen. "The impact of 5G on the evolution of intelligent automation and industry digitization." *Journal of Ambient Intelligence and Humanized Computing* (2021): 1-17. https://doi.org/10.1007/s12652-020-02521-x

[14] Rao, Sriganesh K., and Ramjee Prasad. "Impact of 5G technologies on industry 4.0." *Wireless personal communications* 100 (2018): 145-159. https://doi.org/10.1007/s11277-018-5615-7

[15] Nguyen, Huan X., Ramona Trestian, Duc To, and Mallik Tatipamula. "Digital twin for 5G and beyond." *IEEE Communications Magazine* 59, no. 2 (2021): 10-15. https://doi.org/10.1109/MCOM.001.2000343

[16] Campbell, Karen, Jim Diffley, Bob Flanagan, Bill Morelli, Brendan O'Neil, and Francis Sideco. "The 5G economy: How 5G technology will contribute to the global economy." *IHS economics and IHS technology* 4, no. 16 (2017): 1.

[17] Zulhasni, A. R., J. Kamaliah, Y. Muhamad Roslan, and WMA Wan Md Syukri. "A review of talent adaptive concept and conceptual framework of accelerated Industry4WRD talent adaptation in Malaysia." *Journal of Advanced Research in Business and Management Studies* 21, no. 1 (2020): 10-18. https://doi.org/10.37934/arbms.21.1.1018