

Research Article

Fifth Generation (5G) Network Rollout and Acceptability: Evidence from Nigeria

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Abstract

The Fifth Generation (5G) Network was rolled out in Nigeria in September 2022 to improve communication services in the country. More than two years after the rollout, penetration has been low while acceptance is very poor. The authors examined factors that may have affected the acceptability of the network to be able to inform policy. Data were generated through online questions and the distribution of questionnaires. The logit regression method was used for the analysis with the Probit estimation used for a robust check of the logit result. The probit result supports the logit analysis that the acceptability of a 5G network is significantly explained by the purpose of network use, which is in line with the theory of the Technology Acceptance Model, and secondly, by people's feelings. The findings suggest that the more people have negative feelings (health risks) about 5G, the less the acceptance of the network in Nigeria. Therefore, proper sensitization about the series of network technologies is needed in the country to increase the 5G network acceptance. Nigeria is a high network using country in the world and the results indicate that proper sensitization of the people about the 5G network will increase its use. This can be done through promo by the network operators themselves or by the government through the print and electronic media highlighting the enormous benefits of the 5G network to users.

Keywords

Fifth Generation, Network, Rollout, Acceptability, Nigeria

1. Introduction

Fifth Generation Network, also known as 5G network was approved for rollout in Nigeria on the 8 of September 2021 after two years of trial. The trial on the safety of the network technology started on November 25, 2019, but was stopped after the coronavirus disease was declared a pandemic in March 2020 which led to the lockdown of the economy. The trial of the network in Nigeria was stalled because news fil-

tered the air that the coronavirus disease (COVID-19) outbreak has a link with 5G network technology. Nigerians became apprehensive of the network and youths started attacking some network providers installing communication networks in some parts of the country believing that they were laying 5G networks harmful to human health.

Nigeria is a highly network-consuming country in the

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world. In the world ranking of countries according to Internet use by Internet World Stats in 2021, Nigeria is in the 6th position, only behind China, India, the United States, Indonesia, and Brazil [1]. By internet growth rate, internet use in Nigeria grew by 63% between 2000 and 2021, which is the second highest growth rate after Bangladesh. The growth rate in internet use in Nigeria reveals the value network services are adding to the growth of the country's economy. It was stated that the use of information and communication technology in Nigeria's public administration increased efficiency in service delivery by reducing time and cost of governance due to the introduction of e-government, while in the private sector, the financial sector achieved tremendous growth and prosperity as a result of the deployment of modern technology with cost and time reduction in financial transaction [2].

The invention of the telegraph system of communication in 1816 brought a change in global transportation systems and business transactions. Time taken to carry a message from one location to another, or from one individual to the other was reduced as people were no longer compelled to come face to face to discuss or carry out business. Additionally, the emergence of wireless telecommunication systems not only reduced to a second the time it takes people thousands of miles apart to discuss, but it also made it possible for them to chat, and exchange ideas without physical touch. The whole world has become one village because what is happening in America is immediately known in Ghana not minding the distance between the countries. Cost of seeking information is reduced to the barest minimum while goods and services can be purchased online and delivered without much difficulty.

The fifth generation network (5G) is the latest wireless communication technology which has been deployed in many countries today. As an improved technology over the fourth generation (4G) network, 5G innovation is beyond mere mobile internet services but includes Internet of Things (IoT) features which make it possible for thousands of electronic devices to be connected and information shared at a time. With a peak speed of 20Gbps against 1Gbps of the 4G network, 5G offers high quality, ultra-fast connections, with low cost, reduced latency, and energy-saving services when compared with all the previous generation of networks before it. The belief is that the 5G network offers a big opportunity to improve people's lives as it will facilitate communication among researchers, students and teachers, and business owners at a faster speed with more populations connected at a time with no additional cost [3].

The invention and rollout of the 5G network in 2019 coincided with the outbreak of the novel Coronavirus disease (COVID-19) in Wuhan China. Before the declaration of COVID-19 a pandemic on March 11, 2020, Nigeria began the trial of the 5G network to determine the health as well as the security implications of the network in the economy. Unfortunately, the trial period was not concluded when COVID-19 was declared a pandemic on March 11, 2020, by the World Health Organization. Soon after the declaration of COVID-19

as a pandemic, rumors started trending the social media that COVID-19 is linked to the 5G network. Nigerians became apprehensive about the 5G network to the extent that there was a demonstration in many communities in Nigeria in 2020 against some telecom service providers who were laying cables and erecting masts to boost their services. Due to the youths' restiveness in those communities, the telecom service providers suspended further work in those areas.

In early 2021, the Ministry of Communication and Digital Economy was directed to resume the trial of the safety of the 5G network in Nigeria. After the ministry submitted its report, the government directed her to organize a stakeholder forum to sensitize the people on its safety outcome. With stakeholder sensitization over, the federal government on September 8, 2021, gave the Ministry the approval to roll out the network for use in the country. The network was formally launched in September 2022 by MTN Nigeria. Mafab Communication and Airtel Nigeria rolled out the network in January and June 2023. Between September 2022 and March 2024, statistics showed that only 1.24% of network subscribers in Nigeria have been connected to the 5G network [4]. With the poor acceptance of the network, the authors examined the factors that caused the poor acceptance of the mobile network in Nigeria.

2. The Theory

The model that has guided scholars investigating technology acceptance is the Technology Acceptance Model (TAM) which was developed by Davis in 1986. According to the model, two important variables determine whether a developed technology can be accepted or not in society. They are perceived usefulness and ease of use. The model holds that acceptance is positively associated with perceived usefulness, which suggests that the more people feel the technology will be useful in solving challenging problems, the more they will be willing to use it. The second factor is the ease of operation, hinting that normally, a technology whose operation is very simple is likely to be accepted by the people more than the one whose operation is complex. This is because when the operation of a technology requires extra skill, only very few people may be able to undertake the training needed to use it effectively.

The Technology Acceptance Model (TAM) received criticism for focusing on users' perceptual and utilitarian judgment as the only determinants of acceptance. In an extended TAM, factors like output quality and result demonstrability were added as important variables that can affect technology acceptance [5]. Yet, it was argued that the extended TAM is not complete [6], and performance expectancy, effort expectancy, social influence, and facilitating conditions were added in a new model called the Unified Theory of Acceptance and Use of Technology (UTAUT) [6]. UTAUT was not without criticisms because it foresees technology as only being used by organizations and not by the general public. Upon criticism,

the Unified Theory of Acceptance and Use of Technology (UTAUT2) was developed [7]. In UTAUT2, such variables as motivation, price value, and habit variables were considered important determinants of technology acceptance.

Communication is an important aspect of life because it is through it that information moves from one individual to another and from one location to another. Information is power and the faster information travels the quicker knowledge spreads and the better the positive change for the advancement of the human race. Knowledge that is not communicated does not exist and will not serve any purpose to the human race. It is through communication that people share ideas to bring a better idea towards an issue or problem because two heads will always be better than one. From sign communication which travels at a slow speed, the world is now at a time when communication takes a second due to developments in information and communication technology.

Earlier than 1816 when Francis Ronalds developed a working telegraph, people could only discuss issues or exchange information when they were in physical contact. The physical contact of communication entails that people must move from one place to another before exchanging ideas or discussing any business. The time it takes people to meet depends on the distance between the parties in the discussion. It can take days when the people are in different parts of a country, and months when they are in different countries. Such movements of people from one place to another to communicate delay human actions which often cause irreversible damage. On the other hand, it increases the cost of doing business. With the invention of the telegraph, information began to be passed from one person to another without them coming into physical contact. However, early telegraphic communication used Morse code and was limited to people within a close range of not more than twenty-five kilometers.

The invention of the electric telephone in 1876 by Alexander Graham Bell was remarkable in the science of communication. It became possible for messages to be carried across thousands of miles within some seconds. The telephone enabled people who are in far distant places to discuss and agree on an issue without being in physical contact, or even knowing one other. The only requirement to use the telephone communication systems is to be connected and assigned a number. With the invention of the telephone, the cost of doing business was reduced and the tempo of business activity increased. The drawback of the telephone system was the requirement to lay an electric cable to carry the message. So, telephone communication only serves people connected through a cable. However, Radio wave technology developed in 1947 for long-distance calls helped to minimize the problems, and in 1979, the first cellular phone was launched and people began to move around with phones. The launch of the cellular phone known as the First Generation wireless network (1G) began the generations of wireless or mobile networks of technology, of which the 5G network is the latest in the series.

The rollout of the 2G network was an innovation in com-

munication technology that had a significant effect not only on the way the message was delivered but also on the social life of the people. For the first time, people were able to send text messages, multimedia messages, and pictures to friends and relatives through their phones. With the 2G, the world economy began being driven by digital technology. As if that was not enough, the world became more connected with the development of 3G networks. Among its features are videoconferencing and streaming. So, a person can be in Africa and present a paper at a conference going on in Britain, America, or any other continent of the world without being there physically. The rollout of the 4G network in 2009 brought more advancement in the digital technology space.

As each new generation of the network is always more sophisticated than the former, the expectation is high that the 5G network is going to take the world to a higher digital economic space and growth. This is possible because 5G will promote sustainable industrialization as well as foster innovations [8]. This thinking is in line with the assertion that the 5G technology is fundamental to the digital transformation of the Chinese economy as it will be helpful in the development of artificial intelligence capable of making production more efficient [9]. According to the World Health Organization (WHO), 5G will be helpful in e-health, especially in remote surveillance, telemedicine, and telesurgery [10], which falls in line with expectation that the 5G network will be useful in the Chinese medical sector [7].

Despite the great expectations of the benefits the 5G network may bring to the world, there are concerns about its negative effects on society [11]. This is the fear that there are going to be negative health consequences of the 5G because the radiation from the 5G is higher than the radiation from the former generation of mobile networks, and the spectrum range can cause tumors and later cancer in the body [11]. The other health concerns are the eye where the fear is that the network can increase the risk factor of blindness, and a shift in the nervous system because of the upset the network can cause to it [11]. Because of the health concern, there was recommendation that thorough scientific research should be done in every country on the health implications of the radiofrequency from the 5G before it is rolled out [12].

Few studies have been done to examine the health effects of 5G networks in developing countries. In Nigeria, the effect of the 5G radiation on human health was examined [13]. The finding showed that energy produced by the 5G radiation has no significant negative effect on human health as the radiation from the 5G cannot damage the Deoxyribonucleic Acid (DNA). While some scholars pointed out that the 5G network is bringing transformation in the telecommunication sector in Nigeria because of its fast speed when compared with any other network [14], and that the gains of the deployment of the 5G network in Nigeria's economy will outweigh the political and health concerns since every sector of the economy will benefit from the network as it will aid productivity across all sector activities, including agriculture [15], no study has examined the factors

responsible for poor acceptance of the 5G network in Nigeria.

3. Methodology

The study was cross-sectional and data were generated through online questions as well as the administration of a questionnaire. Both methods of data collection were used to give people the probability of being selected. Moreover, a questionnaire was administered to those who did not respond to the online questions. In all, 208 responses were received. Poor awareness of the existence of the 5G network affected the samples collected as many people maintained that before they would respond to the questions in the questionnaire, they needed a proper understanding of how the 5G works. On that premise, information was generated from only those people who have full education about the workings of the generation of networks.

The dependent variable is a binary response and it is not proper to use the ordinary least square (OLS) method of estimation in a model whose dependent variable is dichotomous. The problems of using OLS as an estimation technique are many when the dependent variable is binary or dichotomous. One such problem is that when the dependent variable is binary, the disturbance term is no longer homoscedastic but heteroscedastic [16]. In such cases, it is better to use the logit or probit regression technique. In the present study, the Logit regression was used for the statistical estimation. However, the probit analysis was used to check the robustness of the logit regression result.

4. The Model

Functionally,

$$APC = f(\text{GEN, USE, AGE, FEL}) \quad (1)$$

Where

APC= acceptance of 5G network (no= 0, yes= 1), USE= Purpose of network use (call only=1, call/social media= 2, call/social media/internet/research= 3, call/social media/internet/office work= 4), AGE= Age of respondent (18-above), FEL= people's feeling about 5G network (fast service=1, may be costly= 2, may have health risk= 3).

In econometric transformation, equation (1) becomes

$$Y_i = \beta_0 + \beta_1 X_i + U_i \quad (2)$$

Where Y= dependent variable, X= explanatory variables, U_i = characteristics that are individual specifics, U= error.

One thing about 2 above is that it cannot be solved by ordinary least square (OLS) because the dependent variable Y is a binary response (acceptance or not acceptance). Hence,

$$P_i = E(Y = 1/X_i) = \beta_0 + \beta_1 X_i \quad (3)$$

Equation (3) is the probability that an individual i accepts 5G network, and

$$P_i = e^V / 1 + e^V \quad (4)$$

Where

$$V_i = \beta_0 + \beta_1 X_i$$

Equation (3) through (4) is the logit representation of model (1).

5. Results

Table 1. Descriptive Statistics.

Variable	Observations	Mean	Std. Deviation	Min	Max
Acceptance (AFG)	208	.7019231	.458517	0	1
Age (AGE)	208	30.30769	11.68225	20	57
Employment (EMP)	208	1.971154	1.243003	0	4
Network Use (USE)	208	3.173077	.6050082	1	4
Feeling (FEL)	208	1.528846	.8218834	1	3

Source: Data analysis

Table 1 above is the descriptive analysis of the variables in the model. The statistics showed there is no negative value in any of the variables. Acceptance has the lowest standard deviation of 0.458517 while age has the highest standard deviation of 11.68225. The minimum age of the respondents is 20 years, while the maximum age of the respondents is 57 years,

violation of 0.458517 while age has the highest standard deviation of 11.68225. The minimum age of the respondents is 20 years, while the maximum age of the respondents is 57 years,

with a mean age of 30.31 years, showing that the sample is a mixture of youths and adults. From the table, Nigerians use networks for a maximum of four different purposes and a

minimum of one purpose.

Multivariate Logit Regression Result

Table 2. Factors affecting acceptance of 5G Network (Dependent variable: Acceptance).

Variable	Coefficient	Std error	'Z'	Prob>Z
Age (AGE)	-.0667262	.0540895	-1.23	0.217
Employment (EMP)	.1042246	.4876409	0.21	0.831
Network Use (USE)	1.295642	.5776261	2.24	0.025
Feeling (FEL)	-4.763242	.771522	-6.17	0.000
Const.	6.639674	2.37035	2.80	0.005
R ²	0.81			

Source: Data analysis

Table 2 is the multivariate result of the logit regression. Age and feeling have negative signs, and employment and network use have positive signs respectively. From a priori expectation, age satisfied the theoretical assumption as it is expected that as people get older, the use of network technology diminishes. Similarly, a positive sign of network use indicates that the more the purpose of network use, the more people are bound to accept the 5G network. This is expected theoretically. In another vein, feeling about 5G is an important factor that will affect its acceptance. Thus, the negative sign suggests that the

more the people feel that it may hurt the health of the people, the less they will accept it. Hence, all the variables satisfied the a priori expectation.

From the statistical test of significance, only two variables out of the four explanatory variables are statistically significant. They are network use (USE) and feeling (FEL). Feeling about the 5G network is significant at a 1% level of significance while network use is significant at a 5% level of significance.

Multivariate Probit Regression Result

Table 3. Factors affecting acceptance of 5G Network (Dependent variable: Acceptance).

Variable	Coefficient	Std error	'Z'	Prob>Z
Age (AGE)	-.0295215	.0251557	-1.17	0.241
Employment (EMP)	-.0043508	.2315526	-0.02	0.985
Network Use (USE)	.7205732	.2868535	2.51	0.012
Feeling (FEL)	-2.417758	.316638	-7.64	0.000
Const.	3.23927	1.075708	3.01	0.003
R ²	0.80			

Source: Data analysis

Table 3 is the result of the probit regression used to check the robustness of the logit regression in Table 2. The probit regression result is not different from the logit analysis either in sign or statistical test of significance. All the variables that had a positive sign in the logit regression equally had positive signs in the probit regression, and all the variables that had negative signs in logit regression turned out with negative

signs in the probit regression. Also, network use and feeling are the variables that are statistically significant in influencing 5G acceptance in probit analysis, which is consistent with the logit regression in Table 2 above. However, the probit regression has a lower standard error than the logit analysis in all the variables.

6. Discussion of Findings

Nigeria rolled out the 5G network in the latter part of 2022 and became the sixth country in Africa to do so. A cross-sectional study was done to examine the factors that affected the acceptance of the network among Nigerians. The outbreak of the coronavirus in 2019 and the subsequent declaration of the virus as a pandemic slowed down the testing of the health and environmental effects of the 5G network in the Nigerian economy. Now that the Ministry of Communication and Digital Economy has pronounced that the network has no serious health threat, the government authorized the ministry to go ahead with its rollout in the country. The rollout was done in September 2022.

An examination of the acceptance of the network in Nigeria showed that people's feeling about the network is a significant factor that affected its use. The effect of the feeling about the network is negative, which suggests that the more people feel that it will be a threat to their health, the less they will accept it for use. Hassan et al (2021) highlighted that the 5G may have an environmental side effect, especially on human health. According to them, 5G can lead to cancer, as well as cataracts which is the major cause of blindness. Because of this, it was suggested that countries should take time to carry out studies on the health implications of the 5G network to avoid what may be adverse health effects emerging from the network technology on humans [12]. These scholars decried the rush by some countries to deploy the network technology without a thorough study of its effect on health and the environment.

The second factor that showed a significant effect on the acceptance of the 5G in Nigeria is the purpose of network use. From the positive sign or coefficient of the variable, people who use network services for many purposes will accept 5G more when compared with those who use network services for a few purposes. That suggests that people who use network service for calls and social media will accept 5G more when compared with people who use network service for calls only, and those who use network service for calls, social media, and research are going to accept 5G network more when compared with people who use network service for calls and social media only. This suggests that with upward trends in social media usage in the country, there is a high expectation that the 5G network will have a good market in the future, based on earlier findings that Nigeria is among the top 6 internet consuming countries in the world [1].

7. Conclusion

Rollout of the 5G network is slow in Africa as only 16 countries have rolled out the network in the continent as of September 2023. The majority of the countries in the continent are on a 'wait and see' attitude because there are concerns that the network may have health consequences [17]. The factors affecting the acceptance of the 5G network in Nigeria were examined. The finding falls in line with the view that

information about 5G is important in people's acceptance of it [18]. From the evidence, it suggests that people's feelings about the 5G may have had a significant effect on its acceptance in Nigeria. On that note, sensitization of the people on the working of the network is highly needed for the network to be well-utilized in the country. Moreover, the other factor that had a significant effect on the 5G acceptance is the purpose of network use.

Abbreviations

5G	Fifth Generation Network
4G	Fourth Generation Network
1G	Coronavirus Disease 2019
COVID-19	First Generation Network
(IoT)	Internet of Things
MTN	Mobile Telecommunication Network
TAM	Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology
UTAUT2	Unified Theory of Acceptance and Use of Technology

Conflicts of Interest

The authors declare no conflicts of interest.

References

- [1] Internet World Stats (2020) Usage and Population Statistics: Top 20 Countries with the Highest Number of Internet Users. <https://www.internetworldstats.com/top20.htm>
- [2] Oladimeji TT and Folayan GB (2018) ICT and Its Impact on National Development In Nigeria: An Overview. Research & Reviews: Journal of Engineering and Technology; 7(1) p5-10.
- [3] Al-Marouf R. S, Akour I, Aljanada R, Alfaisal A. M, Alfaisal R. M, Aburayya A. and Salloum S. A (2021) Acceptance determinants of 5G services. International Journal of Data and Network Science 5 (2021) 613–628.
- [4] Nairametrics (2024) Nigeria's 5G subscriptions rise to 1, 24% in March 2024-NCC. <https://nairametrics.com/2024/04/25/nigerias-5g-subscriptions-rise-to-1-24-in-march-2024-ncc/>
- [5] Venkatesh, V.; Davis, F. D. (2000) A theoretical extension of the technology acceptance model: Four longitudinal field studies. Manag. Sci. 2000, 46, 186–204.
- [6] Venkatesh, V.; Morris, M. G.; Davis, G. B.; Davis, F. D. (2003) User acceptance of information technology: Toward a unified view. MIS Q. 2003, 27, 425–478.
- [7] Venkatesh, V.; Thong, J. Y.; Xu, X. () Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. MIS Q. 2012, 36, 157–178.

- [8] O'Halloran D. (2020) The Impact of 5G: Creating New Value across Industries and Society World Economic Forum White Paper.
- [9] FU J., C. Liu and Y. Chen (2020) The Contribution and Prospect of 5G Technology to China's Economic Development *Journal of Economic Science Research* 03(03) 17-20.
- [10] World Health Organization (2020) Radiation: 5G mobile networks and health.
<https://www.who.int/news-room/questions-and-answers/item/radiation-5g-mobile-networks-and-health>
- [11] Hassan J. H, A. J. Yosef and H. A. Hachem (2021) 5G Radiation and Potential Risks to the Environment and Human Health *Turkish Journal of Computer and Mathematics Education* 12(6) 1689-1693.
- [12] Hardell L. and M. Carberg (2020) Health risks from radiofrequency radiation, including 5G, should be assessed by experts with no conflicts of interest *Oncology Letters* 20(15)
<https://doi.org/10.3892/ol.2020.11876>
- [13] Aru O. E., K. C Adimora and E. J. Nwankwo (2021) Investigating the Impact Of 5G Radiation on Human Health Using Machine Learning *Nigerian Journal of Technology (NI-JOTECH)* 40(4) 694-702.
- [14] Sani H. and Baba M. D. (2024) 5G Networks and their Impact on the Telecommunications Industry in Nigeria Paper Presented at 5. International Mediterranean Congress Conference January 13-14, 2024 Mersin –Türkiye.
- [15] Ukabuiro I. k. (2021) Examining the prospects of 5G Network policy and its Economic Impact in Nigeria. *International Journal of Advances in Engineering and Management (IJAEM)* 3(9) pp: 1367-1371 www.ijaem.net
- [16] Gujarati (2004) Basic Econometrics The McGraw–Hill Companies, 2004.
- [17] Jun J. 2019. Mobile carriers grapple with 'NIMBY' syndrome. The Korea Times, in Koh et al (2020) Koh, T. H, Choi, J. W, Seo, M, Choi, H and Kim K. H (2020). Factors Affecting Risk Perception of Electromagnetic Waves From 5G Network Base Stations. Bioelectromagnetic published by Wiley Periodicals LLC on behalf of Bioelectromagnetic Society.
- [18] Nicolas Martin, Martin Ragot, Vincent Savaux. Acceptability and 5G in the Medical Field: The Impact of the Level of Information. 2021. fihal-03129292.