

**TOWARDS AN EVALUATION FRAMEWORK FOR THE INFLUENCE OF
ACCESS REGULATIONS ON THE PERFORMANCE OF THE 5G MARKETS IN
KENYA**

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DECLARATION

This thesis is exceptional and original work from me and it has not been examined by any other higher learning institutional examination body.

SIGN:  DATE: 18th February, 2022

This thesis is submitted for examination with approval from my Supervisors as my original work.

SIGN:  DATE: 18th February, 2022

Prof. Felix Musau

DEDICATION

I hereby dedicate this work to my beloved wife Christine Nanjala Khaemba, my beloved sons Samuel Makokha, Jed Baraka and Peace Ethan for their great desire for me to study beyond the mortal expectation. You are all my motivation to academic curiosity. Your prayers and guidance have been my pillar in this academic journey.

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I confer my appreciation to several people through whom I was able to finish this research. I thank our almighty God for the strength and ability he has accorded to at this particular point in academic journey. In addition, I also acknowledge the support and input from my project supervisor, **Felix Musau, Ph.D.** for his expert counsel during the inscription of my research project. I wish to acknowledge KCA University for providing a platform and facility that is very instrumental for the successful completion of this work. Finally, all my appreciation goes to my family members for good support they have given to me, to you all I say thank you. I could not have made it without your assistance and dedication.

ABSTRACT

The 5G network constitutes a fundamental part which is the future gigabit communication network and infrastructure which enables a wide part of innovations that are critical for modern digital societies. Notwithstanding clear evidence that 5G innovations in Kenya may have the possibility to release an opportunity for smart cities to take full advantage of what's being called the Fourth Industrial Revolution, the details regarding access regulations and how they impact on 5G network markets performance in Kenya are virtually non-existent. The aim of this subject study intended to examine the consequence of access regulations of 5G network performance in Kenya. The specific objective includes: to evaluate the 5G markets performance in Kenya; to evaluate the effects and impacts of strict network neutrality on the performance of 5G network markets in Kenya; to determine the effect of mobile virtual networks operator's obligations on 5G markets performance in Kenya and to control the effect of unbundling requirements on the performance of 5G network markets in Kenya. A cross-sectional descriptive research was adopted. The study targeted firms in the following six market segments: International gateway operators; Submarine cable landing rights operators; network facilities providers Tier 1; Network facilities providers Tier 2; Network facilities providers Tier 3; and telecommunications contractors. The target firms included the major telecom service providers in terms of user's subscription such as mobile operators, mobile money providers, and fixed data and internet providers registered in Communications Authority. The targeted study respondents constituted of either project management office heads; project managers; solution architects; operations and support teams; procurement or contract managers in each of the target firms. During the study a sample size of 375 companies were randomly selected to participate. The respondents were asked to evaluate the scales operationalizing the variables under study from semi-structured questionnaire which were both open and closed ended questionnaires to audience. Descriptive statistics was used as a tool to summarize the background characteristics of respondents and frequency distributions. In summary the 5G technology will ensure competitive and improved opportunities in technological innovations which will improve drastically the areas of investment like education sector, manufacturing industries, health sector, transport sector, economic and social value across industry sectors.

ACRONYMS AND ABBREVIATIONS

IOT –	Internet of Things
MVNO -	Mobile Virtual Networks
CAK –	Communication Authority of Kenya
ASPs –	Application Service Providers
MNOs –	Mobile Network Operators
ICTs –	Information Communication and Technologies
DCF –	Discounted Cash-Flow
QoS –	Quality of Services
GPT –	General Purpose Technologies
OOTs –	Over the Top Services
OECD –	Organisation, for Economic Co-operation and Development.
IT –	Information Technology
KCA –	Kenya College of Accountancy
MVNO –	A mobile virtual network operator
THz –	terahertz
SM –	Super Massive
MIMO –	Multiple Input and Multiple Output
LISs –	Large intelligent surfaces
HBF –	Holographic Beam Forming
OAM –	Orbital Angular Momentum
VLC –	Visible Light and Communications

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Regulatory frameworks that can best support 5G network services in Kenya are authoritative for policy/decision makers across the globe (KMS Huq, J Rodriguez - 2016). There has been a wide promise that a competitive sector can be superior, although it has also been eluded that evolving models may differ in the specific roles/duties given to policy or a regulation, Deployment of 5G networks was defined as a very disruptive act and this was specifically for enabling new emerging Internet of Things (IoT) applications. Though, such applications required new regulation and business models to encourage less costly infrastructure (A Basaure, B Finley - 2019) . worldwide, the decisions makers have voiced recurring and even growing concerns about the stride of deployment of advanced communication infrastructure. In Europe, several of the consultation studies in preparation for the electronic communications code echo such hesitations (Cave, 2010).

The persistent effects of 5G for innovation and competition, alike concerns arise regarding the forthcoming deployment of 5G networks and services globally (Apatov, Chappell, & Grimes, 2018) . In precise, 5G services in the near future will be more complex than wireless technologies and offer versatile connectivity that can support new services with potentially far-reaching societal influences (Bauer & Bohli R Gerzaguat, N Bartzoudis, LG Baltar, V Berg, 2017) . The 5G network services will provide support for the Internet of Things (IoT) and allow organising special services in sectors such as manufacturing, transportation and health care (Bacache, Bourreau, & Gaudin, 2014). The 5G services globally holds considerable promises for competitiveness if leadership roles in wireless IoT communication, related cars, or tele-medicine (B V Chamola, V Hassija, V Gupta, M Guizani - leee access, 2020) .

In Kenya, communication is discussing a range of suggestions by shareholders and researchers. The 5G network services will accelerate fixed-mobile merging part of the evolving discussion and will focus on the best regulatory approach to joined services. The discussion extents proposals to reinstate regulated mobile virtual network operator (MVNO) access, mandated roaming, and possibly a regulation of backhaul services. By Imposing such regulations and procedures which will affect the degree and way of investment, and

innovation of regulated and unregulated organisations in the 5G bionetwork. As is well known from earlier peers of technologies, market players which will be affected differently by regulatory interferences. Against this environment, the current study seeks to explore more on the influence of access regulations on 5G network sector in Kenya.

6G Network.

The 6G network services will be rated as one of the key enablers for an intelligent data society of 2030 in the world and particularly in Africa as a continent, the 6G network services are foreseen to be more enhanced services compared to 5G network by satisfying evolving services and applications around the globe. In this particular area or article, where we present the vision of what and how 6G networks will be in coming future and also define the usage scenarios and particularly the requirements for the following areas of concern; multi-terabyte per second and how intelligent 6G network services will be around the globe.

From the lesson learnt from 5G networks, 6G will demonstrate and embrace and a large-dimensional and self-sufficient network architecture which will integrates the space, air, ground, and underwater networks that will give ubiquitous and limitless wireless connectivity. The 6G networks study showed artificial intelligence, machine learning, self-directed networks and the innovative air-interface design.

During the study, many technologies for 6G bionetwork were noted as follows; terahertz communications, very-large-scale antenna arrays, the large intelligent surfaces and holographic beamforming, orbital angular momentum multiplexing, laser and visible-light communications, block chain-based spectrum sharing, quantum communications and computing, molecular communications, and the Internet of Nano-things. This was actually referenced in “IEEE Vehicular Technology Magazine (Volume: 14, Issue: 3, Sept. 2019)”.

1.2 Problem statement

Although there has been a considerable effort by the information technology stakeholders worldwide to develop legal frameworks for 5G services (Alnoman & Anpalagan, 2017; Olwal, Djouani, & Kurien, 2016; Siddique, Tabassum, Hossain, & Kim, 2015) , little is known about the impact of these regulations on the performance of 5G networks, not only on 5G networks, but even on previous generations like 4G, 3G and the upcoming 6G networks. The paucity of evidence has resulted in a lack of robust frameworks for evaluating the

performance of 5G markets. In particular, imposing access regulations may have a significant impact on the direction of investment and innovation in the 5G ecosystem especially in Kenya where almost half of the population has access to internet. (Communications Authority of Kenya, 2018). Based on evidence from earlier generations of technologies, market players may be affected differently by access to regulatory frameworks and the resultant effects on the deployment on the performance 5G markets are difficult to anticipate (Bauer & Bohlin, 2019).

Despite clear evidence that 5G innovations in Kenya may have the potential to unleash an opportunity for smart cities to take full advantage of what's being called the Fourth Industrial Revolution, the details regarding access regulations and how they impact on the performance of 5G markets in Kenya are virtually non-existent (Krésová, 2019). According to economic Blueprint, Vision 2030 which is being fast-tracked through the implementation of the Big Four Agenda for socio-economic transformation, there is an urgent need seize the significant socio-economic opportunities that digital technologies bring. To harness these benefits 5G network, it is imperative to develop ecosystems that facilitate the thriving of digital markets nationally, regionally, and globally. With this in mind, the current study sought to employ a framework that assesses most of the influences on access regulations and 5G markets performance in Kenya.

1.3 Objectives.

1.3.1 Main objective

To examine the influence of access regulations on the performance of the 5G markets in Kenya.

1.3.2 Specific Objectives

1. To evaluate the performance of 5G markets in Kenya.
2. To evaluate the influence of strict network neutrality on the performance of 5G markets in Kenya
3. To determine the influence of mobile virtual networks operator's obligations on the performance of 5G markets in Kenya
4. To assess the influence of unbundling obligations on the performance of 5G markets in Kenya

1.4 Research Questions.

1. What is the performance of 5G markets in Kenya?
2. What is the influence of strict network neutrality on the performance of 5G markets in Kenya?
3. What is the influence of mobile virtual networks operator's obligations on the performance of 5G markets in Kenya?
4. What is the influence of unbundling obligations on the performance of 5G markets in Kenya?

1.5 Motivation

The 5G network services constitutes a fundamental part of the forthcoming gigabit communication network infrastructure and enables a wide range of innovations that are critical for mature digital societies. More importantly, it constitutes a new system of value generation. This has far-reaching consequences for how their innovation potential can be unleashed. Knowledge of the influence of access regulations on the performance of the 5G markets in Kenya may provide useful insights for reaping the benefits that new digital technologies provide as well as ensuring that no one is left behind. Furthermore, evidence on the access regulation for the 5G network may be helpful for the government to continue engaging with all stakeholders in the 5G markets to ensure that its approach is not only

forward-looking but also flexible and responsive as new opportunities and challenges arise. The current study sought to contribute a nuanced and differentiated analysis of the potential effects of regulatory interventions on the 5G ecosystem in Kenya.

1.6 Justification and significance

The element of danger in 5G services are very high because many of the potential uses are not yet known and will need to be explored in a process of trial and error by innovative, risk-taking entrepreneurs, it is critically important to find a policy design appropriate for the early stage of market growth. To this end, the study explored various implications of some alternative policy situations that affects innovation and investment of 5G networks and related services in Kenya. Actually the rate of adoption and growth of 5G services will be contingent on how well the markets for network services, applications and services will be aligned. Value generation in 5G market and the rate/direction of innovation turning point on realization of innovation complementarities between networks, applications and services. The 5G networks services are part of the all-purpose infrastructure of the digital economy and the effects of regulation can be examined within that conceptual framework. The legal and regulatory framework for 5G needs to allow market players to explore and exploit these complementarities. Appropriate design will facilitate a virtuous cycle of innovation in which network investment enlarges innovation opportunities in applications and services and vice versa.

CHAPTER TWO

LITRATURE REVIEW

2.1 5G Network Sector

5G wireless service establishes a vital part of the developing gigabit network infrastructure across the world. The pervasive connectivity will enable a wide range of innovations that are critical for a modern digital societies in the world (Agiwal, Roy, & Saxena, 2016). Actually, this wonderful potential will be realized is conditional on the technological aspect, business and policy enacted by the suppliers and users of the services. It also depends on the availability of complementary knowledge and skills of small, medium and large businesses, government of the day, and private users. Just like previous generations of wireless services in the world, the 5G networks markets will greatly benefit from competitive market conditions when implemented well. The competition will be most effective if it explains a legal and regulatory environment that aligns private inducements with the broader public upright (Ahokangas, Matinmikko, Yrjola, Okkonen, & Casey, 2013).

As Kenyan 5G networks policies take shape, it is important to keep the unique aspects of 5G markets in mind that distinguish them from earlier generations of wireless and fixed services. Not only will 5G network services be more complex technologically, they will constitute a new system of value generation with extensive significances on how their innovation potential can best be released (Akyildiz, Nie, Lin, & Chandrasekaran, 2016). The developing 5G market environment just like in the progressive Internet technology, is characterized by many collaborations between players. For successful innovation, one requires coordination and combined inputs from these interdependent group of actors. Examples are innovation complementarities between device manufacturers and application and service providers (ASPs), or between application developers and users (Bauer & Bohlin, 2019). Particularly the strong complementarities that exist between MNOs and ASPs, who interact in a system of vertically related, interdependent innovation. Both need each other to successfully innovate. Technological advances at the network level will enhance the innovation opportunities at the level of applications and services. Similarly, advances in applications and services will stimulate innovation at the level of networks and network services.

Consequently, the direction and rate of innovation is contingent on the extent to which the synergies between players can be realized. These complementarities can best be exploited by entrepreneurs in a marketplace that allows experimenting with new business models and services. If incentives are properly aligned, this will create a virtuous cycle of innovation in which network investment enlarges innovation opportunities in applications and services and vice versa. The process of research on sheer linked markets and the internalization of harmonising externalities (Alnoman & Anpalagan, 2017) in such markets shown that the early, inappropriate regulation can twist and even undermine the way coordination between players at the interrelated layers and prevent them from taking advantage of their complementarities.

The 5G network services for industries, such as health sector, energy, transportation, smart cities, and manufacturing industries, will be very important drivers of 5G markets innovation in the world. Actually, many require specific sector expertise and differentiated network support that will need to be coordinated between multiple stakeholders. This heterogeneity of demands regarding the type and quality of network support will pose new challenges for network operators and other participants in the 5G ecosystem. The market players will require innovative commercial responses and the new forms of contracts and coordination among the stakeholders or players (Bangerter, Talwar, Arefi, & Stewart, 2014). All under these conditions, entrepreneurial freedom will be very critical since it provides a market-driven framework to discover the wide range of potential services that could be supported by 5G markets.

An ideally and appropriate regulatory framework will required to support entrepreneurial experiments to exploit this huge but largely unknown innovation space of 5G market (Chen, Qian, Mao, Tang, & Yang, 2016). This is appropriate because of the interdependent nature of this highly dynamic innovation space in technology, it will attract considerable experimentation to develop sustainable and profitable applications and services. Commercial decision-making and experimentation have historically been the most positive approach to explore and realize such innovation opportunities. In the setting of a standardized network environment, the Internet demonstrates that a dormant innovation potential is best to explored in an environment that is not limited by detailed ex ante regulation (M Bourreau, C Cambini, S Hoernig - Telecommunications Policy, 2012). This is obvious because 5G networks services pose additional technological challenges to establishment the required

technological service support, an even stronger argument for the need to preserve entrepreneurial freedom can be made. The mobile network operators (MNOs) and other players are not narrow-minded and they are aware of the complementarities upon which their operations depend and will consequently shape business models that realize them (Jia, Xie, Huang, Liu, & Liu, 2017).

Given the strategic importance of 5G market services across the world, policy makers are considering a range of options to regulate 5G market services to enhance smart competition among the stakeholders. A discussion on the best regulatory approach to converged services is emerging across the globe. Responses continue to be in flux and include proposals to impose Mobile Virtual Network Operators responsibilities, mandatory national roaming, and possibly the regulation of backhaul. Moreover, there seems to be a renewed interest by policy makers and stakeholders to focus on opening up 5G market stages by imposing strict access or sharing obligations, often with little regard for their impact on investment and innovation among stakeholders.

2.2 Drivers of 5G network investment and innovation

According to the research, the varied innovation processes co-exist in the Internet world and in evolving 5G markets. The innovations are driven by mutual factors, although their relevance depends on the type of intended innovation (Katzis & Ahmadi, 2016). Any time you decide on an innovation and the resources available to it, the stakeholders always form some expectations, benefits and costs of innovation in their organisation, they will assess expected contribution at individual level and organizational objective or prosperity of the innovation (Liu et al., 2016).

In any organisation, only the profit-oriented stakeholders consider reserved benefits and costs that can be commercialised, they will not consider social benefits and spill-over effects on other players. Players who operate in other innovation means, such as noble production, might adopt social benefits even if they face challenges to convert into income. There is dualism that ties investment and innovation such that investment in ICTs consider innovation most. Consecutively, a lot of innovation attract serious resource commitment and investment to succeed. The discounted cash-flow (DCF) approach was utilized to rate investment opportunities and provide guideline for innovation choices, although, it did not capture the indecisiveness that distress non-marginal innovation decisions. Recent contributions to

innovation economics highpoint the significance of venture capital, cash reserves, and operating cash flow to stimulate such risky innovation projects (Li, Da Xu, & Zhao, 2018).

According to these researcher (Noura & Nordin, 2016), he states that innovations can be very risky, and therefore some of the profit-oriented organisation operating in such market environments may need an opportunity to temporarily earn some big profit margins for them to accept innovation risk due to obvious fear. In some situation, riskier innovation requires a chance to earn a higher mark-up or margins and probably over a longer period of time. The contestability and appropriability can be related but not identical, those two terms capture different features of market and competitive process available. In some cases, the innovation incentives can be lower if contestability or appropriability are weak, and highest in the scenarios where both are present. Potential costs and benefits of innovation are also influenced by the availability of technological and economic opportunities in the market, depending on technological, organizational, and business model improvements. A wider range of technical opportunities and the perception of more unexplored spaces or opportunities created by advanced digital technology may provide more chances for innovation experiments as said by (Zhang, Meng, Liu, & Zhang, 2016) in his research.

According to the study, innovation research has revealed that the importance of these factors varies depending on the type of innovation. In the Internet innovation system, several innovation types co-exist in the world. The only important interrelated attributes of innovations include their scope and the degree of complementarity. Innovations might range from different scope such as modular to architectural.

Modular innovation focuses on processes within one element of a larger technical system, for examples; unconnected applications and services. Since they do not affect organisation between different modules, technical and economic interfaces between modules, such as standards, protocols, and service level agreements (SLAs), are effective coordination mechanisms. Innovations can dynamically unfold with changes in individual modules stimulating innovation in related modules. Modular innovations are known to be powerful engines of digital innovation, but they are unable to solve problems that demand for redesigning aspects of the broader innovation system (Siddique et al., 2015). The way of architectural innovations, in contrast, change the relationships between modules and

therefore require different types of coordination among the stakeholders providing the modules (Henderson & Clark, 1990).

In 5G market services, the second and most important dimension is the extent of an innovation. The Incremental innovations can change some of the limited number of attributes of a product or service whereas discontinuous innovations (sometimes-referred to as “radical” innovations) change simultaneously. Discontinuous innovations are riskier and less frequent than incremental innovations. They can also be contingent on different types of coordination among the players in the relevant innovation space (Saha, Saengudomlert, & Aswakul, 2016). By citing an example of a discontinuous innovation is the smartphone. Although its component technologies were known before, few succeeded in putting them together in a way that would support sustainable business models. Early examples are i-Mode in Japan and Nate in South Korea, both coordinated by Mobile Network Operators. The most recent successful example is the iPhone technology, coordinated by Apple.

A third dimension, related to the other two, is the complementarity of innovation in drivers of 5G network investment and innovation. It refers to an extent which innovation in one part of the system can be influenced by the state of innovations in a connected part. This aspect is particularly important as part of innovations in 5G market services as many innovations require coordination between network operators and service providers. Panwar et al. (2016) explored positive effects of the quality of general-purpose technology on innovation opportunities on applications sectors or organisation, that is for our case in Kenya. Such complementarities may be weak or strong, and dimension can be referred to as “coupling”, ranging from independence to tight coupling (Panwar, Sharma, & Singh, 2016). This example cites, current technology, the operation of micro grids requires which very specific QoS and hence is tightly coupled to the capabilities of the network (Olwal et al., 2016).

2.3 Performance of 5G value system

Performance of 5G value system was defined as a simple modelling framework which can be developed by expanding traditional models of investment and innovation by taking the complementarities between network investment/innovation and application and services investment/innovation explicitly into account. In this particular framework, several innovation processes are interrelated. In each of such that the potentially related areas like

MNOs, ASPs, innovation is influenced by the well-known drivers of innovation: competition/contestability, appropriability of innovation premiums, and technological/business opportunities (Li et al., 2018). These factors influence the expected profitability of an innovation. If it is sufficiently high, a project will be pursued. Regulation, in turn, affects appropriability, contestability, and possibly opportunities, thus shaping the rate and direction of investment and innovation via its effects on innovation drivers.

In addition to the conditions in their own market segment, innovation decisions by players or stakeholders will be influenced by the innovation accomplishments of related stakeholders in the market such as network or internet service providers. (Katzis and Ahmadi (2016), demonstrate the constructive things on the quality for a general-purpose technology (GPT) where innovation opportunities in applications sectors and vice versa in the world implies to Kenya as a country.

According to the Li et al. (2018) discussion, the importance of such complementary innovations for the advanced Internet. The study states that such complementarities exist where we have network infrastructure, applications, and services configured at higher levels of the Internet stack. Advances in one area can typically enable further advances in related technologies and services. However, these effects also work in the opposite direction such that constraints in an area may slow down advances in related areas such as suboptimal provision of differentiated network quality which may reduce the innovation opportunities for services and applications and consequently dampen the incentives for further network innovation, potentially putting the entire value system on a slower innovation path. Although innovation can be a solution to some constraints, there must be some of specific areas in which obstacles can be overcome by being more creative in innovative. However, such cases are rarer than potential negative effects of rigid regulation on the rate of innovation (Jia et al., 2017), which is equally applicable to innovations related to policy and access regulatory for 5G markets in Kenya.

The Complementary innovation processes are pervasive in the emerging 5G market system. Sector-specific investment and innovation processes are strongly influenced by complementarities with players in other sectors. For example, application and service providers will have more innovation opportunities if the network provides better quality services (e.g., more widely diffused, higher speed's higher reliability). Likewise, the

innovation at the application or services layer can boost the value of the network and thereafter increase encouragement of network operators to invest and innovate new ideas. These innovation complementarities may be weak (in which case the sectoral model of innovation will be a workable approximation) or strong (in which case they need to be considered explicitly) (Cox et al., 2017), as such, it can influence innovations for 5G markets.

2.4 The role of access regulations on the performance of the 5G sector

For access regulations on the performance of the 5G sector in Kenya to work, a classic rationale for regulatory intervention to mitigate the static and dynamic efficiency losses associated with significant market power and pursuit of social goals that unregulated markets would not accomplish, have been invoked for 5G markets, according to (Bauer & Bohlin, 2019). One set of concerns relates to the spatially differentiated nature of communication markets. The study in sparsely populated areas shows that, no or only one supplier may be able to establish a commercially viable presence. Even if demand were to support multiple providers, limited availability of civil engineering infrastructure may allow only one MNO to deploy the required number of small-cell antennas in an area. Similarly, MNOs in such a dominant position may not make access to backhaul available at reasonable conditions. These challenges could lead to an abuse of market power vis a vis end-users, and ASPs needing access to wholesale connectivity. Related to these market structure issues are concerns that MNOs may make connectivity available to ASPs and OTT providers at conditions that might impede innovation by these players in the market. Given the strategic importance of 5G markets for the digital or modern economy, the concern is that commercial MNOs will not expand coverage at a rate desirable from a societal point of view (Bangerter et al., 2014).

According to Olwal et al. (2016), he correctly points out that claims in favour or opposed to regulation cannot easily be refuted, given the uncertainty surrounding many aspects of 5G market in the world. However, despite uncertainty it is possible to analyse the plausibility of the prospective conditions identified as requiring regulatory intervention and the likely impacts of such measures on investment and innovation through utilization of 5G market. To this end, we will employ the theoretical framework developed in the previous section. When analysing the design of a prospective regulatory framework, it is important to consider the resilience of the approach to potential regulatory errors. An important distinction in this context is the difference between Type I error regulatory (“false positive”, wrongly assuming

a need to regulate) and Type II error regulatory (“false negative”, wrongly assuming there is no need to regulate). In the first case, ex ante regulation may establish an MVNO mandate or sharing obligations assuming the presence of some form of market failure. In the second case, no such regulations are introduced assuming that competition is workable. The difference between the two types of regulatory errors is that recovery from Type II errors is easier. If a Type I error is committed, evidence that the market would have been effectively competitive will not emerge, as all players will design their business models with the regulation in mind. In the second case, evidence will emerge that the market is not effectively competitive, in which case either competition policy or regulation can be invoked, according to (Akyildiz et al., 2016).

For 3G services across the OECD countries, Li et al. (2018) found that Mobile Virtual Network Operator (MVNO) obligations reduced MNO capex significantly by about 17.1%. Voluntary commercial agreements never had a statistically significant effect on capex. Moreover, many new applications in industry, transportation, and health will require sector-specific knowledge and differentiated network support, some of high technical quality of service (Ahokangas et al., 2013). Exploring and exploiting these innovation opportunities will require collaboration among organizations with specialized knowledge of the interrelated domains. Offering a standardized access product will likely be insufficient to explore these innovation spaces. The effects of regulated MVNO requirements at an early stage of 5G network development is to decrease investment and slow down on innovation. However, this may attract higher transaction costs at the beginning, it is the most appropriate strategy to allow negotiations among interested stakeholders. By implementing a competition policy can serve as a tailback in case negotiations are abused by MNOs to obstruct competition in the space.

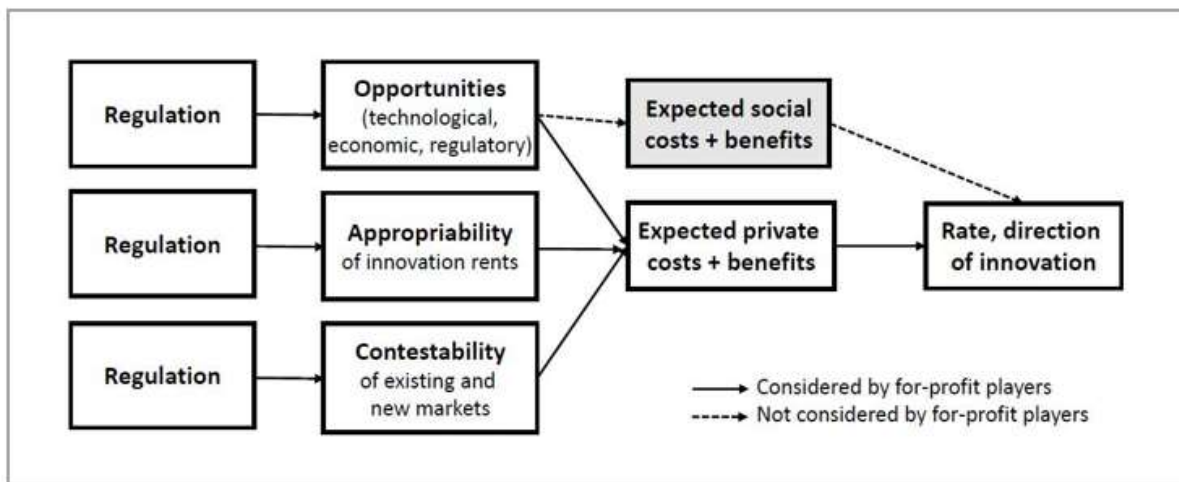
2.5 A modelling framework

Modelling framework is a simple model that explicitly takes into account the complementarities between network and service innovation may be designed through the expansion of the traditional models of innovations. This framework comprises of several interrelated innovation processes. In each of the areas that are potentially related, the well-known predictors including competition or contestability, appropriability of innovation premiums, and technological or business opportunities, affect innovation. These factors influence the expected profitability of innovation. If it is sufficiently high, a project will be

pursued. Regulation, in turn, affects appropriability, contestability, and possible opportunities, thus shaping the rate and direction of investment and innovation via its effects on innovation drivers in the market, according to (Bauer & Knieps, 2018).

In addition to the prevailing market segment conditions, innovation decisions by players may be affected by innovation activities related players for example network service providers, (Bauer and Knieps, 2018) discussed the importance of such complementary innovations on advanced Internet services. Such complementarities normally exist between network infrastructure, applications, and services which are configured at higher levels of the Internet stack. They also exist between devices and the network, devices and applications, and among the available services.

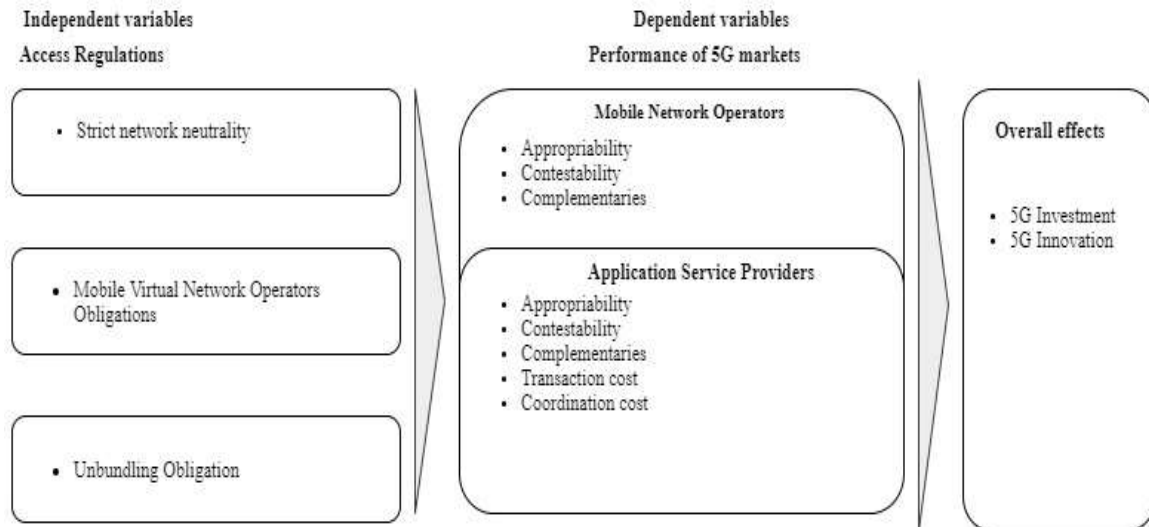
Figure 1: Drivers of innovation



Conceptual framework

Figure 2. demonstrates the conceptual framework for this study, it is an illustration of the likely effects of specific regulatory measures on the performance of 5G markets is provided. This conceptual framework has been adapted from a study by Bauer and Knieps (2018), where the independent variable is access regulations, measured by strict network neutrality, mobile virtual networks operator’s obligations, unbundling obligations. The outcome variable is the performance of 5G markets, measured by appropriability, contestability, complementary, transactions, and coordination costs incurred by mobile network operators and application service providers respectively.

Figure 2: Conceptual Framework.



The emergence of new technologies forced policy makers to decide whether the existing legal and regulatory framework was appropriate or whether a different approach could have been applicable to realize potential benefits for society. There was broad agreement on the desirability of competition in future 5G markets, both national and regional or global models differed widely in regard to the envisioned role of policy and regulations. This explores various rationales, strength, and weaknesses of specific policies that are currently debated, this include regulation of backhaul services, network rollout targets, network neutrality rules, and open platform safeguard.

It will assess the effects of regulatory options on investment and innovation in a theoretical framework that consider strong interdependencies and complementarities between players in the 5G value system. This also reveal the presence of traditional forms of market failure and the possibility of new ones related to coordination of requirements for advanced wireless technologies.

The analysis suggests that multiple policy equilibria will exist and each corresponding to a specific constellation of 5G policy will be associated with different innovation and investment routes in the sector.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter outlines various methodologies used for research design, population of the study, data collection methods, diagnostic tests, data analysis technique. The analytical path and methodological approach adopted in this study will be guided by research objectives.

3.2 Research Design

During research, cross-sectional descriptive research design was used, according to Mugenda and Mugenda (2003), he established that a cross-sectional descriptive design covers the following findings, the what? Why? Where? and how? of a phenomenon. It is a self-report study, which required the collection of quantifiable information from the sample size. Moreover, a descriptive survey research design employed quantitative tools, which involved using of questionnaires and generalization of the results of the sample to the population from which survey was drawn.

This design was deemed fit as it provided the fastest and accurate means of assessing information to help produce data that is holistic, contextual and with rich details for testing the hypothesis, it also answered the questions in the current study. This design was preferred because of its causal effects of relationships, as well as the extent to which the combination of moderating variables influences outcome of the dependent variable as desired. To ensure accurate data to achieve the desired result, the appointment was booked in advance, the point persons were identified and sensitized on how to fill and understand the content of the questionnaire, they were provided extra copies just in case of an error made during the process of answering questions from the target group. This made the process very successful, efficient and accurate.

3.3 Population of Study

Population of the study targeted firms in the following six market segments: International gateway operators; Submarine cable landing rights operators; network facilities providers Tier 1; Network facilities providers Tier 2; Network facilities providers Tier 3; and telecommunications contractors. The target firms included the major telecom service providers in terms of users' subscription such as mobile operators, mobile money providers, and fixed data and internet

providers registered in Communications Authority of Kenya (2019) as licensees in the register of Unified Licensing Framework and who also submitted compliance returns for the period July-September 2019 (Communication Authority of Kenya, 2019). The targeted study respondents constituted of either project management office (PMO) heads; project managers; solution architects; operations and support teams; procurement or contract managers in each of the target firms. The study used Yamane (1967) sample size determination formula because the formula is appropriate in cases where the population is large and known.

$$n = N/[1 + (N\varepsilon^2)] = 800/[1 + (800(0.05)^2)] = 266$$

Assuming that non-response rate is 30%, the final sample size is therefore;

$$n = \frac{266}{(1-0.3)} \approx 375$$

Where;

n is the sample size

N is the target population

ε is the precision error

Based on the above formula, a precision error of 0.05 was used and the sample size was estimated as to be 375. The study combined both probability and non-probability data sampling method to select the respondents. Simple random sampling method was used to select 375 companies from a sampling frame of 800 companies. To conduct simple random sampling, the study listed the 800 companies and apply simple random sampling in Microsoft excel computer package to generate a list of 375 companies. Thereafter, non-probability sampling method, convenience sampling method was used to choose either project management office heads; project managers; solution architects; operations and support teams; procurement or contract managers for each selected company.

3.4 Data Collection Methods

The study intended to collect numerical data from primary data sources which was used to address the concepts of access regulations in the 5G sector, drivers of 5G network investment and innovation, performance of 5G value systems and the role of access regulations on the performance of the 5G sector. Respondents were asked to evaluate the scales operationalizing the variables under study from some semi-structured questionnaires which had both open and close ended questions. Data was put together through an organized questionnaire that has

been adapted from related and relevant studies with some alterations aimed at addressing the exact setting. To access distinct content and format for the response, the reviewed survey for further pre-testing was done and thereafter the questionnaire package was given to potential respondents, the questionnaire had a cover letter giving details of the objectives of the study, and the subsidiary authorization from the National Council on Research and Technology from the Ministry of Higher Education. The questionnaire provided direction on how to respond to the questionnaire and confidentiality issues at the beginning of the questionnaire.

This study intended to employ self-administered survey approach where questionnaires were hand delivered to the respondents in their respective companies. A number of assumptions underpins this study in that the questionnaire was constructed on the assumption that the main respondents were from corporate executives and therefore used in various firm performance research studies for their capability to deliver from the perceptions or experience necessary to respond to definite questions. Further, it was assumed that the responses from the respondents represented the firms' behaviour and practices.

3.5 Reliability and Validity Tests

3.5.1 Reliability

Cronbach's Alpha, given as follows was used to quantify the quality, reliability and validity of the study:

$$a = \frac{N-r}{1+(N-1)r}$$

Where;

N = the number of constituents or items going to be tested

a = the level to which a set of test elements can be treated as evaluating a single variable

r = the average of all correlation coefficients

Cronbach's alpha co-efficient above was used to test for reliability of uncertainty avoidance culture, firm characteristics and foreign market entry strategies. Cronbach's Alpha approach will be employed to measure internal consistency of the questionnaire items, however the reliability does not automatically suggest validity because in as much as reliable measure means measuring something regularly, it may not essentially be what is required to

be measured. Therefore, to confirm internal consistency, this study was considered Cronbach's alpha cut-off value of 0.7 (Nunn ally, 1978).

3.5.2 Validity

For the fact that the study used data collection instruments that were developed by the researcher, validity was evaluated from two perspectives. They included face content validity and the construct validity.

Face content validity look at judgement made on superficial examination of the content in question. It measures the extent to which the selected content appears reasonable on the face of it. To establish face validity of research instruments, the author had to run a pilot study to feel if the model is adequate.

Construct validity is the most sophisticated method of testing validity of all three which aims at ascertaining the contribution such that each construct makes to the total variance observed in the phenomenon. To establish validity of research instrument, the researcher will have sought opinions from experts in the field of study especially the researcher's supervisors and lecturers.

3.6 Data analysis

Descriptive statistics data analysis model was used to summarize the background characteristics of respondents and frequency distributions. Descriptive tables showing counts and proportions were presented for the outcome variable by categorical predictor variables. Multivariate linear regression analysis method was applied to determine the influence of access regulations on 5G performance in Kenya.

3.7 Ethical considerations

The proposal for this study was reviewed and approved by KCA University. Informed consents were sought from all respondents. The selected respondents were approached and requested to fill in questionnaires, where research objectives were first explained to them for understanding, and confidentiality of response was guaranteed. Appointments were made in advance for those respondents who seemed to be busy or inaccessible. The respondents were given time to respond to questions personally, and guided only if they seek some assistance.

CHAPTER FOUR

DATA PRESENTATION, INTERPRETATION AND DISCUSSION OF THE FINDINGS

4.0 Introduction

This chapter focuses on the findings of the study based on data collected through questionnaires from the respondents. The summaries of the findings were presented in tables inform of frequencies and percentages, pie charts and bar graphs. The chapter is divided into two sections as follows, sections one which presents the demographic characteristics of respondents while section two which presents the findings according to the research questions as framed in the questionnaires.

The respondent's response to questionnaire was rated at 100%. According to Mugenda and Mugenda (2003), the percentage of subjects whose respond to questionnaires is adequate if it is 100%. The response rate for this study is therefore sufficiently adequate to justify the research area.

4.1 Demographic Characteristics of Respondents

The respondents were asked to indicate their background information which was collected based on the following areas: - gender, age, utmost academic, professional qualification and work experience. Their responses were as summarized in table 4.1 as shown below.

Table 4.1: Age

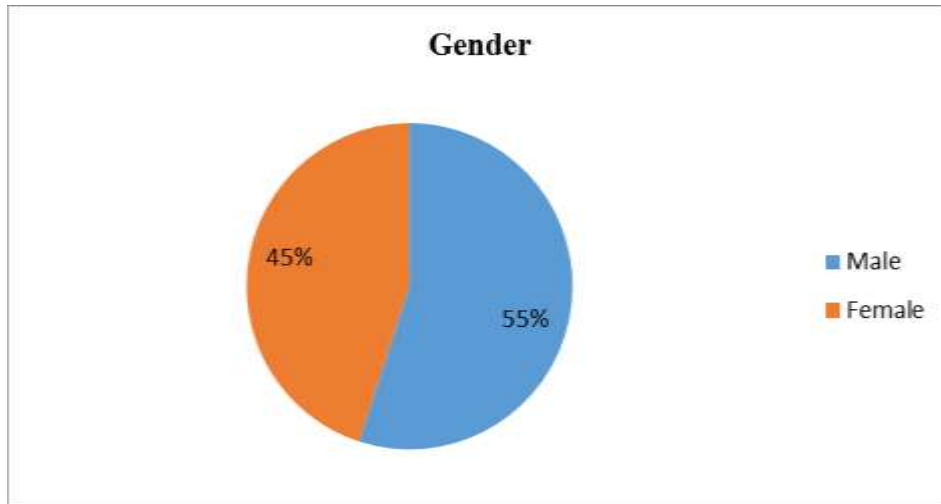
		Frequency	Percentage
Age	18-25	19	5
	26-36	94	25
	37-47	150	40
	Above 47	112	30
	Total	375	100.0

The analysis in table 4.1 above shows that majority of the respondents (40%) were ranging from the age between 37 and 47 years. This suggests that most of the respondents were in the middle of their careers.

4.1.1 Gender

The respondents were requested to show or indicate their gender/sex, and summarized in figure 4.1 as shown below.

Figure 4.1: Gender

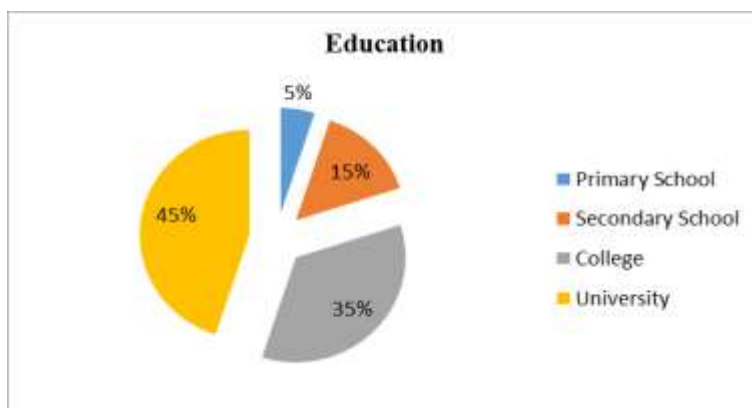


The results in figure 4.1 above showed that 55% of the respondents were male while 45% were female.

4.1.2 Education

The respondents were requested to provide information about their level of education as summarized in figure 4.2 below.

Figure 4.2: Education



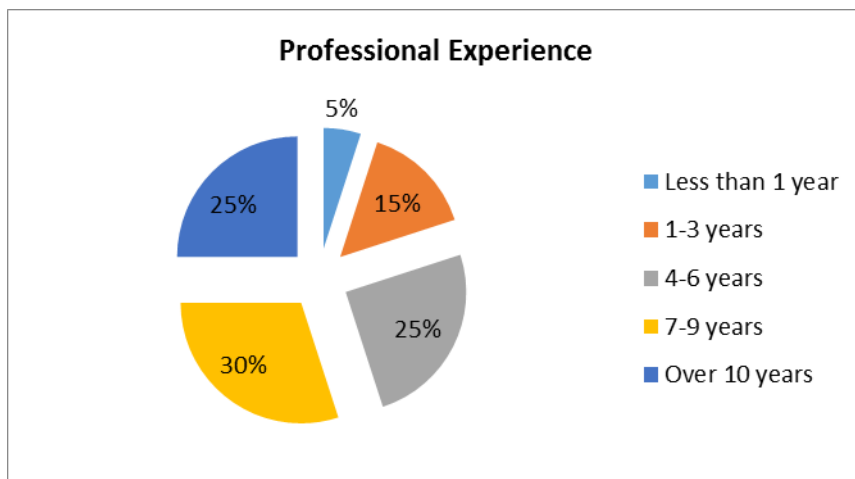
The results in figure 4.2 above suggest that majority of the respondents at 45% had university level of education. These findings showed that majority of the respondents had

formal education hence; they possessed a grasp of information on status of network in their companies.

4.1.3 Experience

The respondents were asked to show or indicate their years of professional experience as summarized in figure 4.3 below.

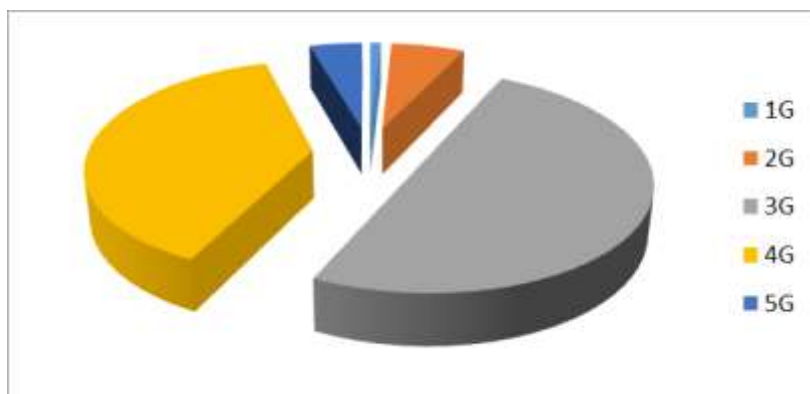
Figure 4.3: Experience



The results in figure 4.3 showed that most the respondents with 30% had a professional experience of between 7 and 9 years.

4.2 Status of mobile network

This objective wanted to establish the position of mobile networks of companies. The results are as shown in the table below.



As shown in the table, mos companies use 3G in the operations at 56% followed closely by 4G network at 43%. Some few companies 7% still use 2G in their operation as shown in

the table, with 1G technology almost non-existent at 1%. Companies however are yet to adopt 5G technology since only 5% of the companies were found to have 5G network.

4.3 Influence of strict network neutrality on the performance of 5G markets.

This objective required to establish the impact of strict network neutrality on the 5G network performance in Kenya markets. The responses are summarized below in table 4.5.

Various sets of questions were asked to find out the influence of strict network neutrality on 5G network markets performance. A Likert scale of 1-5 was used to rate the influence of strict network neutrality on the performance of 5G markets. The respondents were tasked to rate the extent to which they agreed on the various set of statements regarding the impact of strict network neutrality on 5G markets performance. The following scale was applied where 1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree and 5 = strongly agree.

Table 4.3 illustrates the respondents' responses on the impact of strict network neutrality on 5G network performance.

Table 4.3; influence of strict network neutrality on the performance of 5G markets

Statement	%	Mean	STANDARD DEVIATION
The ability of networks to treat all traffic, equal which could discourage useful innovation by network proprietors	40.6	2.03	1.19
Some applications (such as voice calling and online services) are very particular and sensitive to delays in data delivery.	65.2	3.26	1.05
Internet users might benefit if companies pay a the premium to safeguard the latency-sensitive applications and prioritised.	35.0	1.75	1.13
Strict network neutrality guidelines could block ISPs from experimenting this kind of service.	34.8	1.74	1.29
It is very difficult to come up with clear and effective network neutrality guidelines	67.4	3.37	0.84

As shown in table 4.3 above, 40.06% of the respondents were in agreement that necessitating networks to treat all traffic uniformly could not encourage valuable innovation by network possessors. The mean of 2.03 also confirms that there was low level of agreement on this. The results in table 4.2 clearly indicate that most respondents (65.2%) agreed on applications like voice calling and online service as very sensitive to data delivering delays. The mean of 3.26 also confirms that there was high level of agreement on this. In addition, 35% of the respondents agreed that Internet stakeholders are likely to be advantaged if companies could pay a premium to ensure that their latency-sensitive applications were prioritized. The mean of 1.75 also confirms that there was low level of agreement on this.

As shown in table 4.3 above, 34.8% of the respondents are in agreement that stringent network neutrality rules could stop Internet Service Providers from testing such nature of service. The mean of 1.74 also confirms that there was low level of agreement on this. Furthermore, the results in table 4.2 show that 67.4% of the respondents agreed that it is no possible to come up with clear and effective network neutrality rules. The mean of 3.37 also confirms that there was high level of agreement on this. This high number can be attributed to the fact that crafting clear and effective neutrality rules can be quite a challenge.

4.4 Mobile virtual networks operator's obligations on the performance of 5G markets.

This objective sought to establish mobile virtual networks operator's obligations on the performance of 5G markets. The responses are summarized below in table 4.4.

Various sets of questions sought to establish mobile virtual networks operator's obligations on the performance of 5G markets. A Likert scale of 1-5 was used to rate the mobile virtual networks operator's obligations on the performance of 5G markets. The respondents were tasked to rate the degree to which they agreed on various set of statements concerning mobile virtual networks operator's responsibilities on performance of 5G markets, and in that regard, the following scale was adopted where 1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree, and 5 = strongly agree.

Table 4.4 shows the respondents' responses on mobile virtual networks operator's obligations on the performance of 5G markets

Table 4.4 Mobile virtual networks operator’s obligations on the performance of 5G markets

Description	%	Mean	Standard Deviation
MVNOs need regulatory protection	72.6	3.78	1.47
<i>ex ante</i> regulatory interference instead of MVNOs is not strong to imaginary or non-existent	54.2	2.71	1.15
The main mobile market situations favour the unprompted emergence of voluntary MNO-MVNO relationships.	35.6	1.63	0.95
<i>ex ante</i> regulation to facilitate MVNO entry and participation in mobile markets is neither necessary nor inevitable	54.4	2.72	1.37

As shown in table 4.4, most respondents 72.6% agreed that MVNOs need regulatory protection. The mean of 3.78 also confirms that there was high level of agreement on this. This high number can be attributed to the fact that the companies do not have sufficient regulatory protection on 5G markets. The results in figure 4.4 suggest that 54.2% of the respondents agreed that *ex ante* regulatory interference instead of MVNOs is not strong to non-existent. The mean of 2.72 also confirms that there was high level of agreement on this. This high number can be attributed to the fact that the *ex ante* regulatory interference instead of MVNOs is not strong to non-existent.

In addition, majority of the respondents (54.4%) agreed that *ex ante* regulation to facilitate MVNO entry and participation in mobile markets is neither necessary nor inevitable. The mean of 2.71 also confirms that there was moderate level of agreement on this. As shown in table 4.4, 35.6% of respondents considering that the prevailing mobile market circumstances favour the spontaneous emergence of voluntary MNO-MVNO relationships. The mean of 1.63 also confirms that there was low level of agreement on this. This low number can be attributed to the fact that the prevailing mobile market circumstances do not favour the spontaneous emergence of voluntary MNO-MVNO relationships.

4.5 influence of unbundling obligations on the performance of 5G markets

This objective intended to establish an outcome of unbundling obligations on the 5G performance in Kenya. The responses are summarized in table 4.5.

Various sets of questions intend to find out the influence of unbundling obligations concerning 5G performance. A Likert scale of 1-5 was used to rate how unbundling obligations affect performance of 5G markets.

The respondents were questioned to rate the degree to which they agreed with various set of statements concerning the application of different aspects of unbundling obligations on the performance of 5G markets., where 1 = strongly disagree, 2 = disagree, 3 = undecided, = agree and 5 = strongly agree.

Table 4.5 shows the respondents’ responses on unbundling obligations on the performance of 5G markets.

Table 4.5: unbundling obligations on the performance of 5G markets

Description	%	Mean	SD
Unbundling mandates and broad avoided-cost resale requirements have failed to advance consumer interests	54.6	2.79	1.15
The market is able to reward those who can provide the best services at the lowest cost, rather than those that benefit from an out-dated regulatory regime	72.1	3.72	1.47
Removal of the mandates at issue will fuel additional competition, bringing consumers ever-better services	54.2	2.71	1.14
All customers are able to benefit from open competition and deployment that will step from removal of these mandates in the vast majority of locations	42.8	2.14	1.12

As shown in table 4.5 above, 54.6 % of the respondents agreed that unbundling mandates and broad avoided-cost resale requirements have failed to advance consumer interests. The mean of 2.79 also confirms that there was moderate level of agreement on this. This high

number can be attributed to the fact that unbundling mandates and broad avoided-cost resale requirements have failed to advance consumer interests. The results show that majority of respondents 72.1% agreed that the market is able to reward those who can provide the best services at the lowest cost, rather than those that benefit from an out-dated regulatory regime. The mean of 3.72 also confirms that there was high level of agreement on this. This low number can be attributed to the fact the mobile network market is able to reward those who can provide the best services at the lowest cost, rather than those that benefit from an out-dated regulatory regime.

Table 4.5 clearly indicate that 54% of the respondents were in agreement that the removal of the mandates at issue will fuel additional competition, bringing consumers ever-better services. The mean of 2.71 also confirms that there was low level of agreement on this. This high number can be attributed to the fact that the removal of the mandates at issue can fuel additional competition, bringing consumers ever-better services. In addition, 42.8% all customers are able to benefit from open competition and deployment that will step from removal of these mandates in the vast majority of locations. The mean of 2.14 also confirms that there was low level of agreement on this. This low number can be attributed to the fact that not all customers are able to benefit from open competition and deployment that will step from removal of these mandates in the vast majority of locations.

4.6 Performance

This objective sought to establish performance of 5G markets in Kenya and therefore the responses will be summarized in table 4.6

Various sets of questions sought to determine performance of 5G markets in Kenya. A Likert scale of 1 to 5 was used to rate 5G performance in Kenyan market.

The respondents were questioned to rate on the degree to which they agreed with various set of statements pertaining the performance of their companies over the last five years, where 1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree and 5 strongly agree.

Table 4.6 shows the respondents' responses on performance of their companies over the last five years.

Table 4.6 Performance

Description	%	Mean	SD
Appropriability	37.2	1.86	0.82
Contestability	51.8	2.59	0.70
Possible opportunities	54.2	2.71	1.15
Rate and direction of investment and innovation	37.6	1.88	0.80
Increase in overall profits	57.2	2.83	1.23
Increase business assets	53.4	2.61	1.12
Increase in quality of products	61.3	3.11	1.48

As shown in table 4.6 above, 37.2% of the respondents agreed that there was appropriability. The mean of 1.86 also confirms that there was low level of agreement on this. This low number can be attributed to the fact that there has been minimal appropriability in the companies over the last five (5) years. In addition, 51.8% of the respondents agreed that there was contestability. The mean score of 2.59 also confirms that there was a moderate level of agreement on this. This number can be attributed to the fact that there has been moderate contestability level in the company over the last five years.

As shown in figure 4.6 above, 54.2% of the respondents, it was agreed that there are possible opportunities in their companies. The mean of 2.71 also confirms that there was a moderate level of agreement on this. In addition, 37.6% of the respondents agreed that there is increased rate in direction of investment and innovation. The mean of 1.88 also confirms that there was low level of agreement on this. This number can be attributed to the fact that most companies are not very innovative and therefore direction of investment is not well defined.

As shown in table 4.6, 57.2% of the respondents agreed that there has been increase in overall profits over the last five years. The mean of 1.86 also confirms that there was moderate level of agreement on this. This number can be attributed to the fact that there has been minimal increase in overall profits of the companies over the last 5 years. In addition, 53.4% of the respondents agreed that there was increase in business assets. The mean of 2.61 also confirms that there was a moderate level of agreement on this. This number can be attributed to the fact that there has been moderate increase in business assets of the company over the last five years.

As indicated in figure 4.6 above, 61.3% of the respondents agreed that there has been increase in quality of products. The mean of 3.11 also confirms that there was high level of agreement on this. This number can be attributed to the slight increase in innovation and investment over the last five years.

4.7 Regression analysis

Table 4.7.1 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.654 ^a	.209	.723	.501

a. Predictors: (constant) access regulations ie; strict network neutrality; mobile virtual networks operator’s obligations; unbundling obligations

b. Dependent variable: 5G performance in Kenyan markets

As shown in table 4.9, it was evidential that R value equal to 0.654 which showed a positive direction of results. R was a correlation between the observed and predicted values of the dependent variable. The value ranges between -1 to1 (Hiew,2005). R is the correlation coefficient which shows the strength of the relationship between the independent and the dependent variable, it indicates direction of relationship which can be positive or negative. Hence R value shows strong relationship between the predicted vales and the observed values in a positive direction. The coefficient of determinant $R^2 = 0.723$ which indicates that 72.3% of the variance is dependent variable (performance of the 5G markets in Kenya) was explained and predicted by (strict network neutrality; mobile virtual networks operator’s obligations; unbundling obligations).

The results of the analysis are presented in Table 4.7.

Table 4.7.2 ANOVA

ANOVA ^a						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2.967	18	.172	.735	.001 ^b
	Residual	9.645	51	.281		
	Total	12.612	69			
<p>a. Predictors: (constant) access regulations i.e.; strict network neutrality; mobile virtual networks operator's obligations; unbundling obligations.</p> <p>b. Dependent variable: 5G performance in Kenyan markets</p>						

The F-statistics indicated $F=0.735$, which was important at 5% (Sig. $F<0.05$) confirming the suitability of the model and statistical significant relationship between performance of the 5G markets in Kenya and access regulations. This shows that there is significant joint contribution of access regulations; strict network neutrality; mobile virtual networks operator's obligations; unbundling obligations on the performance of the 5G markets in Kenya. It showed that $p = 0.001$ which is lesser than 0.05, therefore the relationship is significant. This position was further strengthened by Multiple Regression Analysis of; strict network neutrality; mobile virtual networks operator's obligations; unbundling obligations and performance of the 5G markets in Kenya.

Table 4.7.3: Regression model

Model	B (Unstandardized coefficients	Std. Error	Beta (Standardized coefficients	T	Significance
Constant	3.615	2.946		1.286	0.001
X1(strict network neutrality)	0.245	0.615	0.411	1.699	0.002
X2(mobile virtual networks operator's obligations)	0.071	0.821	0.123	0.942	0.002
X3(unbundling obligations)	0.175	1.091	0.119	0.873	0.021

- a. Predictors: (constant) access regulations ie; strict network neutrality; mobile virtual networks operator's obligations; unbundling obligations.
- b. Dependent variable: performance of 5G markets in Kenya

Source: research data (2017)

$$Y = 3.615 + 0.411X_1 + 0.123X_2 + 0.119X_3$$

From the above regression equation, it was revealed that strict network neutrality; mobile virtual networks operator's obligations; unbundling obligations to a constant zero, performance of 5G markets in Kenya 3.615 and a unit increase in strict network neutrality; will lead to an increase in the performance of 5G markets in Kenya by a factor of 0.411. A unit increase in mobile virtual networks operator's obligations will lead to the performance of 5G markets by a factor of 0.123, further a unit increase in unbundling obligations will lead to increase in the performance of 5G markets by a factor of 0.119. The p-values for each of the predictor variables (strict network neutrality; mobile virtual networks operator's obligations; unbundling obligations) was found to be less than 0.05 showing that strict network neutrality,

mobile virtual networks operator's obligations and unbundling obligations affect the performance of the 5G markets.

4.8 Discussions

4.8.1 Strict network neutrality

The findings suggest that a slight increase in strict network neutrality will lead to an increase in 5G performance by a factor of 0.411. The p-value for strict network neutrality was found to be less than 0.05 showing that strict network neutrality significantly affects the performance of the 5G markets. The current findings are in tandem with a study conducted by Bauer and Bholin (2019) who argued that weak network neutrality puts less stringent boundaries on how datagrams may be treated, although differentiation of service quality and potentially charges from market participants like users or content providers are permitted if done in a non-discriminatory style.

The findings of this study agreed with a study conducted by researchers and advocate who emphasized that the importance of network neutrality is for the following, protection to access information, supporting digital innovation, preserving free speech, and civic political participation according to (Early & Bustillos, 2018; Lee & Wu, 2009; Novak & Haijbayova, 2019; Nunziato, 2009).

4.8.2 Mobile virtual networks operator's obligations.

The findings of the study showed that a unit increase in mobile virtual networks operator's obligations would contribute to an increase in the performance of the 5G markets in Kenya by a factor of 0.123. The p-value for transformational leadership was found to be less than 0.05 showing that mobile virtual networks operator's obligations significantly affects the performance of the 5G markets. The current findings of the study are in agreement with a study conducted by Olwal et al. (2016) that correctly points out that claims in favour or opposed to regulation cannot easily be refuted, given the uncertainty surrounding many aspects of 5G. However, despite uncertainty it is possible to analyse the plausibility of the prospective conditions identified as requiring regulatory intervention and the likely impacts of such measures on investment and innovation.

The findings suggest that an appropriate regulatory framework in Kenya will ideally support entrepreneurial experiments seeking to exploit this enormous but largely unknown

innovation space (Chen, Qian, Mao, Tang, & Yang, 2016). Because of the interdependent nature of this highly dynamic innovation space, it will require considerable experimentation to develop sustainable and profitable applications and services. Entrepreneurial decision-making and experimentation have historically been the most successful approach to explore and realize such innovation opportunities. In the context of a standardized network environment, the Internet demonstrates that a latent innovation potential is best explored in an environment that is not limited by detailed ex ante regulation (Cox et al., 2017, Jia, Xie, Huang, Liu, & Liu, 2017)

4.8.3 Unbundling obligations

The findings of the current study showed that a unit increase in unbundling obligations will lead to increase in 5G performance in Kenya by a factor of 0.119. The p-value for unbundling obligations was found to be less than 0.05 showing that unbundling obligations significantly affects the performance of 5G markets.

The findings of the this study are in agreement with other studies conducted by Siddique et al.,(2015), who said that the innovations are risky, and therefore only profit making organisations operating in market environments with at least an opportunity to earn or get a super-normal profits can accept the innovation risk. Other studies by, Noura & Nordin, (2016), Zhang, Meng, Liu, & Zhang, (2016), Saha, Saengudomlert, & Aswakul, (2016) and Henderson & Clark, (1990) suggest that the more risky innovation, the more it require an opportunity to earn a higher mark-up and probably over a longer period of time for a firm to decide whether to take up a risk. Contestability and appropriability are related terms but not identical, this is because they capture different features of the markets and the competitive processes. Innovation incentives will be low if contestability or appropriability are weak, at the same time they will be high if both are present (Li, Da Xu, & Zhao, 2018). The potential costs benefit analysis of innovation are shaped by the availability of technological and economic opportunities in the market which consist of technological, organizational, and business model improvements. It is also said by the scholars that a broader range of technical opportunities and perception of wider un-adventured spaces created by digital technology offers more opportunities for innovation experiments (Zhang, Meng, Liu, & Zhang, 2016, Panwar et al. (2016); Panwar, Sharma, & Singh, 2016 and For(Olwal et al., 2016).

4.9 Discussions of Findings

The study indicated that performance of the 5G markets in Kenya has varied because of changes in level of strict network neutrality; mobile virtual networks operator's obligations; unbundling obligations which indicated a positive relationship. From the analysis of the ANOVA the study indicated that strict network neutrality; mobile virtual networks operator's obligations; unbundling obligations were significantly influencing performance of 5G markets in Kenya.

The findings suggest that a unit increase in strict network neutrality can lead to increase in 5G performance by a factor of 0.411 while a unit increase in mobile virtual networks operator's obligations will lead to increase in 5G performance by a factor of 0.123 and therefore a unit increase in unbundling obligations will lead to an increase in 5G performance in Kenya by a factor of 0.119.

The study also found that a unit increase in the following areas: - strict network neutrality; mobile virtual networks operator's obligations; unbundling obligations will affect the performance of the 5G markets in Kenya. The findings of this study agreed with the findings of (Cox et.al., (2017) who suggest that an appropriate regulatory framework will ideally support entrepreneurial experiments seeking to exploit this enormous but largely unknown innovation space. Chen, Qian, Mao, Tang, & Yang, (2016) also opines that because of the interdependent nature of this highly dynamic innovation space, it will require considerable experimentation to develop sustainable and profitable applications and services. As such entrepreneurial decision-making and experimentation have historically been the most successful approach to explore and realize such innovation opportunities. In the context of a standardized network environment, the Internet demonstrates that a latent innovation potential is best explored in an environment that is not limited by detailed ex ante regulation according to (Cox et al., 2017, Jia, Xie, Huang, Liu, & Liu, 2017).

The study shows that for Europe to succeed in deployment of 5G networks, it relied on ensuring that its components and interdependencies are well understood, strong collaboration between stakeholders is put in place. Many of the use cases are technically supported by the functional drivers of 5G and activated through multitasked holder cooperation and partnership.

Regulators, industry associations, network operators, service/ technology providers and public-private partnership organizations had to engage in continuous dialogue to address the challenges facing widespread 5G adoption around the globe and to maximize the opportunities it will bring across sectors. The 5G deployment took place in phases which enabled networks to expand and the technology components mature, hence the importance of fostering innovation and collaboration to accelerate 5G deployment and its benefits. These phases defined that 5G will coexist with other networks like 4G and connectivity solutions especially in areas which did not have proper infrastructure.

During deployment, the security of 5G was guided by European Union competence in the following main areas, the legal regime for electronic communications, the provisions on the security of networks and information systems; and the latest regulations on cybersecurity. That is according to the Council and the Commission of EU

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter summarises the findings and conclusion of my study which are guided by specific objectives. This chapter talk about the future recommendations and research as per the findings of the study. The study examines the effect of access regulations to determine strict network neutrality, mobile virtual networks operator's obligations and unbundling obligations on the performance of 5G markets.

5.2 Summary of the findings

The main objective and purpose of my study was to examine the effect of access regulation on the 5G performance in Kenya. For me to achieve this purpose, a descriptive study approach had to be employed, and the response rate of the study was 100%, that is, 375 companies participated from the expected sample of 375 companies targeted. The study found that a unit increase in strict network neutrality, mobile virtual networks operator's obligations and unbundling obligations would lead to increase in performance of 5G markets in Kenya. Hence the study found that strict network neutrality, mobile virtual networks operator's obligations and unbundling obligations affects the performance of 5G markets.

5.3 Conclusion

As guided by the specific objectives of this study, I therefore conclude that the unbundling obligations is a significant contributor that improves the performance of 5G markets. According to this study, unbundling obligations had very significant positive contributions to the performance of 5G markets in Kenya. The result from regression analysis showed unbundling obligations being statistically a contributor to the performance of the 5G markets in Kenya. These findings also suggested that management should consider engaging more and more on unbundling obligations to enhance performance in the 5G markets in Kenya.

This study concludes that based on the findings, a mobile virtual networks operator's obligations is a significant contributor to improving the performance of 5G markets in Kenya. According to the findings, it is also noted that unbundling obligations had a significant role to the performance of 5G markets in Kenya. Results from the regression analysis showed how

unbundling obligations was statistically significant to the performance of 5G markets in Kenya. These findings suggest that management should consider strengthening mobile virtual networks operator's obligations to enhance performance in the 5G markets in Kenya.

To evaluate the influence of strict network neutrality and mobile virtual networks operator's obligations on the performance of 5G markets in Kenya, the industry observers raised some concern on the chances that network neutrality regulations may interfere with deployment of 5G market. There was need to assess the claims and also look at the kind of technologies likely to be incorporated into 5G market services such as including millimetre wave band radios, massive multiple input/multiple output (MIMO), ultra-densification, multiple radio access technologies (multi-RAT), and support for device-to-device (D2D) and machine-to-machine (M2M) connectivity. This will review the business models likely to be associated with 5G market such as network management through biasing and blanking, an emphasis on business-to-business (B2B) communications, and network function virtualization/network slicing. This lays out the network neutrality regulations created by the EU in 2015 as well as the nonbinding interpretive guidelines issued by European Regulators body for Electronic Communication (BEREC) in 2016 which made an assessment on how to deploy 5G markets across the globe. Network neutrality's impact on 5G markets was likely to be determined by the way exceptions for reasonable traffic is management and specialised services are interpreted. A broad interpretation should accommodate network slicing and other new business models which needed to support the deployment of 5G markets in Kenya as well as narrow interpretation that could restrict innovation and investment.

5.3 Recommendations

Many countries seek a global leadership role in emerging 5G markets. As policy frameworks are put into place, it is necessary to carefully consider the likely impacts of the regulatory model on sector outcomes. Given the tremendous innovation potential anticipated in converging future infrastructure, effects of regulation on investment and innovation (i.e., effects on dynamic sector efficiency) are particularly relevant. Regulatory interventions benefit access-seeker supposed to promote service-based competition while negatively affecting operators investing in spectrum and network deployment. Finding a balance that safeguards the overall performance of the system is challenging. Regulatory interventions in that system require an explicit consideration of the interdependencies between the players. The past regulatory practice only partially succeeded in developing appropriate principles,

whereas facilities-based competition has proven to lead to superior market performance. Experience provides strong testimony that entrepreneurship and the freedom to experiment in the market place often are the strongest drivers of innovation.

The history of mobile markets shows that market stakeholders/players will negotiate voluntary, commercially negotiated agreements to make network access services available across the board. Whereas mandated access risks creating market distortions, voluntary agreements will likely improve outcomes. Therefore, MNOs and other players should set prices and other contractual conditions in commercial negotiations. As a safeguard, forms of ex post regulation or competition policy are available. They are more compatible with preserving the innovation dynamics of the 5G space than ex ante forms of regulation. Overall, the need to support entrepreneurship and innovation experiments in 5G markets and to allow the freedom to develop innovative contractual approaches suggest market forces rather than regulation which should be primarily governed by communication sector.

5.4 Areas for Further Research

While this study provides insight into access regulation and its effect on the performance of 5G markets in Kenya, it also points out several areas that require further research. This study employed descriptive research design of a sample size of 279 companies. The future studies could use a different research design with a bigger sample size to find out any variation. The conceptual framework of this study can also be extended by considering more access regulation strategies since the current study was limited to only three and there could be more others.

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Appendices

Appendix 1: Questionnaire

Instructions

This questionnaire is seeking information on the influence of access regulations on the performance of the 5G markets in Kenya. Kindly provide information as guided by ticking or circling the appropriate option. All the information received will be treated confidentially, and will only be used for academic purposes.

Section A: Respondents Information

1. Please indicate your level of education.
 - a) Primary []
 - b) Secondary []
 - c) Tertiary []
 - d) University
2. How long has your enterprise been in business?
 - a) Less than 1 year []
 - b) 1-5 years []
 - c) 5-10 years []
 - d) 10-15 years []
 - e) 16 years and above []
3. What is the status of your mobile network?
 - 1)1G
 - 2)2G
 - 3)3G
 - 4)4G
 - 5)5G

Project Information

The following survey questions enquires about the type of project you managed.

Select the category that best represents your project.

4. My last project predominantly entailed the following (please select one)
 - a. Information System Development

- b. Consulting and System Integration
 - c. Engineering and Construction
 - d. Research and Development
 - e. Others (please specify) _____
5. In my last project, the end users were predominantly (please select one)
- a. Internal users (staff within organization)
 - b. External users (clients)
6. The total duration of my last project was?
- a. Less than 6 months
 - b. 6 months to but less than 1 year
 - c. 1 year less than 2 years
 - d. over 2 years
7. The value of my last project was
- a. Under \$500,000.00 (or dollar equivalent)
 - b. \$500,000.00 to 999,999
 - c. \$1,000,000.00 to 4,999,999
 - d. \$5,000,000.00 to 50,000,000
 - e. Over \$50,000,000
8. The urgency to deliver my last project was:
- a. Low
 - b. Medium
 - c. High

Section C: Influence of strict network neutrality on the performance of 5G markets.

9. The following statements relate to the influence of strict network neutrality on the performance of 5G markets. Using a scale of 1 to 5, kindly indicate by ticking (✓) the extent to which you agree with the statements below.

Key: (1= Strongly Disagree; 2= Disagree; 3= Fairly Disagree; 4 = Agree; and, 5= Strongly Agree)

Statement	1	2	3	4	5
The need for networks to treat all traffic same could discourage beneficial of innovations by network owners					
Some applications (such as voice calling and online) are particularly sensitive to delays in delivering data					
Internet users might benefit if companies could pay a premium to ensure that their latency-sensitive applications are given priority					
Strict network neutrality rules could bar ISPs from experimenting with this kind of service.					
It is very challenging to come up with clear and effective network neutrality rules					

10. How else do strict network neutrality influence the performance of your company?
Please explain in brief.

.....

Section D: Mobile virtual networks operator’s obligations on the performance of 5G markets.

11. The following statements relate to the effect of mobile virtual networks operator’s obligations on the performance of 5G markets. Using a scale of 1 to 5, kindly indicate by ticking (✓) the extent to which you agree on how the following statements influence performance of the company.

Key: (1= Strongly Disagree, 2= Disagree, 3= Fairly Disagree, 4 = Agree and, 5= Strongly Agree)

Statement	1	2	3	4	5
MVNOs need regulatory protection					
<i>ex ante</i> regulatory intervention on behalf of MVNOs is weak to non-existent					
The prevailing mobile market circumstances favours the spontaneous emergence of voluntary MNO-MVNO relationships					
<i>ex ante</i> regulation to facilitate MVNO entry and participation in mobile markets is neither necessary nor inevitable					
Providing voluntary wholesale access to MVNOs can be a win-win situation					

12. How else do need for mobile virtual networks operator’s obligations influence the performance of your business? Please explain in brief.

.....

Section E: unbundling obligations on the performance of 5G markets.

13. The following statements relate to the unbundling obligations on the performance of 5G markets. Using a scale of 1 to 5, kindly indicate by ticking (✓) the extent you agree with the following statements on influence of performance in the company.

Key: (1= Strongly Disagree, 2= Disagree, 3= Fairly Disagree, 4 = Agree and 5= Strongly Agree)

Statement	1	2	3	4	5
Unbundling mandates and broad avoided-cost resale requirements have failed to advance consumer interests					
The market is able reward those who can provide the best services at the lowest cost, rather than those that benefit from an outdated regulatory regime					
Removal of the mandates at issue will fuel additional competition, bringing consumers ever-better services					
Unbundling mandates and broad avoided-cost resale requirements have failed to advance consumer interests.					
All customers are able to benefit from open competition and deployment that will step from removal of these mandates in the vast majority of locations					

14. How else do unbundling obligations the performance of your company? Please explain in brief

.....

15. Section B: Performance

1. The following statements relate to your company performance over the last 5 years. Using a scale of 1 to 5, kindly indicate by ticking (✓) the extent to which they have been influenced by access regulations.

Key: (1= Strongly Disagree, 2= Disagree, 3= Fairly Disagree, 4 = Agree and 5= Strongly Agree)

Statement	1	2	3	4	5
Appropriability					
Contestability					
Possible opportunities					
Rate of direct investment and innovation					
Rate of increase in overall profits					
Increase business assets					
Increase in quality of products					

Thank you for the opportunity and time you have accorded us to participate in answering this questionnaire.

Appendix 2: Research Plan/Schedule

The year	2019			2020/2021					
Quarters	Quarter 3			Quarter 1	Quarter 2			Quarter 3	
Topic selection									
Proposal writing									
1 st Correction									
Defense									
Piloting									
Data collection									
Analysis									
Preparation of 1 st Draft									
2 nd Correction									
Final submission									
Defense									

Appendix 3: Research Budget.

ITEM	COST IN KSH.
Typing and printing	5,000
Photocopy	6,000
Writing materials	1,000
Pens and diskettes	1,000
Binding cost	3,000
Travelling	6000
To administer questionnaires	2,000
To consult supervisor	7,000
To pilot questionnaire	5,000
Accommodation and food (Field Work)	3,000
Subsistence allowance	15,000
Miscellaneous	1,000
Total	50,000.00