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Telecommunications Infrastructure Sharing as a Strategy for Cost Optimization in Nigeria: A Study of GSM Networks Co-Location in Benue State

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Abstract – *There have been several calls by residents in Benue State for a ban to be placed on the mounting of towers. However, these masts form a necessary infrastructure that telecom operators need in order to carry signals that are necessary for communication to take place. The main objective of this study is to evaluate telecommunications infrastructure sharing as a strategy for cost optimization in Nigeria: A study of GSM networks co-location in Benue State. This study uses a combination of descriptive, correlation and cross sectional type of research. The study respondents consists of senior technical, rollout managers, finance/accountant and adminstrative staff cadre of MTN and GLO working in Benue State. The population of this category of staff in GLO is 120, while MTN is 170, making a total of 290 respondents. Through Yamane sampling technique, the sample size is 168. Tower sharing benefits the environment by reducing unnecessary duplication of masts and their associated infrastructure, thereby causing better city aesthetics. The study found out that there was a growing recognition among operators that the rise of viable competition through collocation will force each operator to give of its best in service delivery. This has been intensified by the recent introduction of mobile number portability which allows subscribers to switch from one network to another while maintaining their numbers. The telecom regulatory body (NCC) should encourage infrastructure sharing trends in Benue State by ensuring that terms of agreement are adhered to by both parties and ensuring that defaulting parties are penalized in forms of fines or surcharges. This would ensure better commitments by the colocating parties*

Keywords: *Cost optimization, telecommunication infrastructure sharing, Capacity Expansions, cost reduction, Infrastructure rollout, network infrastructure sharing*

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Keywords: *Smartphone, Library, Services, Information, and Education*

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1. Introduction

The mobile service market is constantly changing. Network operators are main actors of this market that provide network access and mobile services. They are facing new competitive challenges and need to rethink their business models so as to increase their decreasing revenues (Institute of Telecommunications Professionals, 2007). The new challenges that network operators are currently facing are efficient network and quality of service. Network operators seek for cost reduction so as to compensate for the declining revenues. One possible way of achieving cost reduction and revenue increase is infrastructure sharing, Infrastructure sharing refers to the resources that are essential for mobile service provision that is radio spectrum and network infrastructure.

There is a growing need for operators and providers in the Nigerian telecoms industry to drive down cost of capital assets or infrastructure deployed for telecom services. This has been expressed in recent times by many operators who now come together, on basis of mutual agreements, to consider sharing infrastructure. The telecom market in Nigeria is driven by growing demand for telecommunications services like voice, SMS, data services like internet, fax, etc. as well as high broadband services like video calling, video messaging and video conferencing (Mansell, 1988).

Altogether, the transition from a voice to a data centric business is challenging for operators and it has forced them to launch efficiency programs, cut operational expenditures, reduce headcount, and reduce network operation costs. It is no exaggeration to state that cost cutting have become an inevitable part of the operator business and potentially paving the way for more radical measures that could re-shape the industry. A response to this development has been a growing number of network sharing agreements between operators. The development of network sharing is global and the current usage of network sharing could broadly be grouped into three categories: 1) agreements between operators to share parts or even entire networks, 2) to establish separate network companies that operate on behalf of their owners, and 3) independent infrastructure companies which, primarily, are doing tower and passive infrastructure sharing, but it could also be outsourcing where operator use external partners to run their networks (Chanab, El-Darwich, Hasbani and Mourad, 2007).

Indiscriminate installation of towers in Benue State has congested the skyline of the cities in the State with towers. There have been several calls by residents in Benue State for a ban to be placed on the mounting of towers. However, these masts form a necessary infrastructure that telecom operators need in order to carry signals that are necessary for communication to take place.

The two selected network operators (MTN and Glo) are the most dominant service providers in the State because of their availability in the grassroots, widespread coverage and preferred networks. Three local governments (Makurdi, Otukpo and Katsina-Ala) in each of the three senatorial districts of the State were selected for the study because they are the centre/hub of economic activities in the State. The three senatorial districts are: i) Benue North East comprises of Katsina-Ala, Konshisha, Kwande, Logo, Ukum, Ushongo and Vandeikya. ii) Benue North West comprises of Makurdi, Gboko, Buruku, Guma, Gwer East, Gwer West and Tarka. iii) Benue South comprises of Otukpo, Ado, Agatu, Apa, Obi, Ogbadibo, Ohimini, Oju, and Okpokwu.

Since telecom infrastructure is capital intensive, it becomes more difficult for mobile telephone operators in Benue State to operate profitably and making expansion plans towards meeting subscribers' growth in the remote rural areas. There was also the constraint in getting approval from Local Government Authorities and Benue State Government in building telecommunication towers in their domain. Hence, telecom operators embark on sharing infrastructure as a means of avoiding unnecessary duplication of infrastructures in all the twenty three local governments in the State. Agriculture is the main economic activity in Benue

State. It provides employment for over 80% of the population of the State estimated at over four million people. The high level of production of these crops in Benue State has earned the State the name food basket of the nation. Thus, for telecom service to reach vast majority of the rural population, then telecom infrastructure sharing is needed.

This research work solved the following problems:

i. The problem of high cost of network infrastructure rollout and capacity expansions by telecom operators in Benue State.
ii. The problem of inefficient and ineffective usage of telecom infrastructure by telecomm operators in Benue State.
iii. The problem of high cost of operational expenditures (OPEX) dissipated by telecom operators in Benue State.
iv. The problem of poor quality of service in Benue State.

1.2. Objective of the Study

The main objective of this study is to evaluate telecommunications infrastructure sharing as a strategy for cost optimization in Nigeria: A study of GSM networks co-location in Benue State.

The specific objectives are to:

1. find out if network infrastructure sharing results in a significant reduction in cost of network infrastructure rollout and capacity expansions for telecoms operators in Benue State.
2. explore if network infrastructure sharing results in an improved efficiency in the utilization of telecoms infrastructure for telecom operators in Benue State.
3. ascertain if network infrastructure sharing leads to a significant reduction in the operational expenditures (OPEX) dissipated for telecoms operators in Benue State.
4. assess if network infrastructure sharing does not lead to degraded quality of service and customer usage experience for telecoms operators in Benue State.
5. determine if network infrastructure sharing will enable telecoms operators in Benue State achieve and sustain competitive advantage, through wider coverage .

1.3. Research Questions

The study addresses the following research questions:

1. To what extent has the telecommunication infrastructure sharing led to cost optimization and revenue generation in Benue State?
2. To what extent has network infrastructure sharing led to an improved efficiency in the utilization of telecoms infrastructure in Benue State ?
3. Has telecoms infrastructure sharing led to a significant reduction in the operational expenditures (OPEX) in Benue State?
4. To what extent has the network infrastructure sharing led to improved quality of service and customer usage experience in Benue State?
5. How does network infrastructure sharing enable telecoms operators to achieve sustaining competitive advantage in Benue State?

1.4. Statement of Hypotheses

H_{01}: Network infrastructure sharing does not result in a significant reduction in cost of network infrastructure rollout and capacity expansions for telecoms operators in Benue State.

H_{02}: Network infrastructure sharing does not result in an improved efficiency in the utilization of telecoms infrastructure for telecom operators in Benue.

H_{03}: Network infrastructure sharing does not lead to a significant reduction in the operational expenditures (OPEX) dissipated for telecoms operators in Benue State.

H_{04}: Network infrastructure sharing does not lead to degraded quality of service and customer usage experience for telecoms operators in Benue State.

H_{05}: Network infrastructure sharing will not enable telecoms operators in Benue State to achieve and sustain competitive advantage, through wider coverage and capacity at less costs.

2. Literature Review

2.1. Theoretical Framework

2.1.1. Theory of infrastructure sharing

i. The Resource Based View

The resource based view is a theory that examines the relation between a firm's internal characteristics and performance. Using this theory, the potential of firm resources to generate sustained competitive advantage is analyzed. It is based on the assumption that strategic resources are heterogeneously distributed across the firms (heterogeneous) and this distribution is stable over time (immobile). Barney (1991), specifies the conditions under which strategically relevant resources can be sources of sustained competitive advantage for a firm. The firm resources that are considered are the physical capital resources, the human capital resources and the organizational capital resources (Barney, 1991). In order for a firm's resource to generate sustained competitive advantage, the resource should be valuable, rare, inimitable and non-substitutable.

A resource is valuable if it helps the firm to implement strategies that increase its efficiency and effectiveness. A resource is rare when it is not possessed by many firms whereas a resource is inimitable if firms that do not possess this resource cannot obtain it. For a resource to be non-substitutable, it should not have strategically equivalent valuable resources that are not rare or imitable. Two valuable resources are strategically equivalent when their separate exploitation leads to the same strategies (Barney, 1991).

Infrastructure is a physical capital resource. Infrastructure can lead to sustained competitive advantage if it is valuable, rare, inimitable and non-substitutable. Infrastructure is a valuable resource for the network operator since its use is a precondition for the provision of mobile services. Considering the high investments costs, the required upgrade costs and constant investments we can realize that taking the decision of building a mobile network infrastructure from the scratch is not that easy and entails many risks. This fact makes the mobile network infrastructure rare even though radio spectrum licenses for the new technologies are not rare. If infrastructure sharing does not take place then the actors that do not own it cannot use it that means that infrastructure is also inimitable. Mobile network infrastructure is used for the provision of mobile services.

Review of Resource Based Theory: Barney and Arikan (2001) assert that empirical tests using resource-based logic have been conducted in various academic literatures, from Strategic Management, Human Resources, Marketing, Entrepreneurship, Technology and Innovation Management, amongst others. Despite its broad literature base, the authors acknowledged that it is within the discipline of Strategic Management that theorists have conducted the most empirical tests using resource-based logic. The varied assertions from Strategic Management that denote different topic areas of research a represented below, as identified from Barney and Arikan (2001):

i. Firm versus industry effects. Firm effects should be more important than industry effects in determining firm performance.
ii. The impact of resources and capabilities. Valuable, rare, and costly-to-imitate resources should have a more positive impact on firm performance than other kinds of resources.
    a. Corporate strategies. Corporate strategies (including mergers, acquisitions, and diversification) that exploit valuable, rare, and costly-to-imitate resources should generate greater returns than corporate strategies that exploit other kinds of resources.
    b. International strategies. International strategies that exploit valuable, rare, and costly-to-imitate resources will outperform international strategies that exploit other kinds of resources.
    c. Strategic Alliance. Strategic alliances that exploit valuable, rare, and costly-to-imitate resources will outperform other kinds of alliances.
    d. Rules for Riches. There cannot be a rule for riches derived from strategic management theory.

From the above resource-based assertions denoting the distinct research areas related to resource-based research, it is those concerning (1) firm versus industry effects, and (2) the impact of resources and capabilities (on firm performance) that are most relevant to the current research. Thus, the present research identifies resources that are likely to evidence the attributes that resource-based theory predicts will be important to firms' profitability then explores whether or not any performance difference exists. It further examines the premise that firm effects will be a more important determinant of firm performance than industry effects by comparing outcomes across multiple levels of analysis.

Newbert (2007) identified four approaches and related examples undertaken in resource based view empirical research, as outlined below:

1. Resource heterogeneity approach. A resource, capability or core competence possessed by a firm that is valuable, rare and costly-to-imitate is quantified and correlated to firm

performance, such as a firm's "media favorableness" and the firm's return on assets (Deephouse, 2000).

2. Organising approach. Firm-level conditions are assessed that enable firms to effectively exploit their key resources and capabilities that are being examined. Interactions are examined between a given resource, such as knowledge, and an organising context, such
as entrepreneurial orientation (Wiklund and Shepherd, 2003).
3. Conceptual-level approach. The predictive value of resource-based criteria such as value, rareness and inimitability are tested for their impact on firm performance. King and Zeithaml (2001) test one aspect of the inimitability (causal ambiguity) of a firm's competencies on its performance.
4. Dynamic capabilities approach. The extent to which specific, resource-level processes that are valuable, rare, and inimitable can improve firm performance is examined. Zhu and Kraemer (2002) test the interaction effect between a given resource (information technology infrastructure) and a specific dynamic capability (e-commerce capability) on several measures of firm performance.

From Newbert (2007) approaches above, the "resource heterogeneity approach" is one of the empirical resource-based research areas that are most relevant to the current research. This approach is similar to Barney and Arikan (2001) assertion regarding "the impact of resources and capabilities [on firm performance]" as the resource-based research in these two categories identifies resources that are likely to evidence the attributes that resource-based theory predicts will be important to firms' profitability then explores whether any performance difference exists.

In summary, Barney and Arikan derived six "assertions" from Strategic Management that denoted different topic areas of past resource-based research, while Newbert identified four approaches undertaken in previous resource-based research. These research areas from both authors that are most relevant to the present thesis are: The Impact of Resources and Capabilities (Barney and Arikan, 2001) or the Resource Heterogeneity Approach (Newbert, 2007). This area of research examines the performance effects of various telecoms resources.

Barney and Arikan (2001) and Newbert (2007) acknowledge that the bulk of resource-based empirical research has fallen into this category. However, this thesis examines a combination of resources and capabilities in order to better explore the role of firm assets and processes and their link to firm performance. Barney and Arikan (2001), in particular, suggest that future research examining the impact of resources and capabilities on firm performance include a focus on the conditions under which different resources may be valuable.

ii. Business Models and Network Operators Theory

According to Bouwman, Haaker and De Vos (2008), a business model is a blueprint for a service to be delivered, describing the service definition and the intended value for the target group, the sources of revenue, and providing an architecture for the service delivery, including a description of the resources required, and the organizational and financial arrangement between the involved business actors, including a description of their roles and the division of costs and revenues over the business actors.

Four different domains constitute the components of a business model according to Bouwman, Haaker and De Vos, (2008). Specifically, the service, technology, organization and finance domain are the main components of a business model. If these components are specified then the business model is also specified. Osterwalder and Pingeur (2004) describe a tool named business model canvas that can be used for designing successful business models. There are nine building blocks that should be defined so as to define a business model. The customer segment, the value proposition, the channels, the revenue streams, the customer relationships, the key resources, the key activities, the key partnerships and the cost structure are the nine building blocks.

iii. Once Cost-Sharing Theory

Mainly sharing equally according to participants, the theory is relatively simple. But it does not take into account the complexity of the process to build jointly, while treating various different companies entirely in the same way (Village, Worrall, and Crawford, 2002). So it is a very unfair method, rarely used in practice.

iv. Twice Cost-Sharing Theory (Secondary)

Based on the sharing theory of the separable costs and inseparable costs, one of important rules of twice cost-sharing is that, the costs enterprises participated need to bear should not lesser than the increased costs caused by these enterprises participating in building jointly (Forge and Blackman, 2006). And the increased costs are defined as separable costs of these enterprises; the remaining costs are inseparable costs. In practice, the calculation of separable costs is simple, but the calculation of inseparable costs is difficult.

v. Nash Negotiation Theory

It mainly reflects the process of bargaining of all the players in the cooperative process. The representative study of Li Yongjun (2008), researches fixed cost-sharing with bargaining game method. Chanab, El-Darwich, Hasbani, and Mourad, (2007) proves that, if cost-sharing is looked as a new input, there are some sharing schemes which can meet the collective reason of organization and the individual reason of decision-making units within the organization in the performance assessment. On this basis, the only sharing scheme is given by introducing bargaining game model. Finally, it takes the actual examples to prove that the theory is effective. Although Nash Negotiation meets the collective reason of alliances and the individual reason of enterprises, as the enterprises participated continue to bargain, the stability of alliances is poor.

vi. Shapley Value Algorithm Theory

The theory states that costs are assigned according to the importance of cooperative enterprises in the process of participation, which has higher rationality and enthusiasm (Chandler, 1962). But it does not consider the impact of factors on the distribution of profits. These factors include innovative ability, assumption of risk, and the extent of cooperation and so on. That is, Shapley Value Algorithm implies that innovative ability, assumption of risk and the extent of cooperation are equal, which is not unrealistic. For this reason, Shapley value is modified by some domestic scholars. And the study of Ma Shihua is representative. He introduces Innovation Incentive Index and the other factors to modify the allocation based on Shapley Value Algorithm.

vii. Collaboration Theory

Collaboration is nothing new and goes back to the days of caveman where teams had to work together in hunting animals as this resulted in a better finding (Markendahl, 2011). Strictly speaking, collaboration is at the very heart of every business on the planet. It's very rare that you find someone that is isolated from the rest of the company. Most people are a part of a team that needs to work together to achieve the best possible results; that team is a part of many teams that all need to work together to help grow an enterprise. Collaborate is pretty much part of everything done at work.

The principle behind collocation, if adhered to with a spirit of fairness and a mindset of putting development of the information and communication sector and national interest first, will assist the government, regulators, operators, investors, and even workers to look into how best to use available resources to get maximum result for the industry in all important matters of business interest (Bouwman, Haaker and De Vos, 2008).

There is an inverse relationship between costs which are going up and profits which are coming down. These twin factors, according to the experts, should drive the operators to share resources and facilities in order to reduce cost and raise operating profit. This means collocation needs to be taken seriously by the operators. Collaboration impacts on profitability, sales growth, profit, productivity, product quality, product development and innovation. Infrastructure sharing is capable of reducing operating cost by sharing out the cost.

2.2. Conceptual Framework

i. Passive Infrastructure Sharing (Site Sharing)

This is the sharing of the non-electrocnic infrastructure at the cell site. It is also known as Site Sharing and in this form of sharing, operators agree to share available infrastructure such as site space, buildings and easements, towers and masts, power supply and transmission equipment (Chanab, El-Darwich, Hasbani and Mourad, 2007). This kind of sharing is suitable for densely populated areas with limited availability; expensive sites such as underground subway tunnels and rural areas with high transmission and power costs.

The key challenges in this model are for incumbent operators to accept the opening of the infrastructure to other players and for new operators to trust that incumbents will provide them with the appropriate access to sites without tactical delays to prevent them from rolling out thier networks effectivley (Chanab, El-Darwich, Hasbani and Mourad, 2007). Enforcing such cooperation is a major challenge to regulatory authorities.

It is sharing non-electronic infrastructure at cell site. Passive Infrastructure is becoming popular in telecom industry worldwide. An example of this is base station sharing where each operator maintains control over electronic components so that it will be able to operate the frequencies assigned to the carrier, fully independent from the partner operator and retains control over their respective active base station equipment such as the transceivers that control reception/transmission over radio channels. Radio network controller and core network are not shared here (Håkansson and Snehota, 1995).

ii. Active Infrastrcuture Sharing (Network Sharing)

This form of infrastrcuture sharing entails the operators sharing the electronic infrastrcuture such as sharing base station controllers (BSC), and sharing common networks, both circuit-switched and packet-oriented domains (Chanab, El-Darwich, Hasbani and Mourad, 2007). Network sharing (active sharing) requires additional planning and deployment efforts to accomodate each participating operator’s capacity needs (Chanab, El-Darwich, Hasbani and Mourad, 2007).

Active sharing involves the shared use of electronic infrastructure in a cell site, including the base tower station, switches, antennas, transmission, signal processing transceivers and microwave radio equipment. In other words, single radio equipment can be shared across different frequencies, by different operators to deploy a completely shared radio network and in some case, a partly shared Core Network (i.e. Back bone network). The shared radio network consists of Radio Base Stations, Radio Network Controllers, transmission site etc. Active sharing is not allowed by regulation in most of countries and has to be initiated amongst the operators themselves.

An example of active sharing is spectrum-sharing concept which is based on a lease model and is often termed spectrum trading. An operator can lease a part of their spectrum to another operator on commercial terms. This mechanism exists in the US, Europe, Singapore, India and Australia (International Telecommunication Union, 2004). Passive infrastructure is estimated to reduce deployment costs by 60 percent and active infrastructure by 40 percent (Barney and Arikan, 2001). It is the height of a telecom tower that determines the number of antennas that can be accommodated (i.e. the capacity of the tower). Others factors such as location and geographical conditions (wind speeds, type of terrain, etc.) can also play a part in determining the capacity of the tower. Hence, typically, while Ground Based Towers can accommodate up to six tenants, Roof-Top Towers can accommodate two to three tenants.

iii. Spectrum Sharing

This concept, also known as spectrum trading , is a model that has recently developed in mature, regulated environment and it entails an operator leasing part of its spectrum to another operator on commercial terms. Since spectrum is a scarce that is often under-utilized by one operator in a given location, sharing proves a viable option for two or more operators (Chanab, El-Darwich, Hasbani and Mourad, 2007).

iv. National Roaming (Geographical Splitting)

Mandatory national roaming is a form of infrastructure sharing that allows new operators, while thier networks are still being deployed, to provide national service coverage by means of sharing incumbents’ networks in specific areas (Oliver, 2007). While national roaming is generally introduced with a sunset clause, it could be made permanent in specific locations. National roaming accelarates competition by allowing new players to launch their services within shorter time frames (Chanab, El-Darwich, Hasbani and Mourad, 2007).

v. Tower Companies

The growth of existing tower management companies have also helped to ease out problems of infrastructure. The business model consists of acquiring wireless infrastrcuture for operators and managing it (Park and Russo, 1996). The economics are strongly driven by colocation of operators on sites. Tower management comapnies usually enjoy scalable and long-term recurring revenues with contracted annual escalations. They also benefit from low churn rates and low operating and capital costs. Tower management companies thus can ensure fair treatment of new entrants while providing financial benefits to the incumbents by buying the latter's infrastrcuture and managing it, hence lowering operating expenses in the long run (Chanab, El-Darwich, Hasbani and Mourad, 2007). An example of this is Helio Towers Nigeria, Huawe, Alcatel, the company that provide wireless operators in Nigeria with fully-managed tower sites on a lease basis.

3. Methodology

3.1. Research Design

This study uses a combination of descriptive, correlation and cross sectional type of research. The descriptive aspect refers to that objective of systematically describing the concept of infrastructure sharing and the possible benefits that can be derived from it. The correlation aspect refers to that objective of discovering or establishing the existence of a relationship/ interdependence between two or more variables relating to telecommunication infrastructure sharing such as extent of indulgence vis a vis cost savings. The cross sectional aspect refers to observation of sample subjects done at different points in a short period of time. A deductive approach was used in making conclusions based on hypotheses drawn from the underlying research which was tested for an acceptance or rejection. The survey methodology was used to obtain overall information on the GSM collocation by MTN and GLO in Benue State.

This research study is a case study based on the co-location/infrastructure sharing agreement that is being currently undertaken by Glo and MTN. Basically a case study is an in depth study of a particular situation rather than a sweeping statistical survey. Case study research design is useful for testing whether scientific theories and models actually work in the real world.

3.2. Population and Sampling Procedure

The mobile GSM sector is made up of four (4) operators (MTN, Glo, Airtel and Etisalat) of which the researcher considers co-location relationship mainly between two (2) dominant operators (i.e. Glo and MTN) because the operators have wider coverage and were preferred by subscribers in Benue State. In this study, the researcher developed a well-structured and standardized questionnaire on perceived aspect of co-location that affect cost efficiency of GSM firms in Benue State based on the Likert five-point ordinal scale and they were administered to senior technical, rollout managers, finance/accountant and management staff in the domain of study. The respondents possess technical skills, academic qualification and experience in co-location arrangement of GSM operations in Benue State.

Hence, this study respondents consists of senior technical, rollout managers, finance/accountant and adminstrative staff cadre of MTN and GLO working in Benue State. The population of this category of staff mentioned above in GLO is 120, while MTN is 170, making a total of 290 respondents.

An appropriate response rate was determined. The formula used by Yamane (1967) is shown below.

Formula for population proportion:

$$n_0 = \frac{z^2 P(1-P)N}{z^2 P(1-P)+Ne} \text{........................... (1)}$$

Where:

n_o = sample size

z = confidence interval corresponding to a level of confidence

p = population proportion

N = population size

e = precision or error limit

The Yamane formula assumes a normal distribution. The formula could therefore be considered suitable for determining an appropriate sample size.

The study population is 290 (i.e. N=290). Applying the Yamane technique gave a sample size of 168. A 95% confidence level was deemed acceptable and thus statistically, z = 2. The proportion of responses that would be relevant to the survey is population proportion (p). If p is 0.5. The method of arrival at this sample size is indicated below:

Mathematically derived Yamane formula:

$$n = \frac{N}{1 + N(e)^2}$$

Where: n = required responses/sample size, e^2 = error limit, N = population size

Placing information in the formula at 95% confidence level and an error limit of 5% result in:

$$n = \frac{290}{1+ 290(0.05)^2}$$

$$n = 168$$

Thus, 168 respondents were adequate for the study. This gave a 95 percent, confidence level and potential error limits of 0.05 (5 percent) was found in the field.

To assign/allocate the sample size of 168 to both staff of Glo and MTN, the researcher employed the Bourley's proportional allocation formula:

$$n_b = \frac{n(h)}{N}$$

Where:
n_b = Bourley formula

h = Element within the sample frame. i.e. number allocated to each Glo and MTN employees
n = Sample or proportion of the universe used for the study (total sample size)

N = Population of the study.

Glo Staff: $n_b = \frac{120 \times 168}{290}$

$= \frac{20,160}{290}$

$= 69.5$

$= 70$

MTN Staff: $n_b = \frac{170 \times 168}{290}$

$= \frac{28,560}{290}$

$= 98.4$

$= \underline{98}$

To cross check:

70 + 98 = 168 (Sample size).

3.3. Data Collection Techniques

This research work was based on a well-structured method using standard empirical tools. The research design comprised of combination of descriptive, exploratory, inferential and causal approaches. This was because the concept of telecommunication infrastructure sharing needs to be clarified and existing models explored in order to investigate the causal relationships that exist among the variables under study.

This study consists of both qualitative and quantitative methods of data collection and empirical analysis was employed. Again, this was due to the nature of variables and context being investigated. The researcher employed a case research approach as the method was particularly well suited for this research since the phenomenon under investigation was difficult to study outside its natural context and also the concepts and variables under scrutiny were difficult to a large extent to quantify. The research involved a deductive approach to drawing or making conclusions based on hypotheses drawn from studying existing literature.

This study used a self-administered questionnaire for collecting data on two variables: telecommunication infrastructure sharing (INPUT) and cost optimisation (OUTPUT). Self administered questionnaires were preferred because according to Babbie (1973) and Newman (1977), i) they are comparatively lower costs associated with their administration, ii) they allow for wider geographical coverage; and iii) self administered questionnaires are easier to implement than other kinds of questionnaires.

In addition the study utilized a purposive sampling design. The choice of this sampling design was premised on the fact that a unique group of respondents, who routinely interact with Head Office in respect of telecommunication infrastructure sharing and would therefore, be informative.

This study deals with means and techniques through which data was collected for this research thesis. The primary data (copies of questionnaire) administered here were meant for testing and validating the prior hypotheses postulated through literature review which was the secondary source of data. The mobile GSM sector is made up of four (4) operators of which co-location relationship exists mainly between two (2) dominant operators namely MTN and Glo because they are more preferred and can be found in all twenty three local governments in the State. Hence, this co-location arrangement between these two operators has been selected as a case study. A random sampling strategy was employed; the researcher visited the operators (MTN and Glo) at random.

This research thesis is a case study based and the single case reviewed is the co-location/infrastructure sharing pact that is being currently undertaken by MTN Nigeria and Globacom Nigeria. Both telecommunication companies have undertaken to share infrastructure under a mutual agreement called co-location which has the Nigerian Regulatory Authority's backing. This is as a result of the nature of information / data being sought as certain sections required fixed responses and others were open-ended questions allowing the respondent(s) liberty to discuss his opinion on the problem area and subject matter.

Primary data collection tools were used for this thesis. One form captures information concerning the respondent(s) and his experience in GSM co-location arrangement in Benue State and the other form captures detailed identification of the several aspects of co-location arrangements that affect cost efficiency.

The survey instrument was designed following the procedures for the development of a measurement instrument recommended by several scholars (Babbie, 1977; Spector, 1992; Kervin, 1992; Oppenheim, 1992). The instrument was pre-tested, piloted and purified for the study. In this connection, Likert scales or summated rating scales were chosen for the questionnaire because they have better validity and reliability, they are usually quicker and easier to fill in by respondents. The five steps used for perception statement are, 1: strongly disagree, 2: disagree, 3: Neutral, 4: agree and 5: strongly agree.

This form that captured data on aspect of co-location that affect cost efficiency and development was designed based on the Likert five-point scale. The Likert summated involves statement relating to attitude in question (Ghuari and Gronhaug, 2008). The respondents were required to indicate the degree of agreement or disagreement with each of the statements. A numerical score was assigned to each degree of agreement/disagreement. The scores from the statement were added up to obtain the total score for each respondent.

Table 1: Likert Five-Point

Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

Source: Booz Allen Hamilton, 2007

The use of Likert five-point as an attitude measuring scale was well justified for this study as described below:

i. Respondents were selected and subjected to scoring based on the judgmental assessment on the degree of how the various aspects of collocation affect cost efficiency of GSM firms in Benue State.
ii. Favourable and unfavourable statements of how the aspects of collocation affect cost efficiency and revenue generation of GSM firms in Benue.
iii. Collected statements in the form of questionnaire were administered to a sample deemed to be reasonably representing the population being studied.
iv. Each respondent's score was obtained by adding up the scores of the responses to each statement.

These steps have been followed to obtain data and opinion of respondents regarding aspect of co-location arrangement that affect cost efficiency of GSM firms in Benue State. We argued that attitude are complex and difficult to measure, and that individuals tends to make inaccurate judgment under difficult circumstances, therefore a scale such as Likert, which improves the measurement of attitudes, is ideal and although, it can be used to rank attitude, but cannot be used to measure difference between attitudes. Also attitude vary because respondents may obtain exactly the same score from agreeing with quite different items.

Below is the profile of individuals who provided some information for this research.

Table 2: Profile of Respondents

S/N	Role	Responsibility
1	Radio Frequency Planning Coordinator	Identifies the need for cell sites and also locates suitable sites
2	Site Collocation Manager	Performing feasibility studies and coordinates all collocation
3	Radio Frequency Engineer	Provides details of cell sites i.e coordinates (longitudes and latitudes)

4	Site Acquisition Manager	Undertakes visitations, surveys and also negotiations with site
7	Transmission Planning Engineer	Handles Frequency interference on the microwave links.
8	Network Operations Manager	Ensures that the GSM network is monitored and controlled for
9	Finance/Accountant	Manages funds and keeps financial records
10	Area Manager	Manages installation of BTS in local governments
11	Regional Manager	Provides leadership direction in the State.

Source: Field Survey, 2014

3.4. Validation and Reliability of Instrument

3.4.1. Validity of instrument

Validity: this is a prerequisite in designing a good questionnaire. It is used to decide what to measure. The content validity for this study ensured that the questionnaire fully exhaust all that are implied by the study's research questions in the questionnaire objectively, by seeking the opinions of experts in the field of telecommunication, paying particular attention to the relevance of the subject matter and their coverage of the entire topic study.

The construct validity of the statistical instrument generates data on each dimensions and then test for correlation among them using factor analysis – KMO (Kaiser-Meyer-Olkin) and BTS Test of Sphericity. The assumption here was that different measures of the same construct should be correlated fairly highly. The seven items of network infrastructure components sharing were subjected to exploratory factor analysis to investigate whether the constructs as described in the literature fits the factors derived from the factor analysis.

Factor analysis indicated that the KMO (Kaiser-Meyer-Olkin) measure for network infrastructure components sharing Parameters was 0.731 with Bartlett's Test of Sphericity (BTS) valued 1080.0 at 5% level of significance (p=0.000). From Table 3, seven factors of the input variable with Eigen value, 2.547; was greater than one (1.000) and accounts for 84.9 percent of the total variance for the study. Our KMO result in this analysis surpassed the threshold value of 0.50 as recommended by Hair, Anderson, Tatham, and Black (1998). Therefore, we were confident that our sample and data were adequate for this study. Our result had strong construct validity, because the network infrastructure components sharing activities were tested for correlation and it was found out that there was a high degree of measures between the measures of the same construct, indicating that correlation exists between them.

Before taking any interview, we checked the quality and relevance of our interview questions by interviewing twenty experienced senior staff of both Glo and MTN. That means that they have a good knowledge of the mobile service market in general and that they are fully aware of the notion of sharing from a business perspective. After this mock interview, the interview questions and the interview process were slightly changed considering the feedbacks given by them. By doing so, we increased our confidence that from the created interview protocol we derived the desired type of information.

The initial factor analysis pilot test of 20 respondents, gave a KMO threshold value of 0.692. The difference between the factor analysis of field study survey and pilot test survey was 0.039. This difference between the two different surveys was very negligible. Thus, our pilot test had a high significant correlation as compared with the overall survey.

Table 3. KMO and BTS test of Sphericity

Network Infrastructure Components Sharing	**Initial**	**Extraction (Coefficients)**	**Eigenvalues**	**KMO**	**Determinant**	**Bartlett's Test of Sphericity**	**df**	**Sign.**
Microwave radio	1.000	0.798						
Shelters	1.000	0.856						
Switches	1.000	0.894						
Electrical supply	1.000	0.928	2.547	0.731	0.116	1080.0	3	0.000
Antennas	1.000	0.921	(84.916%)					
Easements	1.000	0.933						
Ducts	1.000	0.786						

Source: Research instrument – SPSS Version 21 for Windows 7

3.4.2. Reliability of instrument

Reliability: this is the consistency between independent measurements of the same phenomenon. It is the stability, dependability and predictability of a measuring instrument. It is also the accuracy or precision of a measuring instrument. Cronbach's Coefficient Analysis or Cronbach's Alpha was used to know the Corrected Item-Total Correlation and Cronbach's Alpha if item deleted. A measuring instrument gives similar, close or the same result when different researchers under the same conditions used it. Reliability therefore, is the consistency between independent measurements of the same phenomenon. It is the stability, dependability and predictability of a measuring instrument. It is also the accuracy or precision of a measuring instrument. Cronbach Alpha is valuable for determining which items from among a set of items contribute to the total alpha. The value presented in table 4 represents the alpha value if the given item were not included. For example, if microwave radio equipment and easements were to be deleted separately from the endogenous variable component, the Cronbach's Alpha (0.911) would drop to 0.914 and 0.927 respectively. Thus, the microwave radio equipment and easements items were useful and should not be dropped from the research. Even though these two items show tendency to be deleted from the network infrastructure components sharing variable. We should instead retain this items, because alpha does not increase by large (e.g. 0.914 – 0.911 = 0.003) if microwave radio equipment for example is removed.

Table 4. Cronbach's Alpha Test of Reliability

Network Infrastructure Components Sharing	No of item	Corrected item – total correlation	Cronbach's Alpha if item deleted	Item Means	Item Variances	Cronbach's Alpha
Microwave radio		0.770	0.914			
Shelters	3	0.830	0.865			
Switches		0.870	0.830			
Electrical supply		0.618	0.150	2.829	1.589	0.911
Antennas	3	0.579	0.203			
Easements		0.102	0.927			
Ducts		0.639	0.381			

Source: Research instrument – SPSS Version 21 for Windows 7

3.5. Variable Specification/Model Specification

3.5.1. Measurement of variables

Telecommunication infrastructure sharing between the two operators was measured in terms of Naira, that is how much each operator spent before collocation and their total cost after the infrastructure sharing.

Network costs (capex and opex): Radio Access Network costs reduced because of location lease, power consumption, maintenance, design and optimization, quality control and joint buying power.

Core and Broadband Switching System: This remains separate and independent; however some additional investments were required due to sharing structure. The overall impact on cost items was increased.

Staff and Overhead Expenses: Potential reduction of operation organization, which is however limited due legacy; the sales organization remains unaffected. Here, sharing and consolidating legacy network provides cost savings. The overall impact on cost item was small. **Customer Costs**: Because of decrease in differentiation between operators, acquisition and retention costs were higher. Overall impact on cost item was increased.

License: Sharing spectrum, the increase of spectrum utilization and a higher spectral efficiency reduced spectrum cost, particularly for new spectrum acquisitions, however effect is limited in case of legacy sharing when operators are not giving up their current channels. Overall impact on cost item was decrease.

Table 5: Summary of the Measurement of Variables

Variable	Indicator
Independent (Input: Infrastructure Sharing)	Micro wave radio equipment, Shelter, Switches, Antennas Easements, Transreverts, Ducts Spectrum Node B Building
Dependent (Output: Cost Optimisation)	capex and opex Maintenance cost Quality of service

Source: Field Survey, 2014

The Table 6 below demonstrates the cost structure (financial saving) before the co-location. The analysis was based on 20 sites that both Glo and MTN engaged on infrastructure sharing in the study area. The MTN has a total of 12 sites located at Makurdi (6), Otukpo (3) and Katsina-Ala (3), the total cost incurred on a site per month was N134,000. Thus, the total cost for the 12 sites per month was N1,608,000, and in a year the total cost was N19,296,000. The Glo had a total of 8 sites located at Makurdi (4), Otukpo (2) and Katsina-Ala (2), the total cost incurred on a site per month was N128,000. Thus, the total cost for the 8 sites per month was N1,024,000, and in a year the total cost was N12,288,000. In a nutshell, the total cost incurred in a year by Glo and MTN on 20 sites was (N19,296,000 + N12,288,000) N32,448,000.

Table 6: Cost Incurred on Sites Before Infrastructure Sharing

Network Operator	Number of Sites	Components of Sites	Cost Incurred on a Site /Month (N'000)	Total Cost (N'000)
MTN	**12**	Micro wave radio equipment,	12	144
		Shelter, Switches, Antennas	13	156
		Easements, Transreverts, Ducts	10	120
		Spectrum	15	180
		Node B	7	84
		Building	7	84

		capex and opex	40	480
		Maintenance cost	20	240
		Quality of service	10	120
		TOTAL	**134**	**1,608**
GLO	**8**	Micro wave radio equipment,	10	80
		Shelter, Switches, Antennas	12	96
		Easements, Transreverts, Ducts	9	72
		Spectrum	15	120
		Node B	7	56
		Building	8	64
		capex and opex	37	296
		Maintenance cost	20	160
		Quality of service	10	80
		TOTAL	**128**	**1,024**

Source: Field Survey, 2014

The table 7 depicts the cost incurred by both operators after infrastructure sharing of 20 sites was N105,000 on a site per month and the total cost for 20 sites per month was N2,100,000. Thus the total cost for a year was N25,200,000.

Table 7: Cost Incurred on Sites After Infrastructure Sharing

Network Operator	Number of Sites	Components of Sites	Cost Incurred on a Site /Month (N'000)	Total Cost (N'000)
MTN &	**20**	Micro wave radio equipment,	12	240
GLO		Shelter, Switches, Antennas	13	260
		Easements, Transreverts, Ducts	10	200
		Spectrum	15	300
		Node B	7	140
		Building	5	100
		capex and opex	25	500
		Maintenance cost	12	240
		Quality of service	6	120
		TOTAL	**105**	**2,100**

Source: Field Survey, 2014

Comparatively, the telecommunication infrastructure before sharing for the two operators cost was (N1,608,000 + N1,024,000) N2,632,000 per month and the cost after sharing was N2,100,000. It was a saving of about 20% per month. Calculating the annual costs, the telecommunication infrastructure before sharing was (N19,296,000 + N12,288,000) N31,584,000 and the cost after sharing was N25,200,000 . The operators save up to N6,384,000, it was a saving of 20% annually.

The considerable operational savings associated with the telecommunication infrastructure sharing however strongly supports the case for operators sharing their infrastructure.

3.5.2. Model specification

The evaluation of relationship between dependent and independent variables was carried out using the multiple regression models. The first step consisted of defining the variables of the study. This was to determine the relationship between the combined explanatory variables and cost incurred. The cost optimisation (CO) in this study is the dependent variable and the telecommunication infrastructure sharing is the independent variables represented by (TIS).

In this study, cost optimisation was regressed and correlated on the set of explanatory variable of telecommunication infrastructure sharing. The coefficients of the variables measure directly or indirectly the marginal effects of the independent variables on cost optimisation in the study area.

The most general form for the model is:

$CO = f(TIS, b)$ ……........................... (i)

where,

CO: the dependent variable is a measure of cost optimisation;
f: a function to be specified;
TIS: explanatory variables of telecommunication infrastructure sharing;
b: variables measuring the explanatory variables (parameters)

In specific form, equation (i) translates into equation (ii)

$CO = a + b_1TIS_1 + b_2TIS_2 + b_3TIS_3 + ..., + b_nTIS_n + e$ ……………… (ii)

where,

CO = dependent variable (cost optimisation – capex and opex, cost reduction, efficiency, quality of service)

a = constant

$TIS_1, TIS_2, TIS_3, ..., ..., ..., ..., ..., TIS_n$ are independent variables (infrastructure sharing - micro wave radio equipment, shelters, switches, electric supply. Antennas, easements, transreverts and ducts).

$b_1, b_2, b_3, ..., ..., ..., ..., ..., b_n$ are the regression coefficients which determines the contribution of the independent variables.

e = residual or stochastic error (which reveals the strength of $bx_1 \ldots b_nx_n$; if e is low the amount of unexplained factors will be low and vice versa.

The multiple regression analysis is relevant to this study as it assists in predicting, making inferences, testing the set hypotheses, and modeling the relationships between the variables.

3.6. Data Analysis Techniques

The researcher provides an exposition on the methods used to measure and analyze data for each study objectives and hypotheses. Multiple-Regression is a multivariate statistical technique which helps to predict one variable from other variables, as long as there are established relationships between the variables (Nworuh, 2004). The variable being predicted is usually known as dependent variables because its values are dependent on the other variables referred to as the independent variables.

4. Results and Discussion

4.1. Survey Response

A total of 168 copies of questionnaire were sent-out and 164 were retrieved. A successful response rate of 97.6% was achieved as 164 copies of the questionnaire were considered acceptable. Given the high percentage of acceptable number of questionnaire retrieved, this response rate was considered reasonably adequate (see Appendix I).

4. 2. Demographics of Respondents

4.2.1. Duration of employment

The highest duration of employment among the respondents fell between 1 – 5 years (43.9%), while 28.1% have worked for their telecommunication organizations between 6 – 10 years. Those who have worked for a few months and up to a year make up 14.6%; this figure is close to 13.4% of the respondents who have worked for their telecommunication organizations for more than 11 years.

4.2.2. Gender distribution

The gender distribution constitutes a very high population for men (90.2%), while the women made up a small percentage of 9.8%, giving the picture that the telecommunication organizations in this region are predominantly dominated by the male counterparts. Given this information, the ratio of male to female is approximately 10:1.

4.2.3. Educational qualifications

The majority of respondents were those with an HND or a B.Sc., which made up the highest distribution of 70.7%. The M.Sc. holders made up 18.3% followed by professionals (11.0%). The study did not take cognizance of both FSLC and WASC holder staff.

Table 8: Summary of Respondents' Demographics

Duration of Employment	No. of Resp.	Percentage (%)
≤ 1 yr	24	14.6
1 – 5 yrs	72	43.9
6 – 10 yrs	46	28.1
11 ≥ yrs	22	13.4
Total	**164**	**100.0**
Gender	**No. of Resp.**	**Percentage (%)**
Male	148	90.2
Female	16	9.8
Total	**164**	**100.0**
Education	**No. of Resp.**	**Percentage (%)**
HND/B.Sc.	116	70.7
M.Sc.	30	18.3
Professionals	18	11.0
Total	**164**	**100.0**

Source: Field survey, 2014

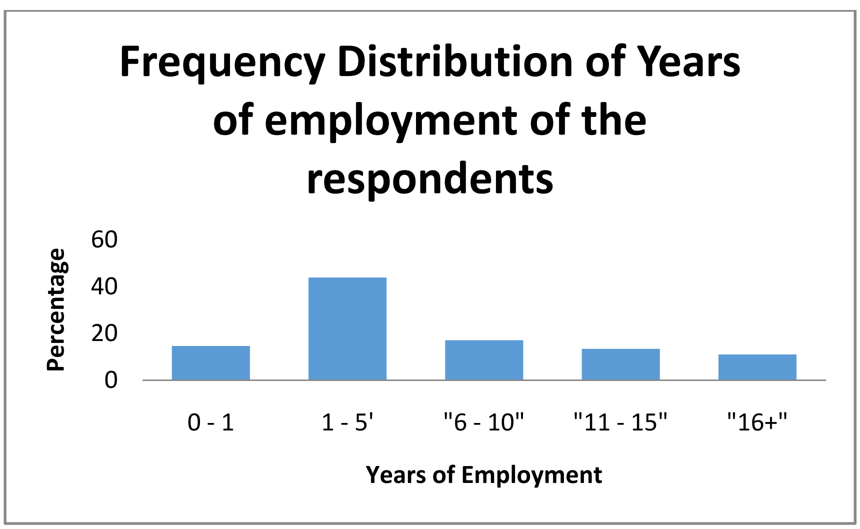

Figure 1: Frequency Distribution of Years of Employment of the Respondents

4.3. Presentation and Analysis of Data

4.3.1. Network infrastructure components sharing

i. **Microwave radio equipment:** Majority of the respondents (42.7%) were neutral that their GSM companies help to reduce cost on customers by sharing their microwave. A large percentage, 18.3%, of the respondents agreed to this fact, while 15.9% did not agreed at all. A lesser percentage (13.4%) of the respondents strongly agreed, while, an uninspiring percentage (9.8%) strongly disagreed. The weighted average for this group was 2.13.

ii. **Your Shelters are very important in reducing operational expenditure:** Most of the respondents (37.8%) were neutral that shelters are very important in reducing operational expenditure. A large percentage of 20.7% of the respondents agreed to this fact, while 18.3% did not agree at all. A lesser percentage (15.9%) of the respondents strongly agreed, while, an uninspiring percentage (7.3%) strongly disagreed. The weighted average for this group was 2.30.

iii. **You have sufficient switches:** Majority of the respondents (34.1%) is neutral that their GSM companies have sufficient switches. A large percentage of 22.0% of the respondents agreed to this fact, while 18.3% strongly agreed. A lesser percentage (13.4%) of the respondents strongly disagreed, while, an uninspiring percentage (12.2%) disagreed. The weighted average for this group is 2.30.

iv. **Electric supply:** Majority of the respondents (37.8%) were neutral that there is efficient electric supply. A large percentage of 22.0% of the respondents disagreed to this fact, while 15.9% strongly disagreed. A lesser percentage (17.1%) of the respondents agreed, while, an uninspiring percentage (7.3%) strongly agreed.

v. **Your antennas are reliable in hosting other GSM networks equipment:** Majority of the respondents (43.9%) were neutral that their GSM companies have reliable antennas for hosting competitors. A large percentage of 18.3% of the respondents disagreed to this fact. Two sets of respondents to a certain percentage (12.2%) both strongly agreed and agreed to this fact, while an uninspiring percentage (13.4%) strongly disagreed. The weighted average for this group was 2.10.

vi. **You have reliable easements:** Most of the respondents (29.3%) were neutral that their GSM companies have reliable easements for sharing. A large percentage of 23.3% of the respondents disagreed to this fact, while 19.5% strongly disagreed. A lesser percentage (17.1%) of the respondents agreed, while, an uninspiring percentage (11.0%) strongly agreed. The weighted average for this group was 1.99.

vii. **Your transreverts are relevant for improving quality of service:** Most of the respondents (25.6%) were neutral that their GSM companies have relevant transreverts for improving quality of service. A large percentage of 26.8% of the respondents disagreed to this fact, while 19.5% strongly disagreed. A lesser percentage (15.9%) of the respondents agreed, while, a lesser percentage (12.2%) of the respondents agreed. The weighted average for this group was 1.97.

viii. **Your ducts are better than other GSM networks:** Most of the respondents (34.1%) were neutral that their companies often make promises to potential customers through advertisement. A considerable percentage (22.0%) of the respondents agreed to this fact, while 18.3% strongly agreed. A lesser percentage (13.4%) of the respondents strongly disagreed, while, an uninspiring percentage (12.2%) disagreed. The weighted average for this group was 2.30.

4.3.2. Cost optimization strategy

i. **Network infrastructure components sharing aids cost reduction for your customers:** Majority of the respondents (26.8%) disagreed that a network infrastructure components sharing aids cost reduction for customers. Considerable percentages (25.6%) of the respondents are neutral to this fact, while 19.5% strongly disagreed. A lesser percentage (15.9%) of the respondents agreed, while, an uninspiring percentage (12.2%) strongly agreed. The weighted average for this group was 1.97.

ii. **Network infrastructure components sharing help to improve the efficiency of your operations:** Most of the respondents (25.6%) were neutral that a network infrastructure component sharing helps to improve the efficiency of operations. A considerable percentage (26.8%) of the respondents disagreed to this fact, while 17.1% strongly agreed. A lesser percentage (14.6%) of the respondents strongly disagreed, while, an uninspiring percentage (11.0%) agreed. The weighted average for this group was 2.08.

iii. **Network infrastructure components sharing help to reduce your operations expenditure:** Majority of the respondents (23.2%) were neutral that a network infrastructure components sharing helps to reduce the operations expenditure. A large percentage of 18.3% of the respondents agreed to this fact while, 15.9% disagreed. A lesser percentage (13.4%) of the respondents strongly agreed, while, an uninspiring percentage (9.8%) strongly disagreed. The weighted average for this group was 1.65.

iv. **Network infrastructure components sharing helps to improve quality of service rendered:** Most of the respondents (37.8%) were neutral that network infrastructure components sharing helps to improve quality of service rendered. A large percentage of 22.0% of the respondents disagreed to this fact, while 17.1% agreed to this fact. A lesser percentage (15.9%) of the respondents strongly disagreed, while, an uninspiring percentage (7.3%) strongly agreed. The weighted average for this group is 2.00.

v. **Network infrastructure components sharing aids competitive advantage:** Most of the respondents (25.6%) were neutral that network infrastructure components sharing aids competitive advantage. Two sets of respondents to a large percentage (23.2%) both strongly disagreed. A certain percentage (14.6%) of the respondents agreed to this fact, while an insignificant 13.4% strongly agreed. The weighted average for this group was 1.96.

Table 9: Summary of Data Presentation

S/N	Statement	SA	A	N	D	SD	Weighted Average

(I)	**Network Infrastructure Components Sharing**	5	4	3	2	1	
(i)	Your microwave radio equipment helps in reducing the cost on customers	22 (13.4)	30 (18.3)	70 (42.7)	26 (15.9)	16 (9.8)	2.13
(ii)	Your shelters are very important in reducing operations expenditure	26 (15.9)	34 (20.7)	62 (37.8)	30 (18.3)	12 (7.3)	2.30
(iii)	You have efficient switches	30 (18.3)	36 (22.0)	56 (34.1)	20 (12.2)	22 (13.4)	2.30
(iv)	Efficient electric supply	6 (7.3)	14 (17.1)	31 (37.8)	18 (22.0)	13 (15.9)	2.00
(v)	Your antennas are reliable in hosting other GSM network's equipment	20 (12.2)	20 (12.2)	72 (43.9)	30 (18.3)	22 (13.4)	2.10
(vi)	You have reliable easements	18 (11.0)	28 (17.1)	48 (29.3)	38 (23.2)	32 (19.5)	1.99
(vii)	Your transreverts are relevant for improving quality of service	20 (12.2)	26 (15.9)	42 (25.6)	44 (26.8)	32 (19.5)	1.97
(viii)	Your ducts are better than the other GSM networks	30 (18.3)	32 (22.0)	56 (34.1)	20 (12.2)	22 (13.4)	2.30
(II)	**Cost optimization strategy**	5	4	3	2	1	
(i)	Network infrastructure components sharing aids cost reduction for your customers	20 (12.2)	26 (15.9)	42 (25.6)	44 (26.8)	32 (19.5)	1.97
(ii)	Network infrastructure components sharing helps to improve the efficiency of your operations	28 (17.1)	18 (11.0)	50 (30.5)	44 (26.8)	24 (14.6)	2.08
(iii)	Network infrastructure components sharing helps to reduce operational expenditure	22 (13.4)	30 (18.3)	70 (23.2)	26 (15.9)	16 (9.8)	2.23
(iv)	Network infrastructure components sharing helps to improve quality of service rendered	12 (7.3)	28 (17.1)	62 (37.8)	36 (22.0)	26 (15.9)	2.00
(v)	Network infrastructure components sharing aids competitive advantage	22 (13.4)	24 (14.6)	42 (25.6)	38 (23.2)	38 (23.2)	1.96

Source: Field survey, 2014

Note: values in parenthesis are in percentages, 5 = Strongly Agreed [SA], 4 = Agreed [A], 3 =Neutral [N], 2 = Disagree [D], 1 = Strongly Disagree

4.4. Test of Hypotheses

4.4.1. Hypothesis one (H_{01})

Network infrastructure sharing does not results in a significant reduction in cost of network infrastructure rollout and capacity expansions for telecoms operators in Benue State. The t-calculated values: 3.541, 2.715, 5.370, 2.351, 2.571, 3.693, 2.430 and 3.804 for microwave radio equipment, shelters, switches, electric supply, antennas, easements, transreverts and ducts respectively showed significant values, because they were greater than the t-tabulated value (1.98) (see Table 10). The F-calculated value was 46.382, which is greater than the F-tabulated value of 2.00 (see Table 10). However, the (n-k, k-1), where, n=the sample size, k=the number of variables in the regression model. Thus (164-9, 9-1) = (156, 8), at a 5% significant level. The null hypothesis was rejected while the alternative hypothesis (**H_{11}**) was accepted, which states that, *"network infrastructure sharing results in a significant reduction in cost of network infrastructure rollout and capacity expansions for telecoms operators in Benue State."*

Table 10: Network Infrastructure Sharing and Cost of Network Infrastructure Rollout and Capacity Expansions for Telecoms Operators in Benue State.

Coefficients[a]

Model 1	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	T	Sig.
(Constant)	0.129	0.246		0.522	0.603
Microwave radio	0.239	0.067	0.278	3.541*	0.001
Shelters	0.195	0.076	0.207	2.715*	0.012
Switches	0.419	0.078	0.443	5.370*	0.000
Electrical supply	0.131	0.056	0.145	2.351*	0.021
Antennas	0.148	0.045	0.183	2.578*	0.000
Easements	0.274	0.054	0.293	3.693*	0.000
Transreverts	0.181	0.082	0.124	2.430*	0.018
Ducts	0.284	0.058	0.317	3.804*	0.000

a. Dependent Variable: cost of network infrastructure rollout and capacity expansions, *Correlation is significant at the 0.05 level (2-tailed), F-Calculated value = 46.382, R = 0.831, R^2 = 0.691.

Source: SPSS print out 2014

4.4.2. Hypothesis two (H_{02})

Network infrastructure sharing does not results in an improved efficiency in the utilization of telecoms infrastructure for telecom operators in Benue State. The t-calculated values: (2.854, 2.251, 4.711, 2.635, 2.193, 2.102, 3.834 and 4.205) for microwave radio equipment, shelters, switches, electric supply, antennas, easements, transreverts and ducts were significant, because they are greater than the t-tabulated value (1.98) (see Table 11). The F-calculated value of 35.315 was greater than the F-tabulated value of 2.00 (see Table 11) and showed significance between the output and input variables. However, the (n-k, k-1), where, n=the sample size, k=the number of variables in the regression model. Thus (164-9, 9-1) = (156, 8), at a 5% significant level. The null hypothesis was rejected and the alternative hypothesis (**H_{12}**) accepted, which states that, *"Network infrastructure sharing aids improved efficiency in the utilization of telecoms infrastructure for telecom operators in Benue State."*

Table 11: Network infrastructure sharing and improved efficiency in the utilization of telecoms infrastructure for telecom operators in Benue State.

Coefficients[a]

Model 2	Unstandardized Coefficients		Standardized Coefficients		
	B	**Std. Error**	**Beta**	**T**	**Sig.**
(Constant)	0.336	0.258		1.306	0.195
Microwave radio	0.201	0.071	0.246	2.854*	0.005
Shelters	0.178	0.079	0.198	2.251*	0.027
Switches	0.385	0.082	0.426	4.711*	0.000
Electrical supply	0.154	0.058	0.178	2.635*	0.010
Antennas	0.199	0.091	0.230	2.193*	0.030
Easements	0.183	0.084	0.217	2.102*	0.039
Transreverts	0.258	0.093	0.389	3.834*	0.023
Ducts	0.314	0.054	0.351	4.205*	0.000

a. Dependent Variable: Efficiency in the utilization of telecom infrastructure, *Correlation is significant at the 0.05 level (2-tailed), F-Calculated value = 35.315at 0.05, R = 0.794, R^2 = 0.630.

Source: SPSS print out 2014

4.4.3. Hypothesis three (H_{03})

Network infrastructure sharing does not leads to a significant reduction in the operational expenditures (OPEX) dissipated for telecoms operators in Benue State. The t-calculated values: 5.041, 3.475, 9.919, 3.826, 5.579, 3.023, 9.472 and 9.362 for microwave radio equipment, shelters, switches, electric supply, antennas, easements, transreverts and ducts respectively showed significant values, because they are greater than the t-tabulated value (1.98) (see Table 12). The F-calculated value was 48.258, which is greater than the F-tabulated value of 2.00 (see Table 12) indicating significance between advertisement and increased sales volume. However, the (n-k, k-1), where, n=the sample size, k=the number of variables in the regression model. Thus (164-9, 9-1) = (156, 8), at a 5% significant level. The null hypothesis was rejected while the alternative hypothesis (**H_{13}**) was accepted, which states that, *"Network infrastructure sharing leads to a significant reduction in the operational expenditures (OPEX) dissipated for telecoms operators in Benue State."*

Table 12: Network infrastructure sharing and reduction in the operational expenditures (OPEX) dissipated for telecoms operators in Benue State.

Coefficients[a]

Model 3	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	T	Sig.
(Constant)	2.539	0.331		7.674*	0.000
Microwave radio	0.604	0.120	0.442	5.041*	0.000
Shelters	0.499	0.144	0.358	3.475*	0.001
Switches	0.960	0.082	0.919	9.919*	0.000
Electrical supply	0.501	0.153	0.384	3.826*	0.000
Antennas	0.645	0.231	0.485	5.579*	0.000
Easements	0.437	0.134	0.316	3.023*	0.002
Transreverts	0.902	0.068	0.874	9.472*	0.000
Ducts	0.870	0.063	0.862	9.362*	0.000

a. Dependent Variable: reduction in the operational expenditures (OPEX), *Correlation is significant at the 0.05 level (2-tailed), F-Calculated value = 48.258 at 0.05, R = 0.790, R^2 = 0.624.

Source: SPSS print out 2014

4.4.4. Hypothesis four (H_{04})

Network infrastructure sharing does not lead to degraded quality of service and customer usage experience for telecoms operators in Benue State. Only the t-calculated values: 7.187, 2.193 and 3.894 for microwave radio equipment, shelters, and antennas respectively showed significant values, because they are greater than the t-tabulated value (1.98) (see Table 13). The F-calculated value was 45.260, which was greater than the F-tabulated value of 2.00 (see Table 13) indicating significance between advertisement and increased sales volume. However, the (n-k, k-1), where, n=the sample size, k=the number of variables in the regression model. Thus (164-9, 9-1) = (156, 8), at a 5% significant level. The null hypothesis was rejected while the alternative hypothesis (**H_{13}**) was accepted, which states that, *"Network infrastructure sharing leads to degraded quality of service and customer usage experience for telecoms operators in Benue State."*

Table 13: Network infrastructure sharing and quality of service for customer usage experience for telecoms operators in Benue State.

Coefficients[a]

Model 4	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	0.391	0.238		1.640	0.104
Microwave radio	0.625	0.087	0.602	7.187*	0.000
Shelters	0.199	0.091	0.230	2.193*	0.030
Switches	0.002	0.167	0.002	0.009	0.993
Electrical supply	0.028	0.140	0.031	0.200	0.842
Antennas	0.219	0.056	0.295	3.894*	0.000
Easements	0.003	0.161	0.003	0.007	0.998
Transreverts	0.016	0.167	0.038	0.239*	0.871
Ducts	0.015	0.189	0.027	0.130	0.885

a. Dependent Variable: quality of service for customer usage, *Correlation is significant at the 0.05 level (2-tailed), F-Calculated value = 45.260, R = 0.782, R^2 = 0.612.

Source: SPSS print out 2014

4.4.5. Hypothesis five (H_{05})

Network infrastructure sharing will not enable telecoms operators in Benue State achieve and sustain competitive advantage through wider coverage and capacity. The t-calculated values: (7.648, 3.652, 5.845, 2.467, 2.640, 7.936, 7.784 and 5.372) for microwave radio equipment, shelters, switches, electric supply, antennas, easements, transreverts and ducts were all significant, because they are greater than the t-tabulated value (1.98) (see Table 14). The F-calculated value of 116.766 was greater than the F tabulated value of 2.00 (see Table 14) and shows significance between the output and input variables. However, the (n-k, k-1), where, n=the sample size, k=the number of variables in the regression model. Thus (164-9, 9-1) = (156, 8), at a 5% significant level. The null hypothesis was rejected and the alternative hypothesis (**H_{15}**) accepted, which states that, *"Network infrastructure sharing will enable telecoms operators in Benue State achieve and sustain competitive advantage through wider coverage and capacity."*

Table 14: Network infrastructure sharing and competitive advantage through wider coverage.

Coefficients[a]

Model 5	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
(Constant)	0.850	0.136		6.227*	0.000
Microwave radio	0.445	0.058	0.580	7.648*	0.000
Shelters	0.600	0.164	0.643	3.652*	0.000
Switches	0.351	0.060	0.394	5.845*	0.000
Electrical supply	0.154	0.063	0.208	2.467*	0.015
Antennas	0.391	0.138	0.422	2.640*	0.024
Easements	0.454	0.043	0.593	7.936*	0.000
transreverts	0.451	0.040	0.594	7.784*	0.000
Ducts	0.311	0.053	0.352	5.372*	0.000

a. Dependent Variable: competitive advantage through wider coverage, *Correlation is significant at the 0.05 level (2-tailed), F-Calculated value = 116.766, R = 0.816, R^2 = 0.667.

Source: SPSS print out 2014

4.5. Implications of the Regression Results

The multiple co-efficient of correlation (R) was 0.831; meaning that there was a strong relationship between the variables of Model 1 (see Table 10). The multiple coefficient of determination (R^2) on the other hand was 0.691 indicating that 69% of cost of network infrastructure rollout and capacity expansions was caused by variation of microwave radio equipment, shelters, switches, electric supply, antennas, easements, transreverts and ducts. Thus, we concluded that network infrastructure components sharing; influence the cost of network infrastructure rollout and capacity expansions.

From Table 11, the multiple coefficients of correlation (R) was 0.794; meaning that there was a strong relationship between relationship between efficiency in the utilization of telecom infrastructure and cost reduction. The multiple coefficient of determination (R^2) on the other hand was 0.630 indicating that 63% of efficiency in the utilization of telecom infrastructure was caused by a variation of microwave radio equipment, shelters, switches, electric supply, antennas, easements, transreverts and ducts.

The multiple coefficient of correlation (R) was 0.790; meaning that there is a strong relationship between the variables of model 3 (see Table 12). The multiple coefficient of determination (R^2) on the other hand was 0.624 indicating that 62% of reduction in the operational expenditures (OPEX), was caused by variation of microwave radio equipment, shelters, switches, electric supply, antennas, easements, transreverts and ducts. Thus we conclude that network infrastructure components sharing therefore, influence reduction in the operational expenditures (OPEX).

The multiple coefficient of correlation (R) is 0.782; meaning that there is a strong relationship between the variables of model 4 (see Table 13). The multiple coefficient of determination (R^2) on the other hand was 0.612 indicating that 61% of quality of service for customer usage was caused by variation of microwave radio equipment, shelters, switches, electric supply, antennas, easements, transreverts and ducts. Thus, we conclude that network infrastructure components sharing therefore, influence quality of service for customer usage.

The multiple coefficient of correlation (R) is 0.816; meaning that there is a strong relationship between the variables of model 4 (see Table 14). The multiple coefficient of determination (R^2) on the other hand is 0.667 indicating that 67% of competitive advantage through wider coverage was caused by variation of microwave radio equipment, shelters, switches, electric supply, antennas, easements, transreverts and ducts. Thus, we conclude that network infrastructure components sharing therefore, influence competitive advantage through wider coverage.

Testing the multiple regression coefficients using t-tests and F-tests not only gives researchers some insight into the fit of the regression models, but it also helps in assessing the strength of individual predictor variables in estimating the dependent variable. The result of the *research models* indicates that regression coefficients or slopes of network infrastructure components sharing variables have significant impacts on cost optimization strategy variables. These findings further support the alternate hypotheses that these regression coefficients or slopes were significantly different from zeros and have predictive powers in estimating cost optimization strategy.

The past theories confirmed that it is crucial for operators to minimize operating costs, which is a major contributor to the overall cost structure. And, with a flat rate pricing, minimizing production costs for a given traffic demand will be highly relevant for operators.

The current study sees a need for the mobile GSM operators to have a basic strategy in order to achieve cost optimisation would be to exploit existing infrastructure and knowledge as far as possible. Two different strategies for cost effective network operations can be identified. A technology diversification path, where available radio access technologies and infrastructure are utilized in a complementary manner to provide the access services of interest. The second strategy would be a technology specialization strategy where one technology is used as far as possible, even for service where it is not optimal. It is likely that the first strategy would be more cost effective in the long run – if demand for mobile data services continues to surge. However, to fully reap the benefits it requires that overhead costs for system integration are sufficiently low.

According to Cohen and Southwood (2008), sharing infrastructure is one strategy for achieving a national broadband infrastructure more quickly than through simply letting the market take its course. Hasbani, El-Darwinche, Mourad and Chanab (2007) argue that there are various advantages of infrastructure sharing by operators, which are to; reduce investment, decrease barriers to entry for new players, shift the focus to service innovation and expand investment to less dense areas to meet universal targets. The traditional forms of infrastructure sharing that have been adopted are restricted to site sharing, co-location and national roaming.

According to Hasbani, El-Darwinche, Mourad and Chanab (2007), in site sharing operators agree to share available infrastructure including site space, buildings and easements, towers and masts, power supply and transmission equipment, while collocation deals with housing of radio and cable transmission facilities. In addition, national roaming allows new operators to provide national service coverage by means of sharing incumbent’s networks in specific areas while their networks are still deployed. However, given the competitive landscape, operators had to adopt and explore other infrastructure sharing business models especially where these have the potential of significant financial benefits to them, for example optic fibre sharing and network sharing of base stations equipment.

Despite the methods of infrastructure sharing mentioned earlier, Hasbani, El-Darwinche, Mourad and Chanab, (2007) refer to other forms of infrastructure sharing to include, amongst others; Spectrum sharing, as a model where operators lease their spectrum to other operators on commercial terms. The writers conclude that the sharing methodologies by operators depend on whether telecoms operators prefer either passive sharing or active sharing. They refer to passive sharing as involving the joint use of the network, co-location and national roaming and furthermore, active sharing as involving the joint use of active components such as switches, antennae’s and base stations.

While infrastructure sharing may have a role in opening up barriers to entry and increasing competition, the literature is divided. Hultel, Johansson and Markendahl, (2004) are of the view that this type of geographical sharing is still associated with considerable risks. In other jurisdictions, policymakers continue to grant permission to share infrastructure with certain conditions. For example, the Indian Regulator granted permission on condition that service providers announce a program of passive infrastructure sharing on the existing infrastructure (where feasible) and for future investment while setting up mobile towers (Bhawan and Marg, 2007). According to Mansell (1994), the traditional relationships between telecoms operators in different national markets continue to be supported by revenue sharing arrangements that are less than transparent and are recognized as resulting in distorted relationships between the costs and prices of service supply.

4.6. Contribution to Knowledge

1. Network infrastructure sharing helps telecoms operators in Benue State to extend their coverage to the rural areas.
2. Network infrastructure sharing is a veritable strategy for reduction in the cost of network infrastructure rollout and capacity expansions for telecoms operators in Benue State.
3. Network infrastructure sharing leads to a reduction in the operational expenditures (OPEX) for telecoms operators in Benue State.

5. Conclusion and Recommendations

5.1. Conclusion

Indiscriminate installation of towers in Benue State has congested the skyline of the cities in the State with towers. There have been several calls by residents in Benue State for a ban to be placed on the mounting of towers. However, these masts form a necessary infrastructure that telecom operators need in order to carry signals that are necessary for communication to take place. The main objective of this study is to explore if network infrastructure sharing results in an improved efficiency in the utilization of telecoms infrastructure for telecom operators in Benue State. This study uses a combination of descriptive, correlation and cross sectional type of research. The study respondents consists of senior technical, rollout managers, finance/accountant and adminstrative staff cadre of MTN and GLO working in Benue State. The population of this category of staff in GLO is 120, while MTN is 170, making a total of 290 respondents. Through Yamane sampling technique, the sample size is 168. Multiple-Regression is a multivariate statistical technique was used to predict one variable from other variables, as long as there are established relationships between the study's variables**.**

The study has shown that both CAPEX and OPEX have been reduced, operators were able to extend their coverage to reach more subscribers in the grassroots areas. Not only is the cost of rollout reduced but also the time to rollout. Tower sharing also benefits the environment by reducing unnecessary duplication of masts and their associated infrastructure, thereby causing better city aesthetics.

The study found out that there was a growing recognition among operators that the rise of viable competition through collocation will force each operator to give of its best in service delivery. This has been intensified by the recent introduction of mobile number portability which allows subscribers to switch from one network to another while maintaining their numbers. This calls for high service quality, and telecom operators in Benue are well poised for this competition by engaging in infrastructure sharing which allows operator to easily extend their network coverage to areas that were covered by their competitor.

The following conclusions have been drawn from the results of this research.

1. Network infrastructure sharing leads to significant reduction in cost of network infrastructure rollout in the rural areas for telecoms operators in Benue State.
2. Network infrastructure sharing leads to an improvement in the usage efficiency of telecoms infrastructure for telecom operators in Benue State.
3. Network infrastructure sharing leads to significant savings in the operational expenditures (OPEX) dissipated by telecoms operators in Benue State.
4. Network infrastructure sharing improves the quality of service by telecoms operators in BenueState.
5. Network infrastructure sharing will enable telecom operators in Benue State to achieve and sustain competitive advantage through wider rollout to the grassroots.
6. Network infrastructure sharing leads to improved service delivery by telecoms providers in Benue State.
7. Network infrastructure sharing helps telecoms operators in Benue State to achieve better competitive advantage through new product development and service innovations.

The study found out that the weighted averages for network infrastructure component sharing variables lay between the ranges of 1.97 – 2.30. The most weighted averages to the list is as follows: ii) shelters, iii) switches, and viii) Ducts =2.30, vii) microwave radio equipment = 2.13, v) Antennas = 2.10, vi) Easements = 1.99, and lastly vii) Transreverts = 1.97.

In the case of cost optimization strategy variables, the weighted averages range from 1.96 – 2.23. The most weighted averages to the list are as follows: iii) reduction in operational expenditure = 2.23, ii) Efficiency = 2.08, iv) quality of service = 2.00, i) cost reduction = 1.97, v) competitive advantage = 1.96.

This range in weighted averages extrapolated from the research questionnaire, implies that the respondents from MTN and GLO were conscious of the subject matter and have agreed to a certain degree that network infrastructure components sharing variables are important for cost optimization strategy. However, most of the respondents answered towards the middle of the likert-like scale range of *"considerable degree (C),"* which emphasizes the need for improvement.

The inferential statistics of testing the regression coefficients using t-tests not only gives researchers some insight into the fit of the regression models, but it also helps in assessing the strength of individual predictor variables in estimating the dependent variable. The result of the *research models* indicates that regression coefficients or slopes of network infrastructure components sharing variables have significant impacts on cost optimization strategy variables. These findings further support the alternate hypotheses that these regression coefficients or slopes were significantly different from zeros and have predictive powers in estimating cost optimization strategy.

The summary of the findings are presented below. Network infrastructure sharing eliminates some setup costs such as land acquisition cost, civil works cost, and tower construction cost as well as long and tedious bureaucratic processes of seeking permits. This helps in rapid rollout to new areas while drastically reducing cost of network expansion cost by over 50 per cent. This helps in improvement on time to market. Network infrastructure sharing reduces operational costs such as electricity and security among others leading to operational efficiency. Network infrastructure sharing has no negative impact on customer experience or network quality of service for customers who were served via sites that are shared with other operators. Therefore, there was no significant risk involved in collocation. Network infrastructure sharing alleviates the pressure of network deployment and allows operators to turn their attention to improved innovation, better customer service and eventually better commercial offerings and healthier competition. In summary, network infrastructure sharing helps telecom operators to reduce cost while maintaining acceptable service levels in a way that does not undermine the operator's efforts to capitalize on future growth opportunities.

5.2. Recommendations

From our conclusion, the study came to the following recommendations for stakeholders:

i. Rural infrastructure sharing is strongly recommended (both 2G and 3G) in Benue State because majority of the population are living in rural areas.

ii. The main recommendation is in respect of the epilepsy power supply. It is recommended to the Federal Government to speed up its power sector reforms, as doing so will bring great relief to the infrastructure sharing in Benue State. The tariffs charged by the telecom operators for their services will be drastically reduced and quality of services provided by the operators will also improve tremendously.

iii. The telecom regulatory body (NCC) should encourage infrastructure sharing trends in Benue State by ensuring that terms of agreement are adhered to by both parties and ensuring that defaulting parties are penalized in forms of fines or surcharges. This would ensure better commitments by the colocating parties.

iv. The NCC should eliminate the issues of non-harmonization of standards in specifications among telecom operators through issuing colocation licenses to third party companies who would be allowed to maintain or build infrastructure as separate companies desiring to share infrastructure. Hence, such issues as lack of commitment from the other party towards taking care of equipment belonging to the other will be eliminated.

5.3. Suggestion for Further Study

1 Future research can be conducted so as to validate the findings of this study. Surveys can be conducted so as to validate the findings of the analysis and the overall study. The decision factor framework can be applied on case studies so as to test the area of its validity and if possible further extend it. According to our framework, the adopted strategy of both the infrastructure provider and receiver is one of the two conditions for the materialization of a potential sharing deal. However, it might be the case that a sharing agreement can be a way

for meeting the adopted strategy and not just a conditional consideration that can lead to reduced costs. Future research can be done so as to investigate when sharing is a conditional consideration that can lead to reduced costs and when it is a way for meeting the adopted strategy.

2 Future research can also be conducted so as to further explore the technical difficulties of infrastructure sharing. Specifically, we can investigate when technical difficulties are real barriers and when they are presented as barriers in order to avoid sharing. Another possible area for future research is related with capacity that can potentially constitute a driver or a barrier for sharing. Research can be conducted so as to find ways to identify the optimum level of sharing that can lead to the desired level of capacity.

3 Another case could be to study deployment of indoor system where some other actor than the mobile operators take the lead for financing, deployment and operation of a local network. This network can then be shared with the mobile operators.

4 One area of future work is related to network theory. Such an activity can include analysis of these kinds of problems from a theory or methodological perspective in order to add to existing theories or to identify new areas where theory need to be developed.

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APPENDIX I: Questionnaire Distribution and Retrieval

S/N	**Group**	**Number Administered**	**Number Retrieved**	**Acceptance Number**	**% of Success**
	Total	168	164	164	97.6

Source: Field survey, 2014