

5G Technology and Its Impact on the Global Economic Landscape

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Abstract: This paper examines the pervasive impact of technology and the Internet on the global economy, with a particular focus on the evolution of mobile telecommunications technologies and the potential implications of the introduction of 5G networks. The analysis is based on a survey of respondents' perceptions of the impact of 5G technology on the business environment, using quantitative and qualitative research methods, including a survey conducted among residents of the Republic of Croatia and the Republic of Slovenia. The paper aims to understand how 5G can reshape the global economy, create new business models, jobs and generate higher revenues, with research on technical aspects and the potential benefits and challenges that 5G brings to different sectors of the economy. The primary focus is on identifying the key advantages of 5G technology compared to previous generations of networks and its possible contribution to further economic growth and innovation, while the respondents' perception of the technical aspects and potential impact of 5G on the global economic environment is also explored.

Keywords: 5G technology; economic impact; global economy; innovation and development; mobile telecommunication technologies

1 INTRODUCTION

The use of technology and the global dependence on it is growing day by day and nowhere is this more evident than in the use of the Internet. Today's world is highly interconnected where a globalized economy, technology and the Internet play a key role in enabling economic growth and innovation. From communications and transportation to commerce and finance, technology is changing not only the way we live, but also the way businesses work and communicate with each other and with their consumers. The Internet is one of the key factors that increasingly drives economic growth and competitiveness, both within individual countries and at the global level. As such, continued investment in technology and its development are critical to the continued success of the global economy. One such technology is the various generations of mobile telecommunications that have been developed and introduced over the past few decades. While 1G (First Generation) and 2G (Second Generation) were significant generations in their own right, it was only with the advent of 3G (Third Generation) that the technology became influential enough to become widely known beyond strictly technical individuals and businesses.

Although the impact of 4G (fourth generation) cannot be underestimated, the world is only entering a potentially revolutionary technological era with the arrival of 5G (fifth generation) networks that could affect the global economy to an unprecedented extent. At a basic technical level, 5G brings significant improvements in terms of speed, latency and connectivity compared to 4G networks. In essence, the widespread deployment of 5G networks will bring new and innovative applications and services that were simply not possible using 4G. Although the technological leap from 4G to 5G is much wider than from 3G to 4G, it is still possible to measure the impact of 5G technology by looking at how 4G transformed the socio-economic landscape when it replaced the previous, 3G network technology. With this in mind, this paper will create an overview of the improvements that occur with 4G networks and use them to analyze the economic impact of 5G networks. The paper will also create an overview of the main technologies driving economic growth, analyzing how they are affected by the development of 5G

networks. The goal is to investigate, present, and determine respondents' perceptions of the key benefits of 5G technology on their business environment.

2 LITERATURE REVIEW

The rapid advancement of technology makes it difficult to correctly measure and predict its impact on economic growth. Since economic growth is a slow and gradual process that takes time to develop and observe, it is entirely possible that a rapidly developing new technology will render all observations and predictions completely obsolete. In the past decade, many different technologies have emerged that are significantly important for economic growth. While these may vary by region and industry, there are some that have taken their place in the socio-economic landscape and are shaping the global economy:

- Artificial Intelligence (AI) and Machine Learning (ML): AI and ML are increasingly used to automate processes and increase business efficiency (McKinsey Global Institute, 2018). This is particularly important in logistics, where artificial intelligence has enabled massive data analysis in different links of the supply chain, and digitalized logistics lead to improvements and acceleration of logistical processes, strategies, and systems, are more available and customer-focused, leading to faster delivery methods. They incorporate machine learning elements for making critical data-based decisions and continuously improving supply chain processes [20].
- Internet of Things (IoT): IoT enables devices to collect and exchange data, leading to the development of new products and services. The combination of new technologies such as machine learning and artificial intelligence can easily be implemented in comprehensive IoT solutions, making IoT even more effective in process automation, creating new value for companies, and generating increased financial revenues [18].
- Blockchain: Blockchain technology is used to create new financial systems, reduce costs, increase transparency, and develop new business models [11].
- 5G and Other Telecommunication Technologies: Advanced network systems are crucial for the development

of new products and services, as well as for connecting businesses and consumers [4].

- Cybersecurity: A combination of advanced software that becomes increasingly important for protection against cyber-attacks and safeguarding sensitive data (World Economic Forum, 2019) [17].
- Renewable Energy Technologies: Renewable energy technologies, such as solar and wind energy, are becoming increasingly important to reduce dependence on non-renewable energy sources and encourage further innovations (OECD Report, 2015).

Although they fall into separate categories, the above-mentioned technologies are increasingly interconnected as the advancement of one influences the advancement of another. This is particularly the case with telecommunication technologies, as all the mentioned technologies depend on access to advanced systems powered and utilized through internet connection. In this sense, the fifth generation of telecommunication networks, or 5G, is the most significant emerging technology that will impact the socioeconomic landscape in the future. According to Rodriguez [15], 5G is the fifth generation of wireless communication technology and has the potential to revolutionize the way we connect and communicate. 5G is designed to be faster, more reliable, and more efficient than its predecessor, 4G, and is developed to support the growing demand for data-intensive applications. A technical comparison of different generations of network technologies is something that should be considered when measuring technological progress, as it is directly related to the use of technology in terms of economic growth. According to the International Telecommunication Union (2020) [10], the main components of network architecture between 3G, 4G, and 5G are:

- Radio Access Technology (RAT): All three generations use radio waves to transmit and receive data.
- Multiple Access Technology: All three generations use multiple access technology to allow a larger number of users to share the same frequency spectrum. For example, 3G uses WCDMA (Wideband Code Division Multiple Access), 4G uses LTE (Long-Term Evolution), and 5G uses both LTE and NR (New Radio).
- Frequency Bands: All three generations use different frequency bands to transmit data. 3G primarily uses the 2G frequency band, while 4G and 5G use more frequency bands of 3G and 4G, respectively.
- Data Transfer Speed: All three generations aim to provide higher data transfer speeds compared to their predecessors. 3G enabled a peak data transfer speed of 2 Mbps, 4G enabled a peak data transfer speed of 1 Gbps, and 5G aims to provide peak data transfer speeds up to 20 Gbps.
- Network Architecture: All three generations use a network architecture that includes a core network and a radio access network. The core network is responsible for routing and switching data, while the radio access network is responsible for transmitting and receiving data through the air.
- IP-based Communication: All three generations use the Internet Protocol (IP) as the primary means of communication. This allows seamless integration with other IP-based technologies, such as the internet.

The underlying technologies that drive each generation of telecommunications networks are improving in ways that either massively improve existing use cases or create entirely new ones that were not possible before. According to a group of authors in McKinsey Quarterly 2 (2017), this has proven to have a significant economic impact, bringing increased productivity, job creation and GDP growth. The same applies to industry-specific impacts, particularly in commerce (with an emphasis on retail due to the need for highly personalized communication), transportation, healthcare, agriculture, manufacturing and logistics. As a result of technological advances with the introduction of the 5G network, retailers have more and more options available that represent a great potential to improve the shopping experience for customers [6]. With these advances, a large proportion of customers have access to use their mobile phones in physical stores, allowing them to receive new information at the point of purchase [5]. At the same time, the mobile phone can be one of the biggest influencing factors on consumer buying behavior during retail sales [12]. The use of mobile phones in retail is therefore gradually opening up various questions among academics and retailers [2].

In terms of productivity, each subsequent network technology has brought faster data transfers, better real-time analytics, and more efficient automation, enabling new business models that can take full advantage of them. Innovations are the basis of improvement and the driving force behind the development of every economic area in a country, and technological innovations are those that relate to changes in technology and that reflect technological progress in a narrower sense [13].

Deloitte's report on 5G (2020) states that both the development of the technology and its implementation have the potential to create new jobs, as well as completely new job categories in the domain of augmented reality, the Internet of Things and smart cities. In particular, infrastructure development creates opportunities for more engineers, technicians and construction workers involved in the design, installation and maintenance of infrastructure. The telecommunications industry creates opportunities for positions related to network management, data analysis, and cyber security, while also creating demand for workers in third-party companies that manufacture and supply equipment such as chipsets, antennas, and radio units. Application development is increasing the demand for software developers, UX/UI designers, data scientists among many other types of IT professionals.

Innovations and digital transformation are ready to become a new driver of economic growth. The key to success in today's world is rapid development based on continuous innovation [19].

3 RESEARCH METHODOLOGY

3.1 Research Problem, Objectives, Hypotheses, and Questions

The research problem of this paper is to examine the impact of modern technologies on the development of the world economy, with a specific focus on exploring the potential impact of the 5G network on the global economy through quantitative and qualitative research methods.

The fundamental hypothesis of this paper states: "5G technology will provide a new platform for growth and development of the global economy", and the auxiliary hypothesis states: "5G technology will create new business models, jobs, and higher revenues".

Where applicable, qualitative research was used to gain a deeper understanding of the subjective experiences and opinions of stakeholders in the 5G ecosystem. This included conducting a survey using a random sample method from the regions of the Republic of Croatia and the Republic of Slovenia, with questions related to how often respondents use mobile devices such as smartphones and tablets that support 5G technology, and how well they understand the technical aspects of 5G technology and its impact on the global economic environment. Furthermore, respondents were asked about their expectations of 5G technology in terms of its impact on the global economic environment, which economic sectors they see as most promising in terms of 5G technology application, the advantages and challenges they see in implementing 5G technology in their business environment, the importance of speed, reliability, and low latency in their mobile devices, and how 5G technology could improve their business and personal activities. They were also asked whether they believe that 5G technology could provide new employment opportunities and create new jobs in various sectors of the economy and what risks they see in the implementation of 5G technology, especially in terms of data security and environmental impact.

This resulted in a nuanced, deeper understanding of the challenges and opportunities associated with 5G technology and its impact on the global economy. The results of a study conducted in 13 countries around the world show that many customers begin their shopping journey with online research through their mobile phones, even before visiting a store. This personal "survey" is also known as "we-brooming" and plays an important role during the retail process. The study further indicates the importance of personalized communication with customers [7].

Authors Bues [1] and author Roy [16] also discuss its importance and emphasize the need for highly personalized communication with specific customers in the retail process, as customer segmentation and division into certain groups can be a useful tool for achieving personalized communication with customers.

The quantitative and qualitative research methods in this sense aimed to provide a comprehensive and in-depth analysis of the potential impact of 5G on the global economy, and the conclusions drawn based on the research are presented in the final part of the paper.

4 PRESENTATION AND INTERPRETATION OF RESEARCH RESULTS

4.1 Sample Research

272 respondents from the Republic of Croatia and the Republic of Slovenia took part in the survey conducted for the purposes of this work, using the method of random sampling, and all answers were anonymous. The survey questionnaire was distributed online on social networks

Facebook and Instagram, in a period of one month, from April 3 to May 5, 2023. For the purposes of this paper, 9 questions from the survey questionnaire were analyzed using a Likert scale.

4.2 Research Results

Tab. 1 shows the profile of respondents by sociodemographic characteristics. Out of a total of 272 respondents, 156 respondents (57.4 %) are female, and 116 respondents (42.6 %) are male. With regard to the age structure, it was the following number of respondents: in the range of 18 to 25 years, 31 of them (11.4 %), from 26 to 33 years 74 respondents (27.2 %), in the age range of 34 to 41 years is 87 respondents (32 %), 35 respondents (12.9 %) are aged 42 to 51, 43 respondents (15.8 %) are 52 to 61 years old, while 2 respondents (0.7 %) are 62 and several years. According to the level of education, the structure of the respondents is as follows: among the respondents, there are no persons with completed elementary school. There are 124 respondents (46.6 %) who have completed secondary school, while 140 respondents (51.5 %) have a university degree, 2 respondents (0.7 %) have a master's degree in profession or science, and 6 of respondents (2.2 %) has a doctorate in science.

Table 1 Profile of respondents

Sociodemographic characteristics	Frequency (N)	Percentage (%)
Age		
18 – 25	31	11.4
26 – 33	74	27.2
34 – 41	87	32.0
42 – 51	35	12.9
52 – 61	43	15.8
62 and more	2	0.7
Sex		
male	116	42.6
female	156	57.4
Level of education		
Elementary School	0	0
High School	124	45.6
College	140	51.5
Master of Science or Profession	2	0.7
Doctor of Science	6	2.2

Table 2 Structure of respondents by employment sector

Employment sector	Frequency (N)	Percentage (%)
Public sector	73	26,8
Private sector	161	59,2
Craft	24	8,8
Family farm	3	1,1
The unemployed	7	2,6
Student or learner	4	1,5

Tab. 2 shows the structure of respondents by employment sector. Out of a total of 272 respondents, 73 (26.8 %) were employed in the public sector, 161 (59.2 %) in the private sector, 24 (8.8 %) in trades, 3 (1.1 %) in family farms, there were 7 unemployed respondents (2.6 %) and 4 students or pupils (1.5 %).

Fig. 1 shows how users use 5G technology, with 157 respondents (57.7 %) using 5G-enabled mobile devices on a daily basis, indicating a high rate of 5G usage and adoption

among these respondents. A smaller number of respondents, 28 (10.3 %) use 5G devices several times a week, and a very small number of respondents, 5 (1.8 %) use 5G devices only a few times a month.

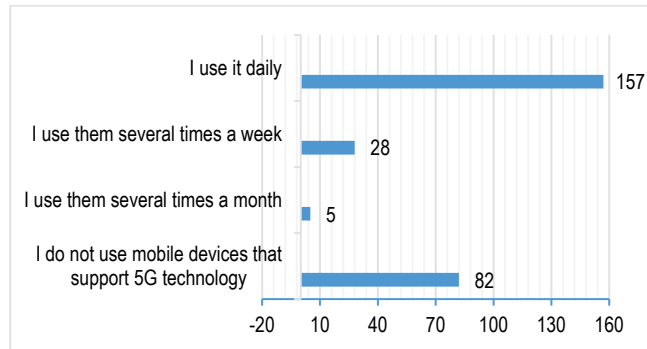


Figure 1 How often do you use mobile devices (such as smartphones and tablets that support 5G technology)?

However, it is evident that a significant number of respondents, 82 of them (30.1 %) do not use mobile devices that support 5G technology. This could indicate various possible factors, such as the unavailability of 5G network, the cost of 5G devices, the lack of information about the benefits of 5G technology, etc. Considering these results, it can be concluded that there is a significant use of 5G technology, but there are still a large number of people who have not yet accepted it. This could indicate opportunities for further expansion and improvement of 5G infrastructure, as well as the need for further education on the benefits of 5G technology.

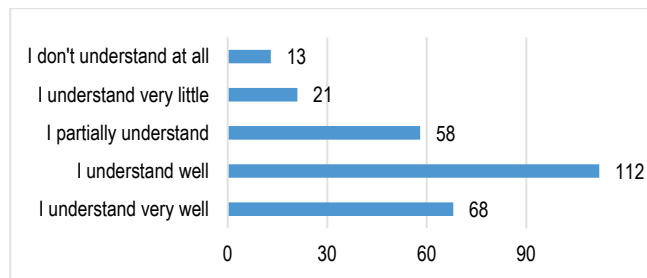


Figure 2 How well do you understand the technical aspects of 5G technology and its impact on the global economic environment?

When it comes to the question related to understanding the technical aspects of 5G technology and its impact on the global economic environment, the results of the survey are shown in Fig. 2.

A small number of respondents, 13 of them (4.8 %) do not understand at all the technical aspects of 5G technology and its impact on the global economic environment, while 21 respondents or 7.7 % understand these aspects very little. Partial understanding was expressed by 58 respondents (21.3 %), 112 of them (41.2 %) understand well the technical aspects of 5G technology and its impact, and 68 (25 %) respondents understand these aspects very well.

These results show that most respondents have at least a partial understanding of the technical aspects of 5G technology and its impact on the global economic

environment. However, there is still a significant number of respondents who have limited or no understanding.

This data can have different implications, on the one hand it shows that information about 5G technology and its advantages is available and easily understandable for a significant number of people, and on the other hand, it shows that there is still a need to improve education about 5G technology, especially for those who have limited understanding.

These results may also provide insight into potential opportunities for telecommunications companies, such as developing educational programs or tools to help users understand and use 5G technology.

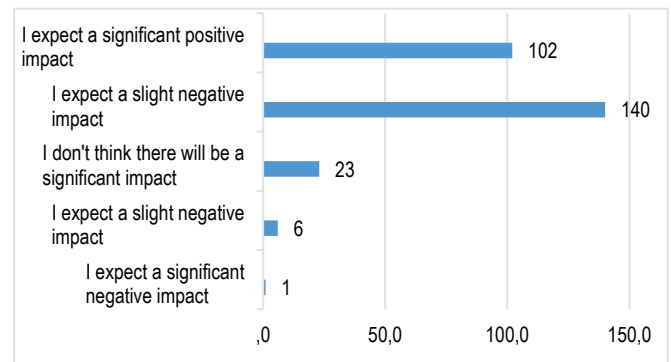


Figure 3 How would you describe your expectations of 5G technology regarding its impact on the global economic environment?

Fig. 3 shows the research related to respondents' expectations about the impact of 5G technology on the global economic environment, showing that a significant number of respondents, 102 of them (37.5 %) expect a significant positive impact of 5G technology on the global economic environment. The largest number of respondents, 140 of them (51.5 %) expect a slight positive impact, while a smaller number of respondents, 23 (8.5 %) do not expect a significant impact of 5G technology on the global economic environment. A very small number of respondents, 6 of them (2.2 %) expect a slight negative impact, while only one respondent (0.4 %) expects a significant negative impact.

These results suggest that the majority of respondents have positive expectations regarding the impact of 5G technology on the global economic environment, whether it is a slight or significant positive impact. Only a small number of respondents do not see a significant impact or predict a negative impact.

The data from Fig. 4 shows that logistics and transport (76 or 27.9 %), and health and financial services (each with 46 or 27.9 %) are the sectors that the largest number of respondents see as the most promising in terms of the application of 5G technology. The average number of respondents sees education, 34 of them (12.5 %), trade 29 of them (10.7 %), and tourism and hospitality 26 (9.6 %) as sectors with potential for 5G application. The fewest respondents believe that the manufacturing sector (15 of them or 5.5 %) is promising for the application of 5G technology.

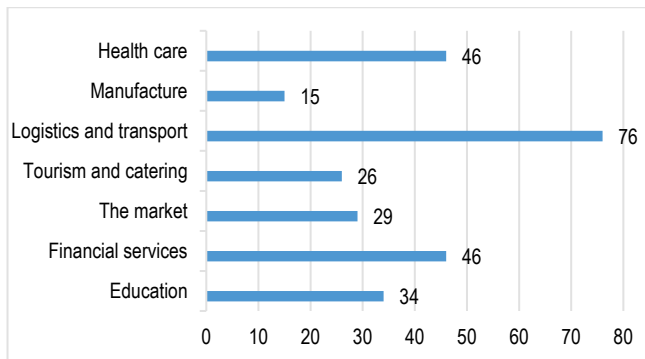


Figure 4 Which sectors of the economy do you see as the most promising in terms of application 5G technology?

These results suggest that respondents recognize a wide range of sectors that could benefit from the application of 5G technology. Healthcare and financial services are areas particularly highlighted by respondents, perhaps because 5G is expected to enable faster and more reliable wireless communications that could transform the way services are delivered in these sectors.

The data also shows that logistics and transportation are also seen as an important area for 5G applications, perhaps because of the potential to improve efficiency through things like autonomous vehicles and supply chain optimization.

It is important to note that although the manufacturing sector has the least votes among these respondents, 5G technology has the potential to provide significant benefits in that sector as well, for example by enabling Industry 4.0, automation, and other innovations.

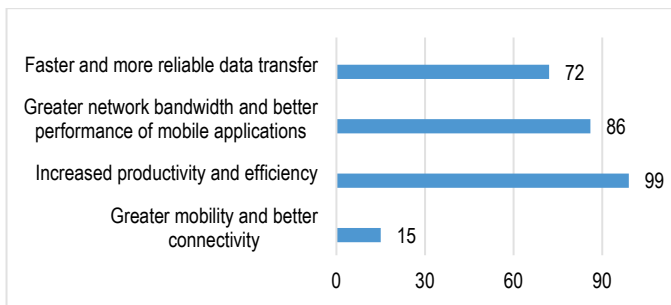


Figure 5 What advantages would you see in the application of 5G technology in your business environment?

From Fig. 5, it is evident that 72 respondents (26.5 %) see faster and more reliable data transmission as an advantage or key to the application of 5G technology in their business environment. This suggests that there is a significant demand for fast and reliable data transfer, which can be essential for activities such as fast download and transfer of large files, video conferencing, and the like. Higher network bandwidth and better performance of mobile applications were recognized as an advantage by 86 respondents (31.6 %). This may indicate that respondents value the ability to support more devices and better mobile application performance, which can be especially important in a business environment where many devices share the same network.

Increased productivity and efficiency were highlighted as an advantage by the largest number, i.e. 99 respondents

(36.4 %). This suggests that respondents see significant value in the possibility of 5G technology improving the productivity and efficiency of their work, perhaps through faster and more reliable connections, better application performance, or other functionalities enabled by 5G technology.

Only 15 respondents (5.5 %) highlighted greater mobility and better connectivity as an advantage. This may indicate that while mobility is important, it may not be the primary factor that respondents see as a key benefit of 5G technology in their business environment.

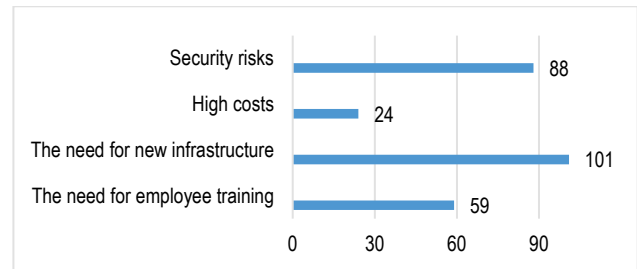


Figure 6 What challenges would you see in the application of 5G technology in your business environment?

Fig. 6 shows how 88 respondents (32.4 %) single out security risks as a challenge, so it is clear that there is a significant concern about the security associated with the introduction of 5G technology. This is understandable because 5G, like any technology that transmits or stores data, can be a target for cyber-attacks. This concern could point to the need to strengthen data protection and cyber security measures when introducing 5G technologies.

24 respondents (8.8 %) consider high costs as a potential challenge. Deploying 5G may require significant upfront investment, including upgrading hardware, software and possibly even infrastructure, which can be a financial challenge for some organizations.

The need for new infrastructure was highlighted as a challenge by most respondents, 101 of them (37.1 %). The implementation of 5G may require the installation of new infrastructure, including new antennas and base stations, which can be time and financially demanding. This suggests that companies and governments should consider how best to support the infrastructure upgrade required for effective 5G deployment.

The need for employee training was identified as a challenge by 59 respondents (21.7 %). The introduction of new technology often requires training of employees to ensure that they are able to use the new technology correctly and effectively. This could suggest the need for comprehensive training plans when introducing 5G technologies.

Fig. 7 shows the results of the survey, which provides an interesting insight into respondents' perceptions of the importance of speed, reliability and low latency - the key features of 5G technology - for their mobile devices. Very important: 21 respondents (7.7 %) consider these features very important, so this could suggest that this minority of respondents have jobs or living conditions that require high-end mobile performance. Important: The majority of respondents, 183 of them (67.3 %) consider speed, reliability

and low latency important, which shows that people value the ability to use their mobile devices quickly and reliably with minimal delays. Less important: 60 respondents (22 %) consider these features less important, which could indicate that these respondents have less demanding needs for their mobile devices, or may not have much experience with online activities that require high speed, reliability or low latency.

Unimportant: Only 8 respondents (2.9 %) consider these features unimportant which could suggest that these respondents may be less dependent on mobile technologies or that their activities do not require high speed, reliability or low latency.

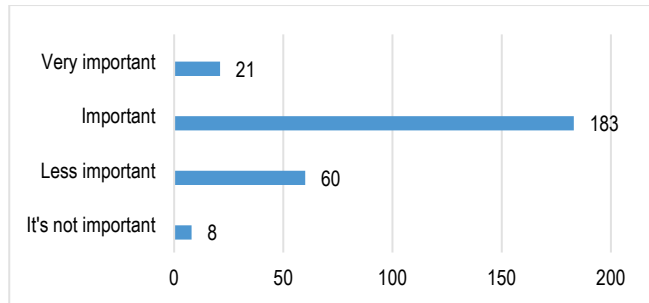


Figure 7 How important are speed, reliability and low latency in your mobile devices to you and how could 5G technology improve your business and personal activities?

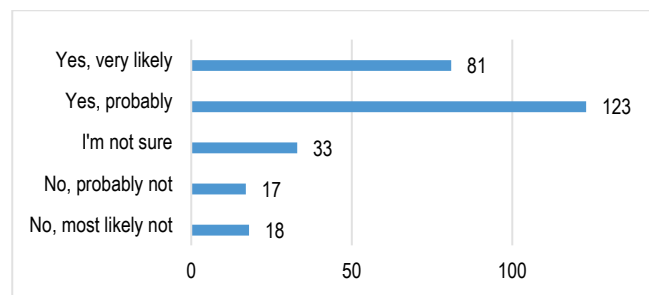


Figure 8 Do you think that 5G technology could provide new opportunities for employment and the creation of new jobs in different sectors of the economy?

Based on the research, Fig. 8 shows that the majority of respondents, 204 of them, believe that 5G technology can probably provide new opportunities for employment and the creation of new jobs in various sectors of the economy (75 %). This perception may indicate optimism about the economic opportunities that 5G can bring, including the creation of new jobs in sectors such as telecommunications, equipment manufacturing, software development, and the like. On the other hand, 33 respondents (12.1 %) are not sure about this question, which may indicate that some respondents may not have enough information or understanding about how 5G technology can affect the labor market. A smaller number of respondents, 35 of them, believe that 5G technology is unlikely to create new employment opportunities (12.9 %). This may indicate scepticism or concern about how technological advances, such as 5G, may affect the labor market, for example through automation or changing the way work is done in some sectors.

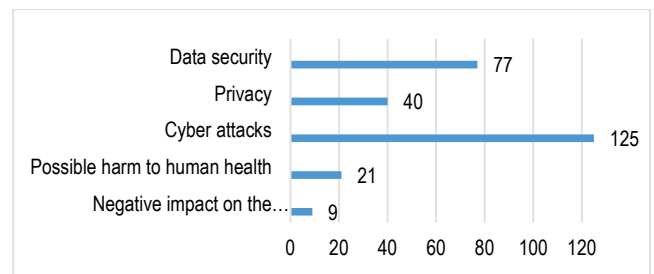


Figure 9 What risks would you see in the application of 5G technology, especially in terms of data security and environmental impact?

Based on the data presented in Fig. 9, it is evident what the respondents' views are on the possible risks associated with the implementation of 5G technology, as follows:

Regarding data security, 77 respondents (28.3%) consider data security as a risk and an area of great concern. Since 5G technology enables the rapid transfer of large amounts of data, the question of how to protect this data is becoming increasingly important.

When it comes to privacy, 40 respondents (14.7%) consider privacy as a potential risk, so this may indicate concern about how personal data is used and shared in the 5G environment. The risk of cyber-attacks was recognized by the most respondents, 125 of them (46 %). As more devices connect to the Internet via 5G networks, the number of potential entry points for cyber-attacks may increase, increasing the importance of cyber security.

Concern about potential harm to human health was highlighted by 21 respondents (7.7 %). Although current scientific research does not show that 5G technology poses a risk to human health, some public opinion continues to express concern about the potential effects of exposure to radio frequency radiation.

Only 9 respondents (3.3 %) believe that 5G can have a negative impact on the environment. Since the deployment of a 5G network may require the installation of a large number of new antennas, there may be some environmental impact, but this appears to be less of a concern among respondents.

4.3 Discussion of Results and Answers to Research Questions

The objective of the empirical part of this paper was to investigate, present and determine respondents' perceptions of the key advantages of 5G technology for their business environment. From these results, it could be assumed that companies developing or implementing 5G technologies could benefit the most by focusing on the benefits that respondents consider most important, such as increasing productivity and efficiency, improving network bandwidth and mobile application performance, and providing faster and more reliable transmission data.

4.4 Research Limitations

When interpreting the research, the limitations of the conducted research should be taken into account, given that the research was conducted on a random sample of 272 respondents who voluntarily wanted to fill out the survey

questionnaire. In order to generalize the conclusions, the sample should be increased and made representative. This research can be the basis for future research that would be conducted on a representative sample of respondents of all age groups.

5 CONCLUSION

These results support the hypothesis that 5G technology will bring improvements that will boost the global economy, through improving productivity, enabling new technological innovations, creating new industries and jobs, etc. However, it is important to note that respondents' perceptions and expectations do not necessarily reflect the actual impact that 5G may have an impact on the global economic environment, but they provide insight into the attitudes and opinions people have about this technology.

Finally, these results can provide insight into potential priorities for companies and governments considering how to best utilize 5G technology. Also, the results provide useful insights into the potential challenges that respondents see in relation to the application of 5G technology in a business environment. Understanding these challenges can help companies, governments and other stakeholders better plan and prepare for effective 5G deployment.

This and numerous other studies and analyzes dealing with the impact of 5G technology on the global economic environment confirm the hypothesis that 5G technology will enable faster and more efficient connection of devices and enable the development of new technologies such as autonomous vehicles, virtual and augmented reality, robotics, etc. Thus, the research confirms the main and auxiliary hypothesis that 5G technology will provide a new platform for the growth and development of the economy, creating new business models, jobs and income. The application of 5G technology in various sectors, such as trade, healthcare, manufacturing and logistics, could result in cost savings and increased efficiency.

However, the research indicates that there are also some challenges and risks that come with the application of 5G technology, such as security issues, environmental impact, technological dependence and the like.

The impact of 5G technology on the global economic environment will also depend on political, legal and regulatory frameworks, as well as on different social and cultural factors in different parts of the world.

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