

**THE EFFECTS OF COLOCATION ARRANGEMENT ON COST
EFFICIENCY OF SELECTED GSM FIRMS IN NIGERIA**

BY

DAWODU BAMIDELE FRIDAY

MATRICULATION NUMBER: 20094717238

**SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES
FEDERAL UNIVERSITY OF TECHNOLOGY (FUTO), IN PARTIAL
FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF
MASTER OF SCIENCES DEGREE (M.Sc) IN INFORMATION
TECHNOLOGY IN THE INFORMATION AND MANAGEMENT
TECHNOLOGY DEPARTMENT**

APRIL 2012

CERTIFICATION

This is to certify that the Thesis titled The Effects of Colocation Arrangement on Cost Efficiency of selected GSM firms in Nigeria submitted to the School of Postgraduate Studies Federal University of Technology (FUTO), in partial fulfillment of the requirement for the award of Master of Sciences Degree (M.Sc) in Information Technology in the Information and Management Technology Department is a record of the original work carried out by **DAWODU BAMIDELE FRIDAY** with registration number **20094717238**.

Sign:

Dr Asiegbu B.C

(Project Supervisor)

Date

(Head of Department)

Date

(Dean of SMAT)

Date

(Dean PG School, FUTO)

Date

External Examiner

Date

DEDICATION

This Thesis is dedicated to Jehovah God.

ACKNOWLEDGEMENT

I acknowledge the effort of B.C Asiegbu (PhD) my project supervisor for his tireless effort towards the actualization of this research work. I thank staff and students of FUTO for their assistance during the programme especially Nwakama Cosmos, Kizito Anyiam, Ikerionwu Charles, Kingsley Egbukole, Osondu Mary and others.

ABSTRACT

This research work focused on the effects of Colocation arrangement on Cost Efficiency of selected GSM firms in Nigeria. The sources of data for this research work were exclusive primary data sources. Primary data sources for this research work were obtained from structured and standardized copies of questionnaire targeted to 200 respondents. The respondents are professionals or stakeholders in the area of the research interest. Data collected were subjected to multiple regression analysis. On the basis of the multiple regression output, a relationship model was estimated. It was found from the results of the study that colocation arrangements as a whole and (or) individually has significant effect of cost efficiency. This significance was attributed to the following aspects of colocation arrangements: security arrangement and spectrum sharing arrangement. Other colocation arrangements such as Network operations arrangement, Core Network arrangement and Human resources arrangement were significant. We therefore make the policy recommendations: (i) the Regulatory body (NCC) should standardized the telecommunication system platforms in Nigeria (ii) Elimination of the monopolistic behaviours by the regulator (iii) Granting of more colocation licences to third party companies (iv) the collocatees should jointly secure sites (v) the collocatees must provide adequate maintenance culture with regard to hardware and software resources (vi) Effective and efficient training and re-training programmes be organized for their staff. We then conclude that when these policies are put in place the following will be the benefits in the telecom sector: (i) Reduction in negative enviromental and health hazards (ii) Optimization in the use of scarce national resources (iii) Shift in focus to service-based innovation instead of network deployment (iv) Releasing of capital for strategic investments (v) Decrease in the barriers to market entry for new entrants

LIST OF ABBREVIATIONS

ARPU	Average revenue per user
AUC	Authentication Centre
BSC	Base Station Controller
BSS	Base Station System
BTS	Base Transceiver Station
CAPEX	Capital expenditures
EBITDA	Earnings before interest, tax, depreciation and amortization
EIR	Equipment Identity Register
GIS	Geographic Information System
GSM	Global System for Mobile Telecommunication
HLR	Home Location Register
HLR	Home Location Register
HLR	Home Location register
HR	human resource
ICT	Information and Communication Technology
ISDN	Integrated Services Digital Network
LA	Location Area
LGA	Local Government Authorities
ME	Mobile Equipement
MS	Mobile Station
MSC	Mobile services Switching Centre
MVNO	Mobile Virtual Network Operator
NCC	Nigerian Communications Commission
NITEL	Nigeria Telecommunication Limited
NMC	Network Management Centre
NSS	Network Switching System
OMC	Operations and Maintenance Centre
OPEX	operational overheads / cost
PLMN	Public Land Mobile Network service area
PSTN	Public Switched Telephone Network
PTOs	Public Telecommunication Operations
RBV	Resource-based theory
ROA	Revenue-on-assets
ROI	Return on investment
SG	State Government
SHE	Safety health and environment
SHRM	Strategic human resource management
SIM	Subscriber Identity Module
SNH	Strategic necessity hypothesis
WECA	West and Central Africa
VLR	Visitor Location Register

TABLE OF CONTENTS

Title Page	i
Certification Page	ii
Dedication	iii
Acknowledgement	iv
Abstract	v
List of abbreviations	vi
Table of content	vii
List of Tables	viii
List of Figures	ix

CHAPTER ONE: INTRODUCTION

1.1	Background of the Study	1
1.2	Statement of the Problems	3
1.3	Objectives of the Study	4
1.4	Research Questions	5
1.5	Research Hypothesis	5
1.6	Scope / Limitations of the Study	6
1.7	Significance of the Study	7
1.8	Historical Development of the Nigeria Telecommunication Industry	8
1.9	Colocation Arrangement and Benefits for GSM Firms in Nigeria	15

CHAPTER TWO: LITERATURE REVIEW

2.1	Theoretical Framework of the Study	19
2.1.1	Theoretical Framework of the Effects of Colocation Arrangement	19
2.1.1.1	Resource Based Theory	19
2.1.1.2	Strategic Necessity Hypotheses	58
2.2	Conceptual Framework of the Study	63
2.2.1	The GSM Mobile Network Architecture	66
2.2.2	GSM Network Components	66
2.2.3	Mobile Service Switching Centre	69
2.2.4	Home Locator Register	70
2.2.5	Visitor Location Register	70
2.2.6	Authentication Centre	70
2.2.7	Equipment Identity Register	71
2.2.8	The Network Monitoring Centres	71
2.2.9	Operations and Maintenance Centre	71
2.2.10	Network Management Centre	72
2.2.11	Mobile Station	72
2.2.12	GSM Geographical Network Structure	74
2.2.13	The Cell System	74
2.2.14	Location Area	74
2.2.15	MSC Service Area	75
2.2.16	PLMN Service Area	75
2.2.17	GSM Service Area	75
2.2.18	GSM Frequency Bands	76
2.2.19	GSM Operators Business Model	77
2.2.19.1	Infrastructure	78
2.2.19.2	Offering	79

2.2.19.3	Customers	79
2.2.19.4	Finance	79
2.2.19.5	Business Value Drivers of GSM Operators	80
2.2.19.6	Value Drivers	81
2.2.19.7	Mobile Subscribers Growth	82
2.2.19.8	Operation Profit Margins	83
2.2.19.9	Revenue Growth	84
2.2.19.10	Average Revenue Per User	84
2.2.19.11	EBITDA- Earnings Before Interest, Tax, Depreciations and Amortizations	85
2.2.19.12	Depreciations	86
2.2.19.13	Return on Assets	89
2.2.19.14	Asset Performance	91
2.2.19.15	Return on Assets	91
2.2.19.16	Capital Expenditure	92
2.2.19.17	Core Network Expenses	93
2.2.19.18	Operating Expenses	94
2.2.19.19	Goodwill and Other Intangible Assets	95
2.2.19.20	Cash Flow	96
2.2.19.21	Cost of Capital	96
2.2.19.22	Human Resource	97
2.2.19.23	Telecoms Infrastructure Categories	100
2.2.19.24	Infrastructure Sharing Models	99
2.2.20	Passive Infrastructure Sharing	100
2.2.21	Active Infrastructure Sharing	101
2.2.22	Spectrum Sharing	101
2.2.23	Mobile Virtual Network Operator	102
2.2.24	National Roaming	102

2.2.25	Tower Companies	102
2.2.26	The Driver for Infrastructure Sharing	103
2.2.27	The Regulatory Perspective	104
2.2.28	The Competitive Perspective	106
2.3	Hindrance to Infrastructure Sharing	107
2.3.1	Use of Different Suppliers in Value	107
2.3.2	Use of Inferior Equipments	108
2.3.3	Monopolistic Behaviours among Big Players	108
CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY		
3.1	Research Methodology	109
3.2	Research Design	111
3.3	Sources of Data	112
3.4	Method of Data Collection	112
3.4.1	Method of Primary Data Collection	113
3.4.2	Population of Study and Sample Survey	115
3.4.3	Questionnaires Distribution	116
3.5	Method of Data Analysis	116
3.5.1	Multiple Regression Analysis	116
3.5.1.1	Test of Hypotheses 1 and 2	117
3.5.1.2	Test of mode Analysis of Variance (ANOVA)	118
3.5.1.3	Test of Model for Coefficient of Determination and F-Test approach	119
3.5.2	Discriminant Function Analysis	121
3.5.3	Formulation of Model for Analyzing Effects	123
3.5.4	Step-wise Discriminant Function of Analyses	123
3.5.5	Validity of Research Instrument	124
CHAPTER FOUR: RESEARCH FINDINGS AND INTERPRETATIONS		
4.1	Research Findings	125

4.2	Data Collection and Analysis	125
4.3	Questionnaire Analysis	126
4.4	Model Estimation and Hypothesis Testing	133
4.4.1	Relationship Model and Interpretation	136
4.5	Result discussion	137
4.5.1	Hypothesis Result Discussion	137
4.5.2	Result Discussion of Research Questions	130
4.6	Cost Implications of Colocating GSM Resources	140
4.6.1	Result Implications and Strategies of Colocation in Nigeria	142
4.6.1.1	Proposed Colocation Strategies	142
4.6.1.2	Sharing the Electrical Energies Supplies	143
4.6.1.3	Sharing of the Air Conditioning	144
4.6.1.4	Sharing of Towers	144
4.6.1.5	Sharing of Links	145
CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS		
5.1	Discussion	147
5.2	Recommendations	150
5.2.1	Increase in Commitment from the regulators	150
5.2.2	Standardization of the Telecoms System Platforms	151
5.2.3	Elimination of the Monopolistic Behaviours by the Regulators	151
5.1.4	Granting of more Colocation Licenses to Third Party Competitors	152
5.2	Conclusion	155
5.3	Further Research Areas	155
References		157
Appendix		172

LIST OF TABLES

Table2.1:	Examples of mobile infrastructure components	101
Table 3.1:	Likert five-point table	115
Table 3.2:	The ANOVA analysis table	120
Table 4.1:	Gender of respondents table	127
Table 4.2:	Age of respondents table	128
Table 4.3:	Nationality of respondents table	128
Table 4.4:	Race of respondents table	129
Table 4.5:	Educational Background of respondents table	130
Table 4.6:	Response to Question 6	130
Table 4.7:	Response to Question 7	131
Table 4.8:	Response to Question 8	132
Table 4.9:	Response to Question 9	132
Table 4.10:	Response to Question 10	133
Table 4.11:	Response to Question 11	133
Table 4.12:	Model summary of the constructs	135
Table 4.13:	ANOVA for the constructs	135
Table 4.14:	Colocation aspect and total cost regression analysis	136
Table 4.15:	Summary of values for the constructs	137
Table 4.16	The table shows the results of the hypothesis	138
Table 5:	Table showing the properties of the software used for regression analysis	172
Table 6:	Mean and Std. deviation descriptive statistics results	173

Table 7: This table shoes result of correlations	173
Table 8: The table showing how the variables were entered / removed	174
Table 9: The table shows the model summary of the F-test	175
Table 10: This table shows the ANOVA table	176
Table 11: showing Total cost when regressed with Core Network Aspect	177
Table 12: showing Total cost when regressed with Network Operations Aspect	177
Table 13: showing Total cost when regressed with Human Resources Aspect	178
Table 14: showing Total cost when regressed with Spectrum Sharing Aspect	178
Table 15: showing Total cost when regressed with Security Aspect	179
Table 16: Table showing Collinearity diagnostics	180
Table 17: Table showing the result of Residual Statistics	181

LIST OF FIGURES

Figure 1.1:	Subscribers lines in Nigeria	8
Figure 1.2:	Market shares of mobile operators in Nigeria	9
Figure 1.3:	Traffic in minutes of users in Nigeria	10
Figure 1.4:	Trends in private infrastructure investments in Nigeria Telecoms	11
Figure 1.5:	Trends in private infrastructure deployment in Nigeria Telecoms	13
Figure 1.6:	MTN Groups subscriber growth	14
Figure 1.7:	CAPEX Cost saving	17
Figure 1.8:	OPEX Reduction	17
Figure 2.1:	GSM Network showing access and core network	63
Figure 2.2:	The BSC Cabinet system	67
Figure 2.3:	The BTS system of the GSM Network	67
Figure 2.4:	BTS System controlled by BSC in the GSM Network	68
Figure 2.5:	The mobile station subsystem of the GSM Mobile network	72
Figure 2.6:	The GSM Mobile network sharing main components	73
Figure 2.7:	The GSM Service area showing sub areas	76
Figure 2.8:	Alexander Osterwalders' Business model design template	78

CHAPTER ONE

INTRODUCTION

1.1 The Background of the Study

The growth of the telecoms market in Nigeria has continued to expand at geometric rates thereby sustaining the market as one of the fastest growing telecom market globally is a task. This growth however has brought with it a huge cost burden on telecom investors and operators as they continue to expend huge capital expenditures on telecom assets and infrastructure in a bid to gain and sustain competitive advantage. Colocation involves the sharing of resources among competing investors on the same site (or location), and this concept is practiced in the telecomms business.

Today, as the telecom market in Nigeria nears maturity, the average revenue per user (ARPU) and revenue-on-assets (ROA) indices begin to dip, telecom operators in Nigeria are beginning to desperately explore new ways of reducing their capital expenditures (CAPEX) and operational overheads / cost (OPEX) on telecom infrastructure (World Bank, 2008).

Presently, key players in the Nigerian telecom industry are now resorting to sharing network infrastructure as a strategy to achieve substantial reduction in their CAPEX and OPEX burden and hence, be able to survive and realise better returns on their investments. Also, the Nigerian Communications Commission (NCC) has given its support to this new model and has also developed a regulatory framework for potential colocatees to share infrastructure in order to promote fair competition and promote infrastructure sharing amongst telecom licensees (NCC, 2004). Sharing of telecommunication infrastructure among

telecom service providers is becoming the requirement and process of business in the telecoms' industry where competitors are becoming partners in order to lower their increasing investments cost (MCI, 2009). The degree and method of infrastructure sharing can vary in each country depending on regulatory and competitive climate. The question being asked in the developed world is whether the developing countries like Nigeria can harness and sustain the telecommunication boom. The high cost of building telecom infrastructure in view of expansion and market entry remains a major concern in the industry in Nigeria (Emeka, 2009).

The growth in this sector is dramatic and the trend is aggressively on the upwards swing. With the improved performance in the communication sector in the last twelve (12) years, there is a widespread optimism among participants in this sector of a brighter future for business outlook (Motorola, 2006). Current statistics on communication services appear to support the optimism expressed by the participants.

Statistics also show a continued pattern of significant rise in demand outstripping the capacity of the operators to expand their infrastructures. The cost of building infrastructure remains ever so high and militates against the progress in the rollout of more capacity and coverage. The cost of sharing facilities and collocating GSM resources is reasonable less when compared to the cost of building one's own infrastructure. Hence, a faster return on investment (ROI) and an opportunity to focus more on core business of the companies which is providing telecom services.

1.2 Statement of the Problem

The unrestricted incidences of masts and towers all over Nigeria are partly due to the failure of the Nigeria Telecommunication Limited (NITEL) to live up to its duties and responsibilities in the telecom sub-sector in over 45 years of her existence. The situation has left players in the sub-sector to literally fend for themselves. They build their own telecom infrastructure including the construction of masts, towers, signal relays, repeaters and cell sites.

Since telecom infrastructure of whatever sort is capital intensive from a business point of view, it becomes more difficult for Information and Communication Technology (ICT), Public Telecommunication Operations (PTOs) and Global System for Mobile Telecommunication (GSM) companies in Nigeria to operate profitably and making expansion plans towards meeting subscribers' growth even more difficult. There is also the constraint in getting approval from Local Government Authorities (LGA) and State Government (SG) in the laying of transmission links such as cables and fibre and building communication towers in their domain (Francis, 2001).

The Nigerian telecoms industry has undergone very rapid growth in the past twelve (12) years and the mobile telecom sector has been identified as the major driver for this impressive growth. Currently, the Nigerian tele-density stands at 51.4% from 16.7% in 2000. The mobile telephony sector contributes 87.9% of the share of the active lines in Nigeria. The Nigerian population stands at 140 million. As a result of the high demand for mobile services operators are under pressure to invest heavily in infrastructure in order to expand their coverage and capacity in order to serve their customers. However, the high operational and

capital expenditures have negatively impacted on their bottom line. Hence, the need for telecom operators to develop new business models to enable them save CAPEX and OPEX costs. Telecommunication infrastructure sharing is a viable business model for CAPEX and OPEX saving and has been proven to save operators costs by approximately 30 - 40 % of costs incurred where operators rollout network infrastructure on their own.

Hence, telecom operators are encouraged to share infrastructure as a means of avoiding unnecessary duplication of infrastructures. Savings achieved via infrastructure sharing could be used to employ better staff, improve network service and introduce value added service and product offerings that would lead to new streams of revenue generation (Hussain, 2009). This project work will try to solve the following problems:

1. The problem of high cost of network infrastructure rollout and capacity expansions by telecom operators in Nigeria.
2. The problem of inefficient and ineffective usage of telecom infrastructure by telecomm operators in Nigeria.
3. The problem of high cost of operational expenditures (OPEX) dissipated by telecom operators in Nigeria.
4. The problem of poor quality of service and security

1.3 Objective of the Study

The central objective of the study is to examine the effect of colocation arrangement on cost efficiency of selected GSM firms in Nigeria. The specific objectives of the study are as follows:

- i. Identify various aspects of colocation
- ii. To examine the collective effect of all aspects of colocation on achieving cost efficiency
- iii. To examine the individual effect of each aspect of colocation on achieving cost efficiency
- iv. To make policy recommendations based on the findings of the study

1.4 Research Question(s)

Based on the statement of the problem, the objectives of the study and the researcher pose the following questions:

- i. To what extent do the collective aspects of colocation affect cost efficiency of GSM firms in Nigeria?
- ii. To what extent does individual aspect of colocation affect cost efficiency of GSM firms in Nigeria?

1.5 Research Hypothesis

On the basis of the statement of problem, objectives of the study and research questions, the following hypothesis have been formulated:

Ho₁: the collective aspects of colocation arrangement among GSM firms in Nigeria have no significant effect on cost efficiency.

Ho₂: the individual aspect of colocation arrangement among GSM firms in Nigeria has no significant effect on cost efficiency

1.6 Scope / Limitations of the Study

This study will be restricted to a survey of GSM operators' staff and users who use GSM facilities and services in the six (6) geo-political regions of Nigeria.

The limitations faced in the course of carrying out these studies are:

- i. Limited time
- ii. Inadequate literature and materials
- iii. Reluctance on the part of staff and customers to speak their minds freely
- iv. Lack of adequate funds

This research faced some other limitations which might influence the validity and reliability of the results of the study. First of all, infrastructure sharing is a relatively new phenomenon or business arrangement in the Nigerian telecom industry. Hence, finding telecomm service providers who are involved in infrastructure sharing was quite difficult except for MTN and Airtel who seem to be the major pioneers in the mobile telecomm industry. The use of the MTN / Airtel colocation arrangement could pose external validity problems as to the generalizability of the findings and results for other telecommunication service providers as many more operators are yet to explore or implement the infrastructure sharing model in their business plans (Emeka, 2009).

Considering the fact that both headquarters of the two telecommunication firms were situated quite far away from each other (20 kilometres on the average) and hence what it takes financially to reach many different departments of both companies knowing that business schedule constraints make several trips to and fro both headquarters inevitable. In order to circumvent this bottleneck. The

researcher had to devise an easier way by reducing the sample size of respondents and copies of the questionnaire. Hence, adopting a convenience representative sampling method.

1.7 Significance of the Study

There is a growing need for GSM operators and providers in the Nigerian telecommunication 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 the basis of mutual agreements to consider sharing infrastructure. The telecommunication market in Nigeria is driven by growing demand for telecom services like voice, SMS, data services like internet, fax etc as well as high broadband services like video calling, video messaging and video conferencing.

This research study is aimed at determining the effect of colocation arrangement on cost efficiency of selected GSM firms in Nigeria. The research is based on a case study analysis of the current colocation arrangement between MTN Nigeria Ltd and Airtel Nigeria Ltd. The study seeks to explore the benefits of the infrastructure sharing deal between these two companies as well as recommend an improved or enhanced framework or model to sustain this strategy model in the context of the Nigerian telecom industry. The research work will rely on data collected using questionnaires.

The findings of the research work will help GSM operators to face and solve challenges that include theft and vandalism of equipment as well as

pressure from authorities to reduce the number of towers scattered all over the country. The findings of the research will help operators greatly to reduce cost of operations, duplication of equipment and waste of scarce resources.

1.8 Historical Development of the Nigeria Telecommunication Industry

The Nigerian telecommunication sector has undergone very rapid change and explosive growth over the past twelve (12) years mainly due to the liberalisation of the sector and the resulting competition by private operators bringing about very substantial benefits to subscribers in terms of reduced tariffs (prices) and enhanced choice (NCC, 2008).

In 2004, the Nigerian telecom sector received global acclaimed status as one of the fastest growing mobile markets in the world. The mobile sector has been particularly pivotal (key) to the growth of telecoms in Nigeria, developing from a 30,000-line subscriber base at the beginning of the millennium to 8.5 million connections at the end of 2004 (NCC, 2005). Today, Nigeria has an average of 70 million line subscriber base.

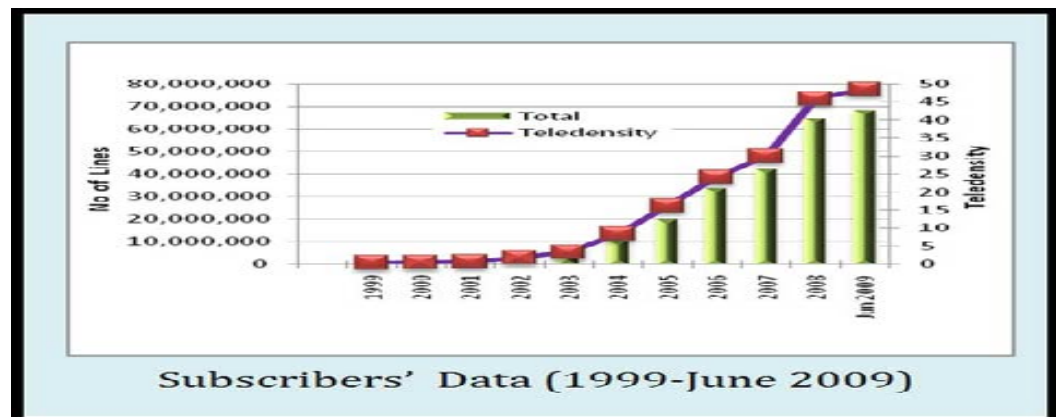


Figure 1.1 Subscriber lines in Nigeria(1999 – June 2009)

Source: NCC©2008

Nigeria is now officially the largest growing market for telecom services in Africa and Middle East and, possesses the most vibrant fixed and mobile telephony companies in Africa (NCC, 2008). For the past twelve (12) years the total subscriber base for connected fixed and mobile lines have risen from 2,271,050 at year-end 2004, an average growth rate of 12.5% annually and today, we have an average of 70 million active subscriber base.

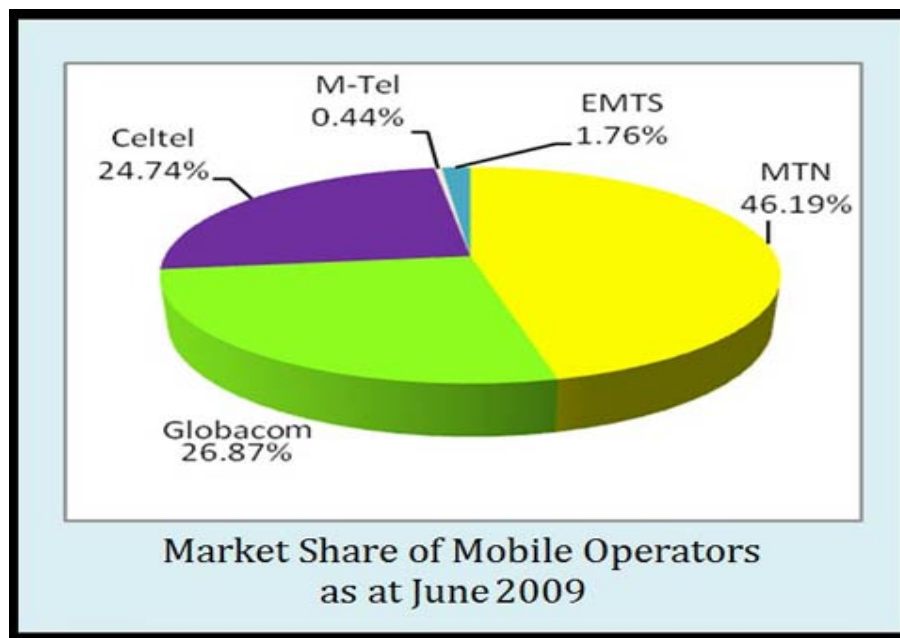


Figure 1.2. Market Share of Mobile Operators in Nigeria

Source: NCC©2008

Yet the demand of more subscribers continues to rise in Nigeria, Africa's most populous country (over 140 million people). There is substantial evidence showing the deep quest by consumers not just for lines but also for good quality services from the operators, a quest many operators are making attempts to satisfy through continuous infrastructure investments (NCC, 2008).

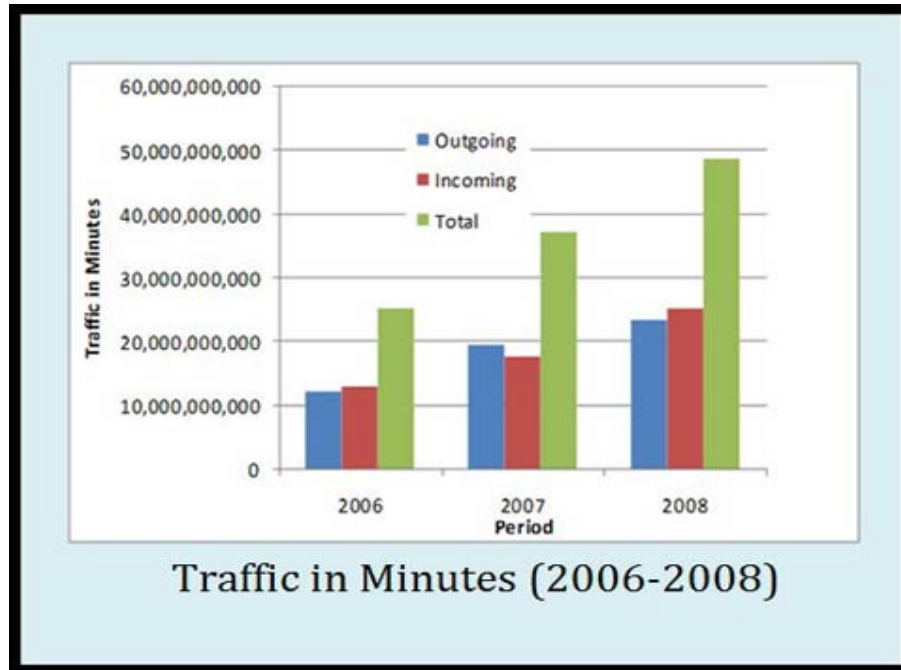


Figure 1.3 Traffic in Minutes of Use in Nigeria

Source: NCC©2008

In spite of this growing trend in the telecommunication sector in Nigeria, the following issues have been observed as major sources of impendence to continuous future growth of the industry:

Poor public power supply;

Poor security, as infrastructure are often vandalized;

High import duty, as duties on telecommunication equipment are in the regimes of 30-70%;

Anti-competetive practices, with some operators alleged to be forming cartels to frustrate the natural interplay of market forces;

The type and quantum of funds needed by operators to expand operations is scarce locally; and;

High operational costs (NCC, 2008).

According to the Nigerian Communications Commission (NCC), investment into the Nigerian telecom sector has grown from US\$50 million to over US\$12 billion over the last twelve (12) years. The growth in terms of investment in the telecom sector in Nigeria is as displayed below:

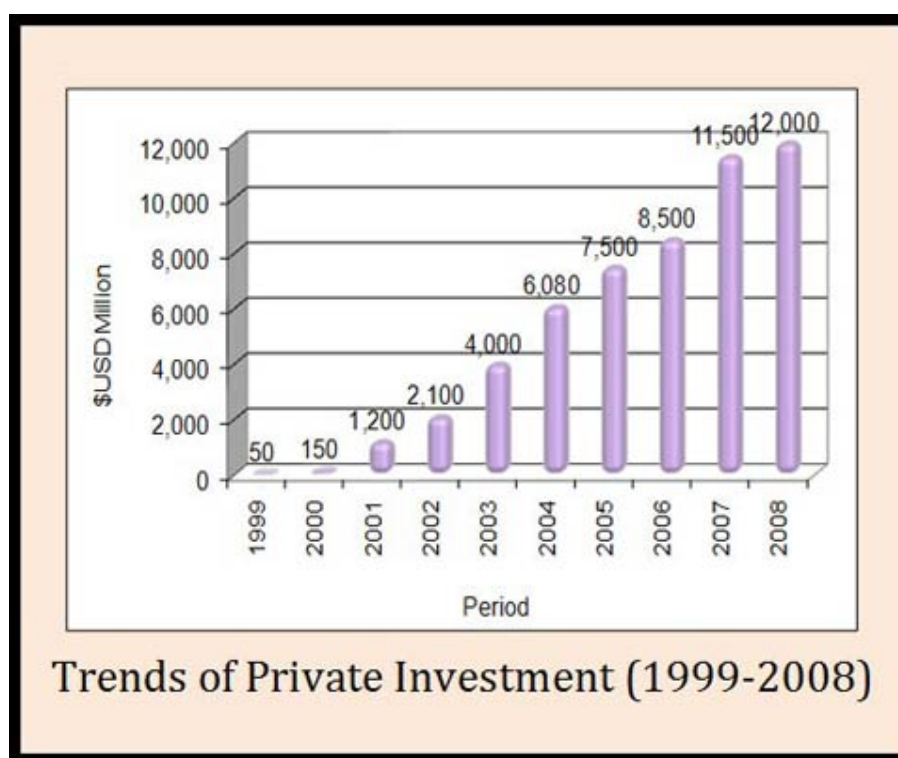


Figure 1.4. Trends of Private Telecommunication Investment in Nigeria

Source: NCC©2008

Principal corporate investors in the mobile telephony business include First Bank, Stanbic IBTC Bank, Zenith Bank, Diamond Bank, Standard Chartered Bank among others, as well as several State governments, notably Lagos State, Delta State, and Akwa-Ibom State of Nigeria have invested heavily in the telecomms sector. Nigerian banks also regularly form syndicates to provide working capital for many telecom companies in the absence of adequate offshore

(foreign) facilities. A snapshot of announced investments, contracts and deals between 2003 and 2004 is as stated below:

€675 million turnkey contract awarded in February 2003 by Globacom to the French vendor Alcatel, for the installation of 1 million mobile lines, 100,000 fixed lines, 3 international gateways and a national fibre-optic backbone.

US\$395 million facility to MTN Nigeria by a syndicate of 14 Nigerian banks led by StanbicIBTC Bank, and Standard Chartered Bank(London) in November 2003, as part of MTN's US\$1.3million capital expenditure budget.

US\$250 million facility to MTN by another consortium led by GTB Bank in October 2004, for network infrastructure.

US\$70 million network upgrade investment by Starcomms in March 2003, in seaparate contracts to LM Ericsson and Huawei Technologies.

US\$120 million equipment finance deal between LM Ericsson and Vmobile(now Airtel Nigeria) in 2003 , for the installation of a north and south transmission backbone.

US\$200 million contract awarded by Globacom to Siemens, for network installation in Northen Nigeria in February 2003.

US\$17 million wireless network provisioning contract to Harris Networks by Odua Tel, in January 2003.

US\$110 million radio network contract awarded by Vmobile(now known as Airtel Nigeria) in February 2004 to LM Ericsson.

US\$145 million network expansion contract awarded by RelTel(now known as ZoomMobile) in April 2003 to LM Ericsson.

US\$53 million GSM contract awarded by NITEL to LM Ericsson in April 2003.

US\$7 million investment by Huawei in establishing a multi-product training centre in Abuja.

Cumulative US\$650 million network investment by MTEL as at April 2004, in separate contracts to Motorola, ZTE, Huawei and LM Ericsson.

US\$12 million network upgrade contract awarded by InterCellular to Motorola in July 2003.

MTN Group declared that it spent US\$620 million on capital expenses incurred by its Nigerian operations between March and September 2004. Amount spent was mainly used to build 344 base stations and 6 switches.

Today, the telecoms infrastructure deployment growth trend by private investors have continued to grow due to the high demand by the teeming mobile subscriber users as well as the quest by telecommunication operators to gain market share through increased network deployment, and expansion in a bid to achieve better coverage and capacity.

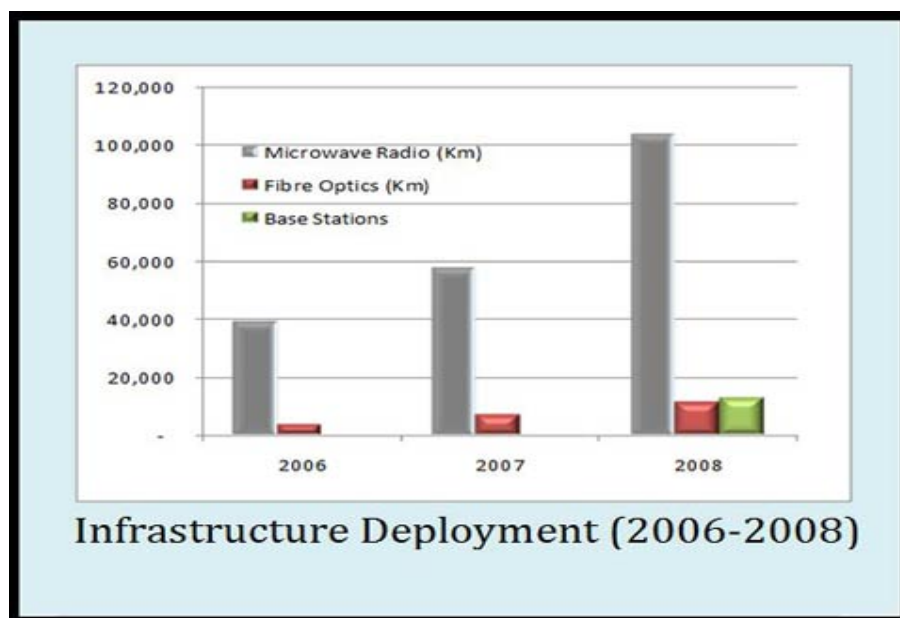


Figure 1. 5. Trends in Private Infrastructure Deployment in Nigeria Telecommunication

Source: NCC©2008

For instance, MTN Group currently has well over 90.7 million subscribers spread across three of its major operational regions, viz: South and East Africa (contributing 24 million subscribers), Middle East and North Africa (contributing

26 million subscribers), and West and Central Africa (WECA) contributing 40 million subscribers (MTN Group Results, 2008).

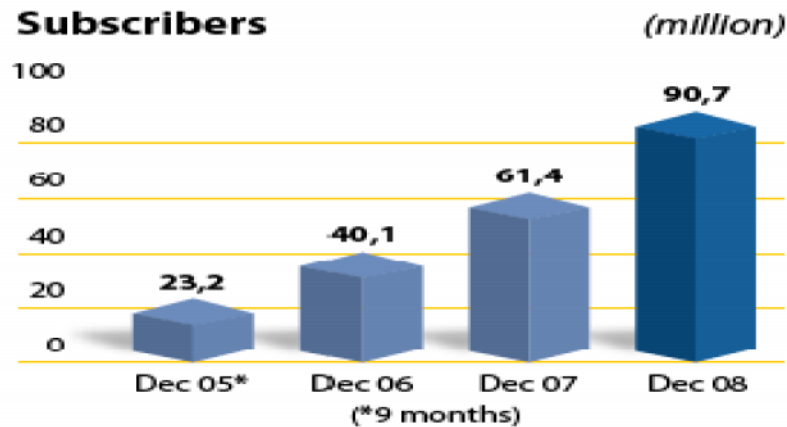


Figure 1. 6. MTN Group Subscriber Growth

Source: MTN Group Results, 2008

Of the 40 million subscribers in the MTN (WECA) region, MTN Nigeria contributed 23.1 million at the end of december 2008. MTN said that there was significant and aggressive network rollout in 2008, gaining strong momentum during the second half of that year, and significantly improved the network quality by providing an enabling increased network connections in the last quarter of 2008. Capital expenditure grew from R4.8 billion in 2007 to R9.8 billion. MTN Nigeria rolled out 1,560 BTS's bringing the total to 4,776. To further improve the network 1,170km of new metro and national fibre was implemented on key routes. Again showing an increase in the trend of telecommunication infrastructure rolled out, expanded and deployed. The Airtel Group expended a capital investment to the tune of \$579 million in telecom infrastructure at the year end december 2008 (Airtel Group Results, 2008).

1.9 Colocation Arrangements and Benefits for GSM Firms in Nigeria

At the inception of the democratic dispensation in May 1999, Nigeria had a total of less than 850,000 telephone lines. Since then, the tempo of communication activities in Nigeria has increased considerably. The telecom sub-sector has been responsible for Nigeria's new-found image. Regionally and internationally, Nigeria has gained admiration for the galloping growth in her telecoms sector. Perhaps what has attracted the attention of the international investor community is the transparency of the process that gave rise to the growth in mobile telephony. The digital mobile phone operator license (GSM) auction of January 2001 in which winners emerged and paid a princely ransom of \$285,000,000.00 each. This has been one investment which has been worth while to Nigeria's economic growth. This signaled the seriousness of and importance with which the government considered the need to ensure rapid growth of the sector. It is now known that the Nigerian mobile sector is the fastest growing in Africa if not the world (Badir, et al, 2001).

The growth in this sector is dramatic and the trend is aggressively on the upwards swing. With the improved performance in the communication sector in the last twelve (12) years or so, there is a wide-spread optimism among participants in this sector of a brighter future for business outlook. Current statistics on communication services appear to support the optimism expressed by the participants. Statistics also show a continued pattern of significant rise in demand outstripping the capacity of the operators to expand their infrastructures.

The cost of building infrastructure remains ever so high and militates against the progress in the rollout of more capacity and coverage. This is different

in developed countries, where operators, new and old do not have to face the worries of building cost of communication infrastructure. Backbone telecom infrastructure and other communications facilities are mainly available and provided for sharing and colocation of operators. The cost of sharing facilities and colocating is reasonable less costly when compared to the cost of building one's own infrastructure. In order to meet the increased communications infrastructures sites rollout demand, statutory requirements for infrastructure sharing and harness economic advantages derivable from colocation and sharing telecom infrastructure, it is important for operators to explore the possibility of site infrastructure colocation with other telecoms operators.

The main argument in favour of colocation and infrastructure sharing put forward by the Nigerian telecoms regulator (NCC) is that of improving quality of service rendered by telecom operators as well as reducing expenditure. Others include revenues obtained through monetization of non-core assets, faster time to market for new entrants and thus the ability to focus on customer service and core business. It believes that with infrastructure sharing and colocation, operators can achieve competitive tariffs for customers, rollout in less attractive areas, and control excessive proliferation of towers and masts (that make the sky-line untidy) in urban areas while encouraging competition (Bala-Gbogbo, 2009). However, telecom operators generally appreciate and welcome infrastructure sharing due to the cost savings that it brings with it (Chanab et al, 2007).

Another telecom expert Ghandhi believes that "the sharing of passive infrastructure will allow service providers to focus on their core sales / marketing areas (Benjamin et al, 1993). This will also free up management time at the carriers. Passive infrastructure sharing will allow operators to defer their tower-

related CAPEX investments into OPEX lease rental payments over an extended period of time.

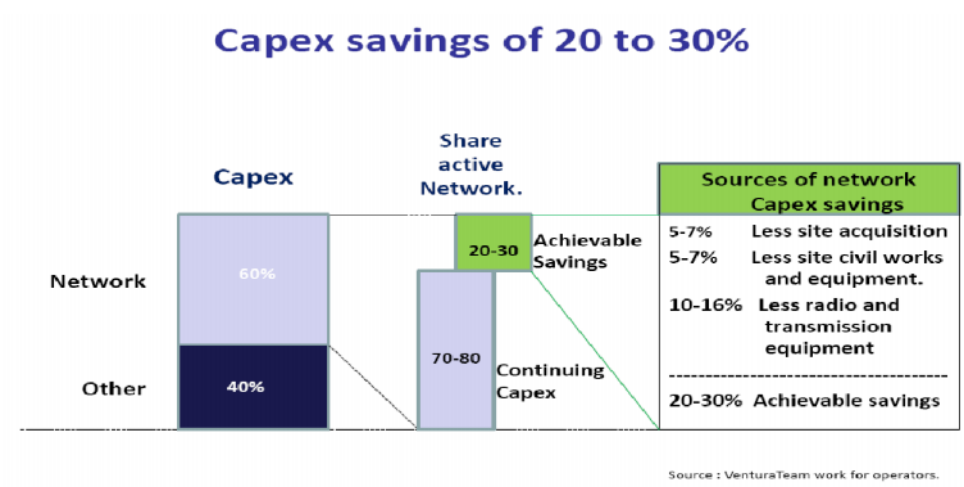


Figure 1.7 : CAPEX Cost Savings

Source: Ventura 2009

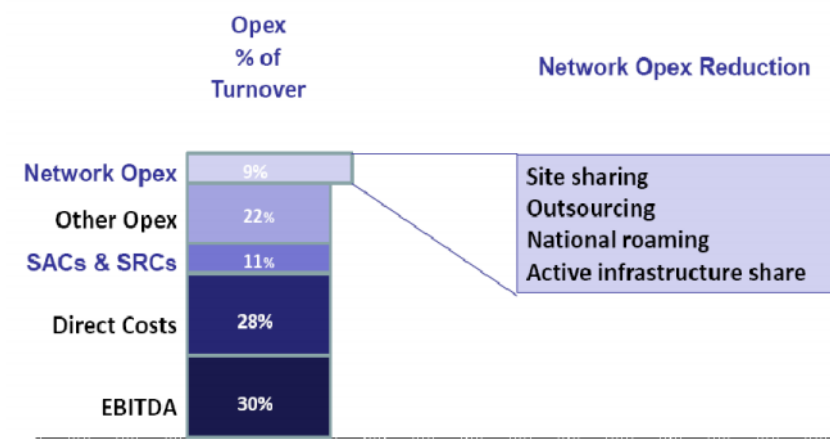


Figure 1.8 : OPEX Reduction

Source: Ventura 2009

Other benefits put forward by other experts include the following:

Releasing of capital for strategic investments: Spinning of the network into an independent company will allow incumbents to focus on customer-centric activities while releasing cash for new strategic investments.

Decrease in the barriers to market entry for new entrants: When infrastructure sharing policy is in place, entry barriers for potential market new entrants will be significantly lowered, hence, making the telecom market more attractive to new investors and players.

Shift in focus to service-based innovation instead of network deployment: Through the reduction in the cost burden imposed by massive network deployments as well as its attendant huge operational costs incurred, infrastructure sharing will also allow operators to turn their attention to improved innovation, improved customer service and eventually get better commercial service offerings and a healthier competition.

Expansion of investments to less dense areas and meeting of universal service targets through infrastructure sharing, operators can use the cost savings harvested from CAPEX and OPEX to undertake network expansions and capacity building in the unreached rural areas.

Optimization in the use of scarce national resources: Infrastructure sharing in its basic forms will result in better use of scarce national resources, such as rights of way and in its more complex forms will allow for better use of spectrum.

Reduction in negative environmental and health hazards: From the environmentalists and health interest groups perspectives, infrastructure sharing and colocation will lead to less network buildup meaning better or improved skyline and lesser potential emissions and radiations harmful for the public and the environment.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical Framework of the Study

2.1.1 Theoretical Framework of the Effect of Colocation Arrangement

There is a need to examine the effect of colocation arrangement on cost efficiency and its effect on performance of GSM firms. Two theories that have been used to explain the relationship between IT and firms performance are resource-based theory (RBV) and strategic necessity hypothesis (SNH). This research work used these two theories and reviewed them below:

2.1.1.1 Resource-Based Theory (RBV)

The resource-based view (RBV) theory of the firms has influenced the field of strategic human resource management (SHRM) in a number of ways. The human resource function has consistently faced a battle in justifying its position in organizations (Daft, 1983).

In times of plenty, firms easily justify expenditures on training, staffing, reward, and employee involvement systems, but when faced with financial difficulties, such human resource (HR) systems fall prey to the earliest cutbacks. The advent of the sub-field of strategic human resource management (SHRM), devoted to exploring HR's role in supporting business strategy, provided one avenue for demonstrating its value to the firms.

Van et al (1989) call for a link between strategic planning and human resource planning. It signified the conception of the field of SHRM, but its birth came in the early 1980s with Tsang (2000) article devoted to extensively

exploring the link between business strategy and HR. Since then, SHRM's evolution has consistently followed (by a few years) developments within the field of strategic management. For example, Miles and Snow's (1978) organizational types were later expanded to include their associated HR systems (Miles and Snow, 1984). Porter's (1980) model of generic strategies was later used by SHRM researchers to delineate the specific HR strategies that one would expect to observe under each of them (Narvel et al, 1990; Jackson and Schuler, 1975; Irvin et al, 1989).

Though the field of SHRM was not directly born of the resource-based view (RBV), it has clearly been instrumental to its development (Jackson and Schuler, 1977). This was largely because of the RBV shifting emphasis in the strategy literature away from external factors (such as industry position) toward internal firms resources as sources of competitive advantage (Hoskisson, Hitt, Wan and Yiu, 1999). Growing acceptance of internal resources as sources of competitive advantage brought legitimacy to HR's assertion that people are strategically important to firms' success (Makadok, 2001).

Thus, given both the need to conceptually justify the value of HR and the propensity for the SHRM field to borrow concepts and theories from the broader strategy literature, the integration of the RBV of the firms into the SHRM literature should surprise no one. However, two developments not as easily predicted have emerged over the past 12 years.

First, the popularity of the RBV within the SHRM literature as a foundation for both theoretical and empirical examinations has probably far surpassed what anyone expected (Batiz et al, 2005). Second, the applications and implications of the RBV within the strategy literature have led to an increasing

convergence between the fields of strategic management and SHRM (Boston Consulting Group, 1981). Within the strategic literature, the RBV has helped to put “people” (or firm’s human resources) on the radar screen. Concepts such as knowledge (Argote and Hood, 1979; Grant, 1996, Hansen, 1989), dynamic capability (Eisenhardt and Kogut, 1991; Teece, Pisano and Schuen, 1997), learning organizations (Fiol and Lyles, 1985; Hoopes, 2003, Hartly 1998), and leadership (Finkelstein and Hambrick, 1996; Norburn and Birley, 1988; Mahoney et al, 1992) as sources of competitive advantage turn attention toward the intersection of strategy and HR issues.

RBV has been applied to the theoretical and empirical research base of SHRM, and to explore how it has provided an accessible bridge between the fields of strategy and HR. While based in the work of Penrose (1959) and others, Wernerfelt’s (1984) articulation of the resource based view of the firms certainly signified the first coherent statement of the theory. This initial statement of the theory served as the foundation that was extended by others such as Rumelt (1984), Barney (1996), and Dierickx and Cool (1989).

However, Barney’s (1991) specification of the characteristics necessary for a sustainable competitive advantage seemed to be a seminal article in popularizing the theory within the strategy and other literatures. In this article he noted that resources which are rare, valuable, inimitable, and non-substitutable can provide sources of sustainable competitive advantages. Although debates about the RBV continue to wage (e.g., whether the RBV is a theory, whether it is tautological, etc (Priem and Butler, 2001; Barney, 2001) even its critics have acknowledged the “breadth of its diffusion” in numerous strategic research programs (Priem and Butler, 2001a).

With its emphasis on internal firms' resources as sources of competitive advantage, the popularity of the RBV in the SHRM literature has been no exception. Since Barney's (1991) article outlining the basic theoretical model and criteria for sources of sustainable competitive advantage, the RBV has become by far, the theory most often used within SHRM, both in the development of theory and the rationale for empirical research (McMahan, Virick and Wright, 1999, Meru, 2008).

As part of Journal of Management's Yearly Review of Management issue, Wright and McMahan (1992) reviewed the theoretical perspectives that had been applied to SHRM. They presented the RBV as one perspective that provided a rationale for how firm's human resources could provide a potential source of sustainable competitive advantage. This was based largely on what was, at the time a working paper, but later became the Hu (1995); Wright, McMahan and McWilliams (1994).

Almost simultaneously, Cappelli and Singh (1992), within the industrial relations literature, provided an examination of the implications of the RBV on SHRM. Specifically, they noted that most models of SHRM based on fit assume that (1) a certain business strategy demands a unique set of behaviors and attitudes from employees and (2) certain human resource policies produce a unique set of responses from employees. They further argued that many within strategy have implicitly assumed that it is easier to rearrange complementary assets / resources given a choice of strategy than it is to rearrange strategy given set of assets / resources, even though empirical research seems to imply the opposite.

Thus, they proposed that the resource-based view might provide a theoretical rationale for why HR could have implications for strategy formulation as well as implementation (Kogut, 1991).

Shortly thereafter, two articles came out arguing almost completely opposite implications of the potential for HR practices to constitute a source of sustainable competitive advantage. Wright et al. (1994), mentioned above, distinguished between the firm's human resources (i.e., the human capital pool) and HR practices (those HR tools used to manage the human capital pool).

In applying the concepts of value, rareness, inimitability, and substitute ability, they argued the HR practices could not form the basis for sustainable competitive advantage since any individual HR practice could be easily copied by competitors. Rather, they proposed that the human capital pool (a highly skilled and highly motivated work-force) had greater potential to constitute a source of sustainable competitive advantage. These authors noted that to constitute a source of competitive advantage, the human capital pool must have both high levels of skill and willingness (i.e., motivation) to exhibit productive behavior (Lewis et al, 1990; Lee, 2000; Hill, 1998).

This skill / behavior distinction appears as a rather consistent theme within this literature. In contrast, Lado and Wilson (1994) proposed that firm's HR practices could provide a source of sustainable competitive advantage. Coming from the perspective of exploring the role of HR in influencing the competencies of the firms, they suggested that HR systems (as opposed to individual practices) can be unique, causally ambiguous and synergistic in how they enhance firm's competencies, and thus could be inimitable.

Thus, where as Wright et al (1994) argued for imitability of individual practices, Lado and Wilson (1994) noted that the system of HR practices, with all the complementarities and interdependencies among the set of practices, would be impossible to imitate. This point of view seems well accepted within the current SHRM paradigm (Snell, Youndt and Wright, 1996).

Boxall (1996) further built upon the RBV / SHRM paradigm, suggesting that human resource advantage (i.e., the superiority of one firm's HRM over another) consists of two parts. First, human capital advantage refers to the potential to capture a stock of exceptional human talent "latent with productive possibilities". Human process advantage can be understood as a "function of causally ambiguous, socially complex, historically evolved processes such as learning, cooperation, and innovation."

Boxall (1998) then expanded upon this basic model presenting a more comprehensive model of strategic HRM. He argued that one major task of organizations is the management of mutuality (i.e. alignment of interests) to create a talented and committed work-force. It is the successful accomplishment of this task that results in a human capital advantage. A second task is to develop employees and teams in such a way as to create an organization capable of learning within and across industry cycles. Successful accomplishment of this task results in the organizational process advantage (Ghauri, 2008).

Most recently, Lepak and Snell (1999) presented an architectural approach to SHRM based atleast partly in the RBV. They proposed that within organizations, considerable variance exists with regard to both the uniqueness and value of skills. Juxtaposing these two dimensions, they built 2 by 2 matrix

describing different combinations with their corresponding employment relationships and HR systems (Lewis et al, 1990, Hunt, 1995; Hill, 1985).

. The major implication of that model was that some employee groups are more instrumental to competitive advantage than others. As a consequence, they are likely to be managed differently. While the premise of an architectural perspective is rooted in extant research in HR (cf., Baron et al., 1986; Osterman, 1987; Tsui, Pearce, Porter and Tripoli, 1997; Lei, 1996) and strategy (cf., Matusik and Hill, 1998), Lepak and Snell (1999) helped SHRM researchers recognize that real and valid variance exists in HR practices within the organization, and looking for one HR strategy may mask important differences in the types of human capital available to firms (Truss and Gratton, 1994; Malone, 1987; Lippman, 1982; Hofer, 1978).

In essence, the conceptual development within the field of SHRM has leveraged the RBV to achieve some consensus on the areas within the human resource architecture in which sustainable competitive advantage might be achieved. First, the human capital pool refers to the stock of employee skills that exist within a format any given point in time. Theorists focus on the need to develop a pool of human capital that has either higher levels of skills (general and / or firms specific), or achieving a better alignment between the skills represented in the firms and those required by its strategic intent (Hacki, 2001; Hunt, 1995 and 1996).

The actual stock of human capital can and does change overtime, and must constantly be monitored for its match with the strategic needs of the firms. Second, an increasing consensus is emerging among researchers that employee behavior is an important independent component of SHRM. Distinct from skills of

the human capital pool, employee behavior recognizes individuals as cognitive and emotional beings who possess free will. This free will enables them to make decisions regarding the behaviors in which they will engage (Kuropatwa, 2009). This is an important, if subtle, distinction. A basic premise of human capital theory is that firms do not own it; individuals do (Hall, 1992). Firms may have access to valuable human capital, but either through the poor design of work or the mismanagement of people, may not adequately deploy it to achieve strategic impact (Hakansson, 1989).

For example, MacDuffie (1995) focuses on the concept of discretionary behavior. Discretionary behavior recognizes that even within prescribed organizational roles, employees exhibit discretion that may have either positive or negative consequences to the firms (Hall, 1989). Thus, a machine operator who hears a “pinging” has discretion to simply run the machine until something breaks or to fix the problem immediately, and thus save significant down-time. Similar to March and Simon’s (1958) concept of “the decision to contribute” SHRM’s focus on discretionary behavior recognizes that competitive advantage can only be achieved if the members of the human capital pool individually and collectively choose to engage in behavior that benefits the firms (Hall, 1993).

Finally, while many authors describe HR practice or High Performance Work Systems, a broader conceptualization might simply be the people management system. By using the term *system*, this work turn focus to the importance of understanding the multiple practices that impact employees (Wright and Boswell, in press) rather than single practices. By using the term *people*, rather than HR, this work expand the relevant practices to those beyond the control of the HR function, such as communication (both upward and downward),

work design, culture, leadership, and a host of others that impact employees and shape their competencies, cognitions, and attitudes. Effective systems for managing people evolve through unique historical paths and maintain interdependence among the components that competitors cannot easily imitate (Becker and Huselid, 1998; Holey 1997).

The important aspect of these systems is that they are the means through which the firms continues to generate advantage over time as the actual employees flow in and out and the required behaviors change because of changing environmental and strategic contingencies. It is through the people management system that the firms influences the human capital pool and elicits the desired employee behavior. This common interests and provides a framework for developing collaborative effort. The implications of this model is that while a firms might achieve a superior position in any one of the three, sustainable competitive advantage requires superior positions on all three (Hammer, 1993).

This is because of three reasons. First, the value that skills and behaviors can generate requires that they be paired together (i.e., without skills, certain behaviors cannot be exhibited, and that the value of skills can only be realized through exhibited behavior).

Second, it is difficult to conceive of a firm's human capital pool containing both the highest levels of skills and exhibiting optimal behaviors in the absence of an aligned people management system (Holey 1996, Itami, 1987, Hill, 1997).

Finally, the effects of the people management systems are subject to time compression diseconomies (Dierickx and Cool, 1989; Lodge 1986; Kotler, 1994; Kohli, 1990). While these systems might be immediately imitated, a significant time lag will occur before their impact is realized, thus making it costly or

difficult for competitors to imitate the value generated by the human capital pool. This work will later build upon this model to explore how this fits within the larger organization (Loiacon, 2002; Kenova, 2006; Marshai, 1988).

In addition to the many applications of the RBV to theoretical developments within SHRM, this perspective also has emerged as one of the more popular foundations for exploring empirical relationships within SHRM. In fact, one is hard pressed to find any SHRM empirical studies conducted over the past few years that do not at least pay lip service to the RBV. In the interest of brevity, this thesis work will cover a sample of such studies that illustrate the application of RBV concepts to empirical SHRM research. The researcher chose this study either because they specifically attempt to build on resource-based theory or because they tend to be most frequently cited within the SHRM literature and at least tangentially rely on resource-based logic (Mentzer, 2001; Markide, 1996; Hill 1996).

In an early application, Huselid (1995) argued at a general level that HR practices could help create a source of competitive advantage, particularly if they are aligned with the firm's competitive strategy. His study revealed a relationship between HR practices (or High Performance Work Systems) and employee turnover, gross rate of return on assets, and Tobin's Q (Henderson, 1993). That study received considerable attention because it demonstrated that HR practices could have a profound impact on both accounting and market based measures of performance.

Koch and McGrath (1996) took a similar logic in their study of the relationship between HR planning, recruitment, and staffing practices and labor productivity. They argued that ". . . a highly productive work-force is likely to

have attributes that make it a particularly valuable strategic asset,” They suggested firms that develop effective routines for acquiring human assets develop a stock of talent that cannot be easily imitated. They found that these HR practices were related to labor productivity in a sample of business units, and that this relationship was stronger in capital intensive organizations (Henderson, 1993).

Boxall and Steeneveld (1999) conducted a longitudinal case study of participants in the New Zealand engineering consultancy industry. They suggested that one of the firms in the industry had achieved a superior competitive position because of its human resource advantage in 1994, but that by 1997 two of the competitors had caught up in the competitive market-place.

They posited that this could mean that either the two competitors had been able to successfully imitate the former leaders’ human resource advantage, or that the former leader has developed an advantage about which there is presently uncertainty, but which will be exploited in the future.

Diverging from the focus on HR practices, Wright, McMahan and Smart (1995) studied NCAA Men’s basketball teams using an RBV framework. They focused on the skills of the team members and experience of the coach, and examined how it fit between skills and strategy impacted the team’s performance. They found that the relationship between certain skills and team performance depended upon the strategy in which the team was engaged. In addition, their results indicated that teams whose coaches who were using a strategy different from their preferred strategy performed lower than teams where the coach was able to use his preferred strategy (1979). Recent empirical studies using the RBV build on Lepak and Snell’s (1999) architectural framework discussed below.

Lepak and Snell (1999) asked executives to describe the HR systems that existed for jobs that represented particular quadrants of their model (Henderson, 1994; Maijoor, 1996; lower, 2000; Krnemer, 2002). They found considerable support for the idea that the value and uniqueness of skills are associated with different types of HR systems within the same organization.

These results were mostly consistent with the Lepak and Snell (1999) model, and supported the basic proposition that diverse HR strategies exist within firms. A follow up study (Lepak, Takeuchi and Snell, 2001) indicated that a combination of knowledge work and contract labor was associated with higher firm's performance. This finding not only raises some interesting ideas about the development of valuable human resources, but also highlights the importance of combinations of various types used in conjunction with one another (Hoopes, 2003; Tele, 2007; Reed, 1990; Ries, 1982; Nunnally, 1978).

In another example of examining the human capital pool, Richard (2001) used resource-based logic to examine the impact of racial diversity on firms' performance. He argued that diversity provides value through ensuring a variety of perspectives that it is rare in that very few firms have achieved significant levels of diversity, and that the socially complex dynamics inherent in diversity lead to its inimitability (Ho, 1999). He found in a sample of banks that diversity was positively related to productivity, return on equity, and market performance for firms engaged in a growth strategy, but negatively related for firms down-sizing.

In an effort to look beyond human capital pool alone, Youndt and Snell (2001) studied the differential effects of HR practices on human capital, social capital, and organizational capital. They found that intensive / extensive staffing,

competitive pay, intensive / extensive training and promotion from within policies were most important for distinguishing high levels of human capital in organizations. In contrast, broad banding, compressed wages, team structures, socialization, monitoring, and group incentives distinguished those with high social capital (i.e. relationships that engender knowledge exchange) but had very little effect on human capital itself.

Finally, organizational capital (i.e. knowledge embedded in the organization's systems and processes) was established most through lessons learned databases and HR policies that reinforced knowledge capture and access (Hone et al, 1998).

Recent debate about the usefulness of the RBV provides an interesting commentary about the current state of SHRM research (Barney, 2001; Priem and Butler, 2001a, Tallmnn, 1997). In response to claims that the RBV is tautological and does not generate testable hypotheses, Barney recognizes that most research applying the RBV has failed to test its fundamental concepts. Rather, he notes that much of the existing research has used the RBV to “establish the context of some empirical research—for example that the focus is on the performance implications of some internal attribute of a firms—and are not really direct tests of the theory developed in the 1991 article” (Barney, 2001).

Much of the existing SHRM research falls into this category. Although the empirical application of the RBV has taken a variety of forms, ranging in focus from high performance work systems and stocks of talent, to the fit between employee skills and strategy it has employed a common underlying logic: Human resource activities are thought to lead to the development of a skilled work-force

and one that engages in functional behavior for the firms, thus forming a source of competitive advantage (Timmers, 2000).

This results in higher operating performance, which translates into increased profitability, and consequently results in higher stock prices or market values (Becker and Huselid, 1998). While this theoretical story is appealing, it is important to note that ultimately, most of the empirical studies assess only two variables: HR practices and performance. While establishing such a relationship provides empirical evidence for the potential value of HR to firms, it fails to adequately test the RBV in two important ways.

First, no attempt that yet been made to empirically assess the validity of the proposition that HR practices are path dependent or causally ambiguous, nor whether they are actually difficult to imitate. While intuitively obvious and possibly supported by anecdotal data, the field lacks verifiable quantitative data to support these assertions.

In fact, Boxall and Steeneveld's (1999) findings might suggest that HR systems are more easily imitated (or at least substitutable) than SHRM researchers previously believed. Certainly, efforts such as King and Zeithaml's (2001) study assessing causal ambiguity of competencies could be replicated with regard to SHRM issues. These authors asked managers to evaluate their firms' competencies and the generated measures of causal ambiguity based on these responses (Stigler, 1961, Learned Edmond, 1969; Rao 1994; Rubin, 1973; Rugman, 2002). While ambiguity was negatively related to firm's performance in their study, they provide an example of how one might attempt to measure some of the variables within the RBV (Sirmon, 2007; Rics, 1981; Oliver, 1997; Peteraf, 1993; Santos, 2003). Second, few attempts have been made to demonstrate that

the HR practices actually impact the skills or behaviors of the work-force, nor that these skills or behaviors are related to any performance measures. Arthur (1994) and Huselid (1995) did find a relationship between HR practices and turnover. Wright, McCormick, Sherman and McMahan (1999) found that appraisal and training practices were related to executives' assessment of the skills and that compensation practices were related to their assessments of work-force motivation (Porter, 2001; Rumeit. 1991; Powell, 1997; Samil, 2001; Robinson, 1994; Polzin, 1999).

However, as yet no study has demonstrated anything close to a full causal model through which HR practices are purported to impact firm's performance (Stevenson, 1976; Prahalad, 1990; Sanchez, 2004; Rackoff, 1985, Robinson, 1933). In short, a major step forward for the SHRM literature will be to move beyond simply the application of RBV logic to HR issues toward research that directly tests the RBV's core concepts. In fairness, this state of affairs does not differ from attempts to study competitive advantage within the strategy literature (Schenider, 1991; Polzin 1999, Robert, 2000); Sermon, 2007).

As noted by Godfrey and Hill (1995), it is impossible to assess the degree of UN-observe ability of an unobservable, and inimitable resources are often purported to be unobservable. Thus, strategy researchers are often left to using proxy variables that may not be valid for measuring the underlying constructs (Ramamurthy, 2008; Polanyi, 1967, Hoskisson, Hitt, 1998, Wan and Yiu, 1999).

However, given the single respondent, cross sectional, survey designs inherent in much of this research, one cannot rule out alternative explanations for the findings of empirical relationships. For example, Gerhart, Wright, McMahan and Snell (2000) and Wright, Gardner, Moynihan, Park, Gerhart and Delery

(2000) both found that single respondent measures of HR practices may contain significant amounts of measurement error. Gardner, Wright and Gerhart (2000) also found evidence of implicit performance theories suggesting that respondents to HR surveys might base their descriptions of the HR practices on their assessments of the organization's performance. This raises the possibility that research purporting to support the RBV through demonstrating a relationship between HR and performance may result from spurious relationships, or even reverse causation (Wright and Gardner, 2000). The point is not to discount the significant research that has been conducted to date, but rather to highlight the importance of more rigorous and longitudinal studies of HR from a RBV perspective (Texas, 1971; Rackoff, 1985; Porter, 2004).

Taking a deeper understanding the resource-based view of the firms into empirical SHRM research entails focusing primarily on the competencies and capabilities of firms and the role that people management systems play in developing these. It requires recognizing that the inimitability of these competencies may stem from unobserved ability (e.g., causal ambiguity), complexity (e.g., social complexity), and / or time compression diseconomies (e.g., path dependence). This implies that rather than simply positing a relationship between HR practices and sustainable competitive advantage, one must realize that people management systems might impact this advantage in a variety of ways (Taube, 1988; Parker, 2004; Saiter, 1980; Scendel, 1985 Shoemaker, 1992).

For instance, these systems might play a role in creating cultures or mindsets that enable the maintenance of unique. Or these systems may promote and maintain socially complex relationships characterized by trust, knowledge

sharing, and team-work (e.g., South-West Airlines' unique culture). Finally, these systems might have resulted in the creation of a high quality human capital pool that cannot be easily imitated because of time compression diseconomies (e.g., Merck's R and D capability).

Whichever the case, it certainly calls for a more complex view of the relationship between HR and performance than is usually demonstrated within the empirical literature. In addition to a more complex view, such grounding would imply different strategies for studying HR and competitive advantage. For instance, recognizing time compression diseconomies implies more longitudinal or at least historical approaches to examining competitive advantage as opposed to the more popular cross-sectional studies (Stevenson, 1976; Porter, 1990, Parasuraman, 2000; Swinyard, 1987).

Focusing on causal ambiguity and social complexity might suggest more qualitative approaches than simply asking subjects to report via survey about the HR practices that exist. In sum, strategic HRM research more strongly anchored in the RBV of the firms would look significantly different than what currently exists. However, such research would shed light on both HR and strategy issues.

Extending this further, strategists who embrace the RBV point out that competitive advantage vis: core competence comes from aligning skills, motives, and so forth with organizational systems, structures, and processes that achieve capabilities at the organizational level (Hamel and Prahalad, 1994; Peteraf, 1993; Teece, Pisano and Shuen, 1997, Selznick, 1957, Porter, 1985 and 1980, Pento, 1959). Too frequently, HR researchers have acted as if organizational performance derives solely from the (aggregated) actions of individuals. But the RVB suggests that strategic resources are more complex than that, and more

interesting. Companies that are good at product development and innovation, for example, don't simply have the most creative people who continually generate new ideas. Product development capabilities are imbedded in the organizational systems and processes. People execute those systems, but they are not independent from them (Pitts, 1995; Shan, 1992; Robin, 1995; Panzer, 1981; Rumelt, 1991).

So while core competencies are knowledge-based, they are not solely human. They are comprised of human capital, social capital (i.e., internal / external relationships and exchanges), and organizational capital (i.e. processes, technologies, databases (Snell, Youndt and Wright, 1996).

That doesn't negate the importance of HR; it amplifies it and extends it. The RVB provides a broader foundation for exploring the impact of HR on strategic resources. In this context, HR is not limited to its direct effects on employee skills and behavior. Its effects are more encompassing in that they help weave those skills and behaviors within the broader fabric of organizational processes, systems and, ultimately, competencies (Venkatagiri, 2007).

Notwithstanding a great deal of room for development; it is clear from the preceding review that the conceptual and empirical application of the RBV has led to considerable advancement of the SHRM literature. In a broader sense, the RBV has impacted the field of HRM in two important ways. First, the RBV's influence has been instrumental in establishing a macro perspective in the field of HRM research (Snell et al, 2001). This macro view has provided complimentary depth to a historically micro discipline rooted in psychology. Relatedly, a second major contribution of the RBV has been the theoretical and contextual grounding that it

has provided to a field that has often been criticized for being a theoretical and excessively applied in nature (Snell et al., 2001).

Thus far, this work has discussed how the RBV has contributed to the field of SHRM. As noted before, however, that the RBV has also effectively put “people” on the strategy radar screen (Snell et al, 2001). In the search for competitive advantage, strategy researchers increasingly acknowledge human capital (Hitt, Bierman, Shimizu and Kochar, 2001), intellectual capital (Edvinsson and Malon, 1997) and knowledge (Grant, 1996; Leibeskind, 1996; Matusik and Hill, 1998) as critical components. In so doing, the RBV has provided an excellent platform for high-lighting the importance of people to competitive advantage, and thus, the inescapable fact that RBV strategy researchers must bump up against people and / or HR issues (Wernefeil, 1984).

In fact, recent developments within the field of strategy seem to evidence a converging of that field and SHRM (Snell et al., 2001). It seems that these areas present unique opportunities for inter-disciplinary research streams that provide significant leaps forward in the knowledge base. This work will discuss the concept of core competencies, the focus on dynamic capabilities, and knowledge-based views of the firms as potential bridges between the HR and strategy literatures. The researcher chooses these concepts because of both their popularity within the strategy literature and their heavy reliance on HR related issues (Wernefeil, 1977).

Prahalad and Hamel (1990) certainly popularized the core competency concept within the strategy literature. They stated that core competencies are “. . . the collective learning in the organization, especially how to coordinate diverse production skills and integrate multiple streams of technologies,” and that they

involve “many levels of people and all functions,” While the distinctions between core competencies and capabilities (Stalk, Evans and Schulman, 1992) seem blurred, one can hardly conceptualize a firms capability or competency absent neither the people who comprise them nor the systems that maintain them (Barney, Jay B. 1991). For example, competencies or capabilities refer to organizational processes, engaged in by people, resulting in superior products, and generally these must endure over time as employees flow in, through and out of the firms. Numerous researchers within the strategy field focus on firms competencies (e.g., King and Zeithaml, 2001; Leonard-Barton, 1992, 1995).

This researcher universally recognizes the inseparability of the competence and the skills of the employees who comprise the competence. In addition, some (e.g., Leonard-Barton, 1992) specifically also recognize the behavioral aspect of these employees (i.e., their need to engage in behaviors that execute the competency) and the supportive nature of people management systems to the development / maintenance of the competency. However, often these treatments begin quite specifically when examining the competency and its competitive potential within the market-place (Wernefeil, 1989).

However, they then sometimes become more generic and ambiguous as they delve into the more specific people-related concepts such as knowledge's, skills, abilities, behaviors, and HR practices.

This illustrates the potential synergy that might result from deeper integration of the strategy and strategic HRM literatures. To deeply understand the competency one must examine (in addition to the systems and processes that underlie them) the people who engage in the process, the skills they individually and collectively must possess, and the behavior they must engage in (individually

and interactively) to implement the process (Wernefeil, 1995). In addition to understand how such a competency can be developed or maintained requires at least impart examining the people management systems that ensure that the competency remains as specific employees leave and new employees must be brought in to replace them. This again exemplifies the interaction of people and processes as they comprise competencies.

Focusing on the people-related elements of a core competency provides a linking pin between the strategy and HR literatures. Traditional HR researchers refer to a “competence “as being work related knowledge, skill, or ability (Nordhaug, 1993) held by an individual. This is not the same as the core competencies to which strategy researchers refer.

Nordhaug and Gronhaug (1994) argues that firms possess individuals with different competences that they refer to as a portfolio of competences. They further propose that a core (or distinctive) competence exists when a firm is able to collaboratively blend the many competences in the portfolio, through a shared mindset, to better perform something than their competitors. For SHRM researchers, this implies a need to develop an understanding of firms, the activities in their value chains, and the relative superiority in value creation for each of these activities (William, 1992).

For strategy researchers, it suggests a need to more deeply delve into the issues of the individuals and groups who comprise the competency, and the systems that develop and engage them to exhibit and maintain the competency. Lepak and Snell’s (1999) model provides one tool for making this link between the firm’s competency, the people that comprise it, and the systems that maintain it. The RBV has frequently focused on resources or competencies as a stable

concept that can be identified at a point in time and will endure over time. The argument goes that when firms have bundles of resources that are valuable, rare, inimitable, and non-substitutable, they can implement value creating strategies not easily duplicated by competing firms (Barney, 1991; Conner and Prahalad, 1996; Peteraf, 1993; Wernerfelt, 1984, 1995).

However, recent attention has focused on the need for many organizations to constantly develop new capabilities or competencies in a dynamic environment (Teece, Pisano and Schuen, 1997). Such capabilities have been referred to as “dynamic capabilities” which have been defined as:

The firm’s processes that use resources—specifically the processes to integrate, reconfigure, gain, and release resources—to match and even create market change. Thus are the organizational and strategic routines by which firms achieve new resource reconfigurations as markets emerge, collide, split, evolve, and die (Eisenhardt and Martin, 2000).

Such dynamic capabilities require that organizations establish processes that enable them to change their routines, services, products, and even markets over time. While in theory, one can easily posit how organizations must adapt to changing environmental contingencies, in reality changes of this magnitude are quite difficult to achieve, and the difficulty stems almost entirely from the human architecture of the firms. The firms may require different skill sets implying a release of some existing employees and acquisition of new employees. The change entails different organizational processes implying new networks and new behavioral repertoires of employees. The new skills and new behaviors theoretically must be driven by new administrative, (i.e., HR) systems (Wright and Snell, 1998). This implies the centrality of HR issues to the understanding and

development of dynamic capabilities. This centrality is well articulated by Teece et al. (1997) who note: “Indeed if control over scarce resources is the source of economic profits, then it follows that such issues as skill acquisition, the management of knowledge and know-how and learning become fundamental strategic issues. It is in this second dimension, encompassing skill acquisition, learning and accumulation of organizational and intangible or invisible assets that the researcher believes lays the greatest potential for contributions to strategy”.

Unarguably significant attention in the strategy literature within the RBV paradigm has focused on knowledge and efforts to understand how firms generate, leverage, transfer, integrate and protect knowledge have moved to the fore front of the field (Hansen, 1999; Hedlund, 1994; Nonaka, 1991; Sveiby, 1997; Szulanski, 1996). In fact, Grant (1996) argues for a knowledge base theory of the firms, positing that firms exist because they better integrate and apply specialized knowledge than do markets. Liebeskind (1996) similarly believes in a knowledge-based theory of the firms, suggesting that firms exist because they can better protect knowledge from expropriation and imitation than can market (William, 1975).

Interestingly, knowledge-centered strategy research inevitably confronts a number of HR issues. Knowledge management requires that firms define knowledge, identify existing knowledge bases, and provide mechanisms to promote the creation, protection and transfer of knowledge (Argote and Ingram, 2000; Henderson and Cockburn, 1994; Leibeskind, 1996). While information systems provide a technological repository of knowledge, increasingly firms recognize that the key to successful knowledge management requires attending to the social and cultural systems of the organization (Conference Board, 2000).

Knowledge has long been a topic within the HR literature, whether the focus was on testing applicants for job-related knowledge (Hatrup and Schmitt, 1990), training employees to build their job-related knowledge (Gephart, Marsick, Van Buren and Spiro, 1996), developing participation and communication systems to transfer knowledge (Cooke, 1994), or providing incentives for individuals to apply their knowledge (Gerhart, Milkovich and Murray, 1992).

The major distinctions between the strategy and HR literatures with regard to knowledge have to do with the focus of the knowledge and its level. While the HR literature has focused on job related knowledge, the strategy literature has focused on more market relevant knowledge, such as knowledge regarding customers, competitors, or knowledge relevant to the creation of new products (Grant, 1996; Leibeskind, 1996).

In addition, while HR literature tends to treat knowledge as an individual phenomenon, the strategy and organizational literatures view it more broadly as organizationally shared, accessible, and transferable (cf. Argyris and Schon, 1978; Brown and Duguid, 1991; Snell, Stueber and Lepak, in press). Knowledge can be viewed as something that characterizes individuals (i.e., human capital), but it can also be shared within groups or networks (i.e., social capital) or institutionalized within organization processes and databases (organizational capital).

These distinctions represent something of a departure for HR researchers. However, the processes of creation, transfer, and exploitation of knowledge provide common ground across the two fields, again highlighting their potential convergence within the RBV paradigm. Although theorists such as Argyris and Schon (1978) argue that all learning begins at the individual level, it is conditioned by the social context and routines within organizations (Nonaka and

Takeuchi, 1995). Coleman (1988), for example, noted that social capital has an important influence on the creation of human capital. What seems clear is that these different “knowledge repositories” complement and influence one another in defining an organization’s capabilities (William, 1985)

But there are substantial differences between HR systems that support individual learning and those that support organizational learning. Leonard-Barton (1992), for example, noted that organizational learning and innovation were built on four inter-related processes and their related values: (1) owning / solving problems (egalitarianism), (2) integrating internal knowledge (shared knowledge), (3) continuous experimentation (positive risk), and (4) integrating external knowledge (openness to outside).

Each of these processes and values works systemically with the others to inculcate organizational learning and innovation. Each process / value combination is in turn supported by different administrative (HR) systems that incorporate elements of staffing, job design, training, career management, rewards, and appraisal. Again, the concept of knowledge brings together the fields of strategy and HR. But a good deal more work needs to be done to integrate these research streams. Strategy theory and research provides the basis for understanding the value of knowledge to the firms and highlights the need to manage it (Whiteing, 2000).

The HR field has lacked such a perspective, but has provided more theory and research regarding how knowledge is generated, retained, and transferred among individuals comprising the firms. This work has discussed the concepts of core competencies, dynamic capabilities, and knowledge as bridge constructs connecting the fields of strategy and SHRM. The work also proposed that both

fields could benefit greatly from sharing respective areas of expertise. In fact, at the risk of over-simplification, the strategy literature has generated significant amounts of knowledge regarding who (i.e., employees / executives or groups of employees / executives) provides sources of competitive advantage and why. However, absent from that literature are specific techniques for attracting, developing, motivating, maintaining, or retaining these people (Williamson, 1975).

SHRM, on the other hand has generated knowledge regarding the attraction, development, motivation, maintenance, and retention of people. However, it has not been particularly successful yet at identifying who the focus of these systems should be on. The strategy literature has also highlighted the importance of the stock and flow of knowledge for competitive advantage. However, it has not explored in great detail the role that individuals as well as their interactions with others contribute to this. Conversely SHRM has missed much of the organizational view of knowledge, but can provide significant guidance regarding the role that individuals play (Bartels, R. 1988).

The RBV has significantly and independently influenced the fields of strategy and SHRM. More importantly however it has provided a theoretical bridge between these two fields by turning attention toward the internal resources, capabilities and competencies of the firms such as knowledge, learning and dynamic capabilities (Hoskisson et al., 1999). It has brought strategy researchers to inescapably face a number of issues with regard to the management of people (Barney, 1996). The work would guess that few strategy researchers are well versed in the existing research base regarding the effectiveness of various specific retools and techniques for managing people, and thus addressing these issues with

necessary specificity. This internal focus also has provided the traditionally theoretical field of SHRM with theoretical foundation from which it can begin exploring the strategic role that people and HR functions can play in organizations (Wright and McMahan, 1992). In addition to the lack of theory, this literature has also displayed little, or at least overly simplistic views of strategy, thus limiting its ability to contribute to the strategy literature (Chadwick and Cappelli, 1998).

The RBV provides the framework from which HR researchers and practitioners can better understand the challenges of strategy, and thus be better able to play a positive role in the strategic management of firms. This work proposes that both fields will benefit from greater levels of interaction in the future. This interaction should be deeper than simply reading each other's literature, but rather organizing conferences aimed at promoting face-to-face discussions of the common issues and challenges. In fact, the work believe that future inter-disciplinary research studies conducted jointly by strategy and SHRM researchers would exploit the unique knowledge and expertise of both fields, and synergistically contribute to the generation of new knowledge regarding the roles that people play in organizational competitive advantage (Yang et al, 2004).

The resource-based view (RBV) is a business management tool used to determine the strategic resources available to a company. The fundamental principle of the RBV is that the basis for a competitive advantage of firms lies primarily in the application of the bundle of valuable resources at the firm's disposal (Wernerfelt, and Rumelt, 1984). To transform a short-run competitive advantage into a sustained competitive advantage requires that these resources are heterogeneous in nature and not perfectly mobile (Peteraf, 1993). Effectively, this translates into valuable resources that are neither perfectly imitable nor

substitutable without great effort (Barney, 1991). If these conditions hold, the firm's bundle of resources can assist the firms sustaining above average returns. The valuation rare in-imitable Operations (VRIO) model also constitutes a part of RBV. The key points of the theory are:

1. Identify the firm's potential key resources
2. Evaluate whether these resources fulfill the following criteria (referred to as VRIN):
 - Valuable – A resource must enable a firms to employ a value-creating strategy, by either outperforming its competitors or reduce its own weaknesses (Barney, 1991). Relevant in this perspective is that the transaction costs associated with the investment in the resource cannot be higher than the discounted future rents that flow out of the value-creating strategy (Mahoney and Prahalad, 1992; Conner, 1992).
 - Rare – To be of value, a resource must be rare by definition. In a perfectly competitive strategic factor market for a resource, the price of the resource will be a reflection of the expected discounted future above-average returns (Barney, 1986a; Dierickx and Cool, 1989, Zeilhamil et al, 2000).
 - In-imitable – If a valuable resource is controlled by only one firm it could be a source of a competitive advantage (Barney, 1991). This advantage could be sustainable if competitors are not able to duplicate this strategic asset perfectly (Barney, 1986b). The term isolating mechanism was introduced by Rumelt (1984) to explain why firms might not be able to imitate a resource to the degree that they are able to compete with the firms having the valuable resource (Peteraf, 1993; Mahoney and Pandian, 1992). An important underlying factor of inimitability is causal ambiguity,

which occurs if the source from which a firm's competitive advantage stems is unknown (Peteraf, 1993; Lippman and Rumelt, 1982). If the resource in question is knowledge-based or socially complex, causal ambiguity is more likely to occur as these types of resources are more likely to be idiosyncratic to the firms in which it resides (Peteraf, 1993; Mahoney and Pandian, 1992). Conner and Prahalad go so far as to say knowledge-based resources are "...the essence of the resource-based perspective" (1996).

- Non-substitutable – Even if a resource is rare, potentially value-creating and imperfectly imitable, an equally important aspect is lack of substitutability (Dierickx and Cool, 1989). If competitors are able to counter the firm's value-creating strategy with a substitute, prices are driven down to the point that the price equals the discounted future rents (Barney, 1986; sheikh, 1991), resulting in zero economic profits.
3. Care for and protect resources that possess these evaluations, because doing so can improve organizational performance (Crook, Ketchen, Combs, and Todd, 2008).

The VRIN characteristics mentioned are individually necessary, but not sufficient conditions for a sustained competitive advantage (Dierickx and Cool, 1989; Priem and Butler, 2001a). Within the framework of the resource-based view, the chain is as strong as its weakest link and therefore requires the resource to display each of the four characteristics to be a possible source of a sustainable competitive advantage (Barney, 1991). Jay Barney (Barney, 1991) referring to Daft (1983) says: "...firms resources include all assets, capabilities, organizational processes, firms attributes, information, knowledge, etc; controlled by a firms that

enable the firms to conceive of and implement strategies that improve its efficiency and effectiveness (Daft,1983)."

A subsequent distinction, made by Amit and Schoemaker (1993), is that the encompassing construct previously called "resources" can be divided into resources and capabilities. In this respect, resources are tradable and non-specific to the firms, while capabilities are firms-specific and are used to engage the resources within the firms, such as implicit processes to transfer knowledge within the firms (Makadok, 2001; Hoopes, Madsen and Walker, 2003). This distinction has been widely adopted throughout the resource-based view literature (Conner and Prahalad, 1996; Makadok, 2001; Barney, Wright and Ketchen, 2001).

Makadok (2001) emphasizes the distinction between capabilities and resources by defining capabilities as "a special type of resource, specifically an organizationally embedded non-transferable firms-specific resource whose purpose is to improve the productivity of the other resources possessed by the firms". "Resources are stocks of available factors that are owned or controlled by the organization, and capabilities are an organization's capacity to deploy resources". Essentially, it is the bundling of the resources that builds capabilities.

A competitive advantage can be attained if the current strategy is value-creating, and not currently being implemented by present or possible future competitors (Barney, 1991). Although a competitive advantage has the ability to become sustained, this is not necessarily the case. A competing firms can enter the market with a resource that has the ability to invalidate the prior firm's competitive advantage, which results in reduced (read: normal) rents (Barney, 1986b). Sustainability in the context of a sustainable competitive advantage is

independent with regards to the time frame. Rather, a competitive advantage is sustainable when the efforts by competitors to render the competitive advantage redundant have ceased (Rumelt, 1984). When the imitative actions have come to an end without disrupting the firm's competitive advantage, the firm's strategy can be called sustainable. This is in contrast to views of others (e.g., Porter) that a competitive advantage is sustained when it provides above-average returns in the long run. (1985).

Some aspects of theories are thought of long before they are formally adopted and brought together into the strict framework of an academic theory. The same could be said with regards to the resource-based view. While this influential body of research within the field of Strategic Management was named by Birger Wernerfelt in his article a resource-based view of the firms (1984), the origins of the resource-based view can be traced back to earlier research. Retrospectively, elements can be found in works by Coase (1937), Selznick (1957), Penrose(1959), Stigler (1961), Chandler (1962, 1977), and Williamson (1975), where emphasis is put on the importance of resources and its implications for firms performance (Conner, 1991; Rumelt, 1984; Mahoney and Pandian, 1992; Rugman and Verbeke, 2002).

This paradigm shift from the narrow neo-classical focus to a broader rationale, and the coming closer of different academic fields (industrial organization economics and organizational economics being most prominent) was a particular important contribution (Conner, 1991; Mahoney and Pandian, 1992).

Two publications closely following Wernerfelt's initial article came from Barney (1986a, 1986b). Even though Wernerfelt was not referenced directly, the

statements made by Barney about strategic factor markets and the role of expectations can clearly be seen within the resource-based framework as later developed by Barney (1991). Other concepts that were later integrated into the resource-based framework have been articulated by Lippman and Rumelt (uncertain imitability, 1982), Rumelt (isolating mechanisms, 1984) and Dierickx and Cool (inimitability and its causes, 1989).

Barney's framework proved a solid foundation upon which others might build, and its theoretical underpinnings were strengthened by Conner (1991), Mahoney and Pandian (1992), Conner and Prahalad (1996) and Makadok (2001), who positioned the resource-based view with regards to various other research fields. More practical approaches were provided for by Amit and Shoemaker (1993), while later criticism came from among others from Priem and Butler (2001a, 2001b) and Hoopes, Madsen and Walker (2003).

The resource based view has been a common interest for management researchers and numerous writings could be found for same. A resource-based view of a firm explains its ability to deliver sustainable competitive advantage when resources are managed such that their outcomes cannot be imitated by competitors, which ultimately creates a competitive barrier (Mahoney and Pandian 1992 cited by Hooley and Greenley 2005, Smith and Rupp 2002). RBV explains that a firm's sustainable competitive advantage is reached by virtue of unique resources being rare, valuable, inimitable, non-tradable, and non-substitutable, as well as firms-specific (Barney 1999 cited by Finney et al.2004, p. 1722, Makadok 2001). These authors write about the fact that firms may reach a sustainable competitive advantage through unique resources which it holds, and these

resources cannot be easily bought, transferred, or copied, and simultaneously, they add value to a firm while being rare. It also highlights the fact that not all resources of a firm may contribute to a firm's sustainable competitive advantage. Varying performance between firms is a result of heterogeneity of assets (Lopez 2005, Helfat and Peteraf 2003) and RBV is focused on the factors that cause these differences to prevail (Grant 1991, Mahoney and Pandian 1992, cited by Lopez 2005).

Resources are the inputs or the factors available to a company which helps to perform its operations or carry out its activities (Black and Boal, 1994, Grant 1995 cited by Ordaz et al., 2003). Also, these authors state that resources, if considered as isolated factors do not result in productivity; hence, coordination of resources is important. The ways a firm can create a barrier to imitation are known as "isolating mechanisms", and are reflected in the aspects of corporate culture, managerial capabilities, information asymmetries and property rights (Hooley and Greenlay, 2005, Winter 2003). Further, they mention that except for legislative restrictions created through property rights, the other three aspects are direct or indirect results of managerial practices.

King (2007) mentions inter-firms causal ambiguity may result in sustainable competitive advantage for some firms. Causal ambiguity is the continuum that describes the degree to which decision makers understand the relationship between organizational inputs and outputs (Ghingold and Johnson 1998, Lippman and Rumelt 1982 cited by King 2007, Matthyssens and Vandenbempt 1998). Their argument is that inability of competitors to understand what causes the superior performance of another (inter-firms causal ambiguity),

helps to reach a sustainable competitive advantage for the one who is presently performing at a superior level. Holley and Greenley (2005) state that social context of certain resource conditions act as an element to create isolating mechanisms and quote Wernerfelt (1986) that tacitness (accumulated skill-based resources acquired through learning by doing) complexity (large number of inter-related resources being used) and specificity (dedication of certain resources to specific activities) and ultimately, these three characteristics will result in a competitive barrier.

Referring back to the definitions stated previously regarding the competitive advantage that mentions superior performance is correlated to resources of the firms (Christensen and Fahey 1984, Kay 1994, Porter 1980 cited by Chacarbaghi and Lynch 1999) and consolidating writings of King (2007) stated above, we may derive the fact that inter-firms causal ambiguity regarding resources will generate a competitive advantage at a sustainable level. Further, it explains that the depth of understanding of competitors—regarding which resources underlie the superior performance—will determine the sustainability strength of a competitive advantage. Should a firm be unable to overcome the inter-firms causal ambiguity, this does not necessarily result in imitating resources?

As to Johnson (2006) and Mahoney (2001), even after recognizing competitors' valuable resources, a firm may not imitate due to the social context of these resources or availability of more pursuing alternatives. Certain resources, like company reputation, are path-dependent and are accumulated over time, and a competitor may not be able to perfectly imitate such resources (Zander and Zander

2005, Santala and Parvinen 2007; Chatterjee 1991; Capgemini, 2009; De wit, 1981). They argue on the basis that certain resources, even if imitated, may not bring the same impact, since the maximum impact of the same is achieved over longer periods of time. Hence, such imitation will not be successful. In consideration of the reputation of fact as a resource and whether a late entrant may exploit any opportunity for a competitive advantage, Kim and Park (2006) mention three reasons why new entrants may be outperformed by earlier entrants. First, early entrants have a technological know-how which helps them to perform at a superior level. Secondly, early entrants have developed capabilities with time that enhance their strength to out-perform late entrants.

Thirdly, switching costs incurred to customers, if they decide to migrate, will help early entrants to dominate the market, evading the late entrants' opportunity to capture market share. Customer awareness and loyalty is another rational benefit early entrants enjoy (Lieberman and Montgomery 1988, Porter 1985, Hill 1997, Yoffie 1990 cited by Ma 2004, Agarwal et al. 2003).

However, first mover advantage is active in evolutionary technological transitions, which are technological innovations based on previous developments (Kim and Park 2006, Cottam et al. 2001; deligoni, 1997; day, 1994).

The same authors further argue that revolutionary technological changes (changes that significantly disturb the existing technology) will eliminate the advantage of early entrants. Such writings elaborate that though early entrants enjoy certain resources by virtue of the forgone time periods in the markets, rapidly changing technological environments may make those resources obsolete and curtail the firm's dominance. Late entrants may comply with the technological

innovativeness and increased pressure of competition, seeking a competitive advantage by making the existing competencies and resources of early entrants invalid or outdated. In other words, innovative technological implications will significantly change the landscape of the industry and the market, making early movers' advantage minimal. However, in a market where technology does not play a dynamic role, early mover advantage may prevail.

Analyzing the above-developed framework for the resource-based view, it reflects a unique feature, namely, that sustainable competitive advantage is achieved in an environment where competition does not exist. According to the characteristics of the resource-based view, rival firms may not perform at a level that could be identified as considerable competition for the incumbents of the market, since they do not possess the required resources to perform at a level that creates a threat and competition.

Through barriers to imitation, incumbents ensure that rival firms do not reach a level at which they may perform in a similar manner to the former. In other words, the sustainability of the winning edge is determined by the strength of not letting other firms compete at the same level. The moment competition becomes active, competitive advantage becomes ineffective, since two or more firms begin to perform at a superior level, evading the possibility of single-firm dominance; hence, no firms will enjoy a competitive advantage. Ma (2003) agrees stating that, by definition, the sustainable competitive advantage discussed in the resource based view is anti-competitive. Further such sustainable competitive advantage could exist in the world of no competitive imitation (Peteraf 1993 cited by Ma 2003, Ethiraj et al., 2005, Dickson, 1996; Crook, 2008).

Based on the empirical writings stated above, RBV provides the understanding that certain unique existing resources will result in superior performance and ultimately build a competitive advantage. Sustainability of such an advantage will be determined by the ability of competitors to imitate such resources. However, the existing resources of a firm may not be adequate to facilitate the future market requirement, due to volatility of the contemporary markets. There is a vital need to modify and develop resources in order to encounter the future market competition.

An organization should exploit existing business opportunities using the present resources while generating and developing a new set of resources to sustain its competitiveness in the future market environments; hence, an organization should be engaged in resource management and resource development (Chaharbaghi and Lynch 1999, Song et al., 2002). Their writings explain that in order to sustain the competitive advantage, it is crucial to develop resources that will strengthen the firm's ability to continue the superior performance. Any industry or market reflects high uncertainty and, in order to survive and stay ahead of competition, new resources become highly necessary. Morgan (2000 cited by Finney et al, 2004) agrees, stating that the need to update resources is a major management task since all business environments reflect highly unpredictable market and environmental conditions. The existing winning edge needed to be developed since various market dynamics may make existing value-creating resources obsolete. Building on the RBV, Hoopes, Madsen and Walker (2003) suggest a more expansive discussion of sustained differences among firms, and develop a broad theory of competitive heterogeneity. "The RBV seems to assume what it seeks to explain. This dilutes its explanatory power. For

example, one might argue that the RBV defines, rather than hypothesizes, that sustained performance differences are the result of variation in resources and capabilities across firms. The difference is subtle, but it frustrates understanding the RBV's possible contributions (Hoopes et al., 2003; Dunning 1981; Corner, 1996).

The RBV's lack of clarity regarding its core premise and its lack of any clear boundary impedes fruitful debate. Given the theory's lack of specificity, one can invoke the definition-based or hypothesis-based logic any time. Again, this work argues that resources are but one potential source of competitive heterogeneity. Competitive heterogeneity can obtain for reasons other than sticky resources or capabilities" (Hoopes et al. 2003). Competitive heterogeneity refers to enduring and systematic performance differences among close competitors (Hoopes et al., 2003). Priem and Butler (2001) raised four key points of criticism:

- The RBV is tautological, or self-verifying. Barney has defined a competitive advantage as a value-creating strategy that is based on resources that are, among other characteristics, valuable (1991). This reasoning is circular and therefore operationally invalid (Priem and Butler, 2001a).
- Different resource configurations can generate the same value for firms and thus would not be competitive advantage (Academy of Marketing Science Review Volume 1999)
- The role of product markets is underdeveloped in the argument
- The theory has limited prescriptive implications

However, Barney (2001) provided counter-arguments to these points of criticism.

Further criticisms are:

- It is perhaps difficult (if not impossible) to find a resource which satisfies all of the Barney's VRIN criteria.
- There is the assumption that a firm can be profitable in a highly competitive market as long as it can exploit advantageous resources, but this may not necessarily be the case. It ignores external factors concerning the industry as a whole; a firm should also consider Porter's Industry Structure Analysis (Porter's Five Forces).
- Long-term implications that flow from its premises: A prominent source of sustainable competitive advantages is causal ambiguity (Lippman and Rumelt, 1982). While this is undeniably true, this leaves an awkward possibility: the firm is not able to manage a resource it does not know exists, even if a changing environment requires this (Lippman and Rumelt, 1982). Through such an external change, the initial sustainable competitive advantage could be nullified or even transformed into a weakness (Priem and Butler, 2001a; Peteraf, 1993; Rumelt, 1984).
- Premise of efficient markets: Much research hinges on the premise that markets in general or factor markets are efficient, and that firms are capable of precisely pricing in the exact future value of any value-creating strategy that could flow from the resource (Barney, 1986a). Dierickx and Cool argue that purchasable assets cannot be sources of sustained competitive advantage, just because they can be purchased. Either the price of the resource will increase to the point that it equals the future above-average return, or other competitors will purchase the resource as well and use it in a value-increasing strategy that diminishes rents to zero (Peteraf, 1993; Conner, 1991; cubbin, 1988; De wit, 1999).

- The concept of rarity is obsolete: Although prominently present in Wernerfelt's original articulation of the resource-based view (1984) and Barney's subsequent frame-work (1991), the concept that resources need to be rare to be able to function as a possible source of a sustained competitive advantage is unnecessary (Hoopes, Madsen and Walker, 2003). Because of the implications of the other concepts (e.g. valuable, inimitable and non-substitutability) any resource that follows from the previous characteristics is inherently rare.
- Sustainable: The lack of an exact definition of sustainability makes its premise difficult to test empirically. Barney's statement (1991) that the competitive advantage is sustained if current and future rivals have ceased their imitative efforts is versatile from the point of view of developing a theoretical framework, but is a disadvantage from a more practical point of view, as there is no explicit end-goal.

2.1.1.2 Strategic Necessity Hypothesis (SNH)

Internationalization of trade and information flows; market liberalization and new technological opportunities are urging many transportation and logistics companies to take action (Arthur Andersen, 2000; General electrical, 1981; Cihaddan, 1992). Customer's requirements expressed whether in terms of reliability, transperence, flow, payments, and international connectivity have put some tremendous pressure on logistics companies. In this context, the race to most sophisticated information technology (IT) applications appears to lots of companies to be the key to success or at least to survival. This is reflected in the massive investment in IT for logistics activities (for example, Stephens Inc. (2000) estimates it to reach 1 trillion \$ world-wide only for cross-border logistics

by the year 2005. However, while the software and consultant companies are marketing the advent of the e-logistic firms, in which IT is pervasive, the question of whether the adoption of these systems can really be a source of competitive advantage is still largely unsolved.

Actually, earlier research on IT and strategic management indicates that IT does not deliver competitive advantage per se (Powell and Dent-Micallef, 1997, Clemons and Row, 1991). Indeed, to do so it needs to fulfill three minimal requirements: first, it needs to bring some value (Porter, 1985; Chandler, 1977; Champy, 1995); second it needs to support the firm's business strategy (Porter and Millar, 1985) and third, it has to contribute to the development of distinctive resources (Peteraf, 1983).

The objective of this article is to apply these "general, rather abstract" strategic management concepts to the assessment of specific IT solutions and in particular of e-logistics solutions. The research did so by building an analytical framework deduced from both the position-based and the resource-based views, and then by applying it to identify the conditions in which e-logistics solutions may help Logistics Service Providers' (LSPs) creating a sustainable competitive advantage.

From the outset, IT researchers' advocated tight IT-strategy linkages, asserting that IT affects firms strategies that strategies have IT implications, and that firms must some-how integrate strategic thrust with IT capabilities (Fabbe-Costes, 2000; Cash, 1985; Di Angel, 2002). However, the role that IT plays in organizational performance has been tackled from two different stand-points in strategic management: the position-based (outside-in) view.

According to Porter (1984), formulating a competitive strategy turns around two central choices: selecting a competitive domain with attractive characteristics and positioning the firms vis-à-vis the five competitive forces encountered. Then, the only feasible ways of achieving a sustainable competitive advantage is to select one of the three generic strategies: cost leadership, differentiation or focus. In this perspective, the next logical step is to align the activities with strategy (Porter, 1985; Chatterjee, 1991).

IT has impacts at both industry (meso) and organizational level (micro). At the industry level, IT innovation can alter a full range of industry structure variables that finally determines the sector's profitability; it includes cost positions, scale economies, power relations with buyers and suppliers, and market structure (Benjamin et al, 1984; Cash and Konsynski, 1985; Porter, 1985; Clemons, 1986; Malone, 1987).

At the organizational level, the primary focus of IT is to coordinate the value chain (Porter and Millar, 1985; Rockart and Short, 1989). If the first over disadvantages are not too high, IT can also deliver a first-mover advantage (Porter, 1985). In any case, IT should support the "strategy" (Rackoff et al, 1985) through some sort of "strategic alignment". The general view from the position-based view of IT is quite pessimistic (Warner, 1987; Clemons, 1986) with further empirical evidence that there is no direct correlation between IT adoption and firm's performance (Neo, 1988; Floyd and Wooldridge, 1990).

In short, it states that (1) IT does not provide competitive advantage per se, that (2) IT can impact the industry structure and the general profitability of an industry (although it is rare), that (3) IT has mainly a coordinating role in the value chain, and that (4) IT should be aligned with the overall strategy.

Whereas traditional (position-based) strategy research has focused on advantages derived from industry and competitive positioning, the resource-based research focuses on advantages stemming from firms-specific, intangible resources such as organization culture, learning and capabilities (Hall, 1993; Clemons, 1986; Dorward, 2008). Resource-based theory begins with the notion of resource heterogeneity, arguing that firms hold heterogeneous resource portfolios – whether by history, accident, or design- and that this resource heterogeneity is responsible for observed variability in financial returns across firms (Peteraf, 1993).

Firms achieve sustained performance advantages by accumulating resource portfolios that produce economic value, are relatively scarce, and can sustain competitive attempts at imitation, acquisition or substitution (Barney, 1986). Valuable, scarce resources may survive competitive imitation if protected by imitation barriers, or “isolating mechanisms” (Rumelt, 1984), such as: time compression diseconomies, historical uniqueness (first mover advantages), embeddedness of resources, and causal ambiguity (Lieberman and Montgomery, 1988; Dierickx and Cool, 1989; Barney, 1991).

Considering this set of hypothesis, does IT meet resource-based criteria for sustained competitive advantage? Clemons and Row (1991) pushed forward a commodity view of IT. In their perspective, IT per se does not generate sustainable performance advantages but is rather a “strategic necessity”. This hypothesis consists of two propositions: (1) IT provides value to the firms by increasing internal and external coordinating efficiencies, and firms that do not adopt them will have higher cost structures and therefore competitive disadvantage; and (2) notwithstanding (1), firms cannot expect IT to produce

sustainable advantages because most IT is readily available to all firms—competitors, buyers, suppliers, and potential new entrants— in competitive factor markets (Clemons and Row, 1991).

According to this view, firms appear to have only three feasible paths to IT- based competitive advantage: either (1) to reinvent IT advantages perpetually through continuous, leading edge IT innovation; or (2) to move first and erect unassailable first-mover advantages; or (3) to embed ITs in organizations in such a way as to produce valuable, sustainable resource complementarily (Powell and Dent-Micaleff, 1997; Fabbe, 2000, Darch, 2004; Cooper, 1991).

Although, the three propositions are theoretically valid, in reality the third one is the most realistic because most developments in IT are either done by third parties and/ or are easily imitable. If IT per se does not provide distinctive advantages, however firms can use them to leverage or exploit firms specific, intangible resources such as organizational leadership, culture, and business processes (Clemons and Row, 1991; Henderson and Venkataraman, 1993).

Walton (1989) and Benjamin and Levinson (1993) classified resources as organizational, business, and technological, and argued that IT performance depends on the integration of resources across these categories. Powell (1997) shows how human and business resources combine with IT to produce competitive advantage through resource complementarily in retailing. In short, the resource-based view states that (1) IT does not provide a competitive advantage per se but is rather a strategic necessity and (2) IT has to be embedded with other resources, typically human and business resources. Both position-based and resource-based views stress the importance of the integration of IT in a specific organization, whether with its resource or by a strategic alignment. Of course, this

can only happen if there is some clear contribution to the value chain. Although, not stated explicitly, there is no doubt that it depends of a given application

2.2 Conceptual Framework of the Study

Telecommunication infrastructure sharing has been defined as an arrangement whereby two or more telecom service providers can agree to share infrastructure located in a common place or area for the purpose of reducing capital and operational expenditure (Bala-Gbogbo, 2009). In this new model, competitors are becoming partners in order to lower their increasing investments and the degree and method of infrastructure sharing can vary in each country depending on regulatory and competitive climate (http://en.wikipedia.org/wiki/Local-loop_unbundling, accessed 2009-08-20).

In other literatures telecom infrastructure sharing is referred to as Local Loop Unbundling (LLU or LLUB) which implies the regulatory process of allowing multiple telecommunication operators to use connections from the telephone exchange's central office to the customer's-premises.

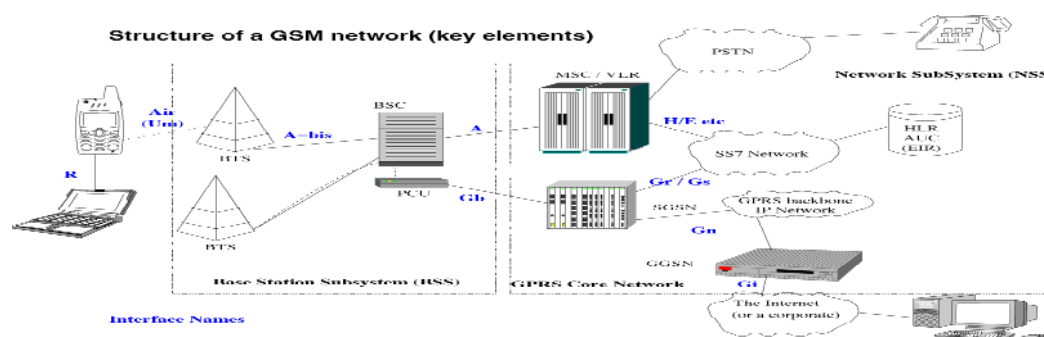


Figure 2.1. GSM Network Showing Access and Core Networks

Source: Ericsson @ 2008

In this latter model (i.e. LLU) telecom infrastructure sharing is viewed as a way through which the National Regulator Agency (NRA) seeks to stimulate competition in the telecommunication and information processing sectors (ITU, 2002). However, for the purpose of this research thesis, infrastructure sharing will be viewed from the former model whereby two or more telecom operators or providers come together to share infrastructure located in a common place as a means of reducing costs of investment.

Telecom infrastructure (such as towers and backhaul) for a telecom provider account for about 60 percent of the cost of doing business (Aggarwal, 2009). The rising trends of infrastructure sharing among telecom providers can be seen as being driven by this rising cost of ownership which represents the total capital costs required to deploy network infrastructure.

In line with the model proposed by Osterwalder (2004) above, the telecommunication operators in Nigeria maintain or employ the following infrastructure model. Most of the telecommunication operator in Nigeria obtain licence from NCC for the main purpose of providing users network coverage at certain tariffs designed for specific customer segments with revenue assurance in mind as profit maximisation entities. They simply provide subscribers with such mobile services as voice, data, short message services (SMS), etc for a fee or tariff.

Their core capabilities include high investment in GSM infrastructure as already discussed above including staff with such competencies as planning and designing all aspects of the GSM network, namely NSS (Core), BSS and transmission. Other capabilities include RF (radio frequency) planning and optimisation, value and design engineering, transmission planning, core network

capacity planning, network performance monitoring, quality assurance and quality processes, BTS implementation auditing and Safety Health Environment (SHE).

All these competencies are necessary for maintaining the super-structure or network that ensures that users or subscribers can access network services every-time and every-where. Telecom operators also maintain partner networks or business alliances such as vendors and suppliers who supply and provide them with technical support for GSM equipment which make up their huge capital investments in their respective businesses. An example is MTN Nigeria relationship with Ericsson for supply of critical telecom carrier class equipment such as MSCs or switches, BSCs, BTSs and multiplexers.

Their value offerings or propositions usually involve pre-paid and post-paid voice and sms or text services as well as special product offerings tailored towards targeted customer segments like family and friends, teenagers and youth, and business or enterprise users. These differentiation of their product offerings at varying tariffs help them maximise revenue from consumer surpluses existing in the mobile services market. They also employ the use of trade or distribution channels for the sales of their customized SIMs (subscriber identity modules) and recharge or refill vouchers for pre-paid segment customers. Finally, integral to their businesses, telecommunication operators usually maintain a finance or accounting division whose main roles is to model the cost structure of their products and services offerings. This division is also tasked with the duty of ensuring their incomes or revenues are assured through the development of strategic tariff plans that would ensure profit maximisation for shareholders.

2.2.1 The GSM Mobile Network Architecture

GSM simply means global system for mobile telecommunication. It was designed to be platform-independent, hence specifications do not specify the actual hardware requirements, rather they specify the network functions and interfaces in detail. This allows hardware designers to be creative on how they provide the actual functionality, but at the same time makes it possible for operators to buy equipment from different suppliers (Ericsson, 2003).

2.2.2 GSM Network Components

The GSM network is sub-divided into two systems. Each system comprises a number of functional units or individual components of the mobile network. These four subsystems are:

Network Switching System (NSS)

Base Station System (BSS)

Operations and Maintenance Centre (OMC)

Mobile Station (MS)

In addition to these, as with all telecommunication networks, GSM networks are operated, maintained and managed from computerized centres. The NSS is responsible for performing call processing and subscriber related functions and it includes the following functional units:

Mobile services Switching Centre (MSC)

Home Location Register (HLR)

Visitor Location Register (VLR)

Authentication Centre (AUC)

Equipment Identity Register (EIR)

The BSS performs all the radio-related functions and is comprised of the following functional units:

Base Station Controller (BSC)

Base Transceiver Station (BTS)

The Base Station Controller (BSC) manages all the radio-related functions of a GSM network. It is a high capacity switch that provides functions such as MS (mobile station) handover, radio channel assignment and the collection of cell configuration data. A number of BSCs may be controlled by one MSC.



Figure 2.2. The BSC Cabinet System

Source: Ericsson @ 2008

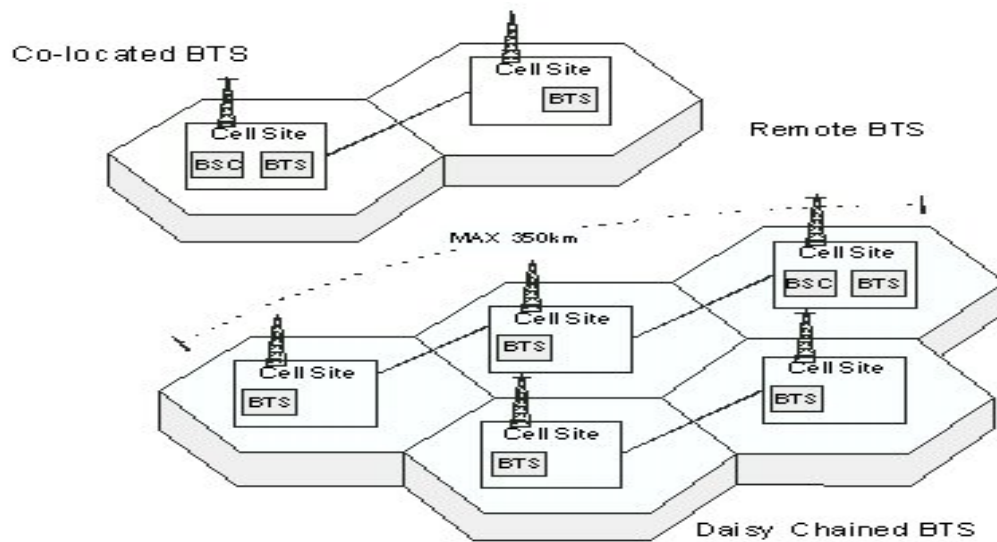


Figure 2.3. The BTS System of the GSM Network

Source: Ericsson @ 2008

The Base Transceiver Station (BTS) subsystem of a GSM network is responsible for controlling the radio interfaces to the MS (Mobile Station) at the subscriber side of the wireless link. It comprises the radio equipment such as transceivers and antennas which are needed to serve each cell in the network. A group of BTSs are controlled by a BSC (Ericsson, 2003).

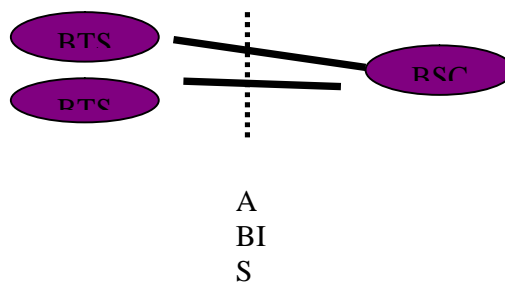


Figure 2.4. Two BTS System controlled by a BSC in the GSM Network

Source: Ericsson @ 2003

2.2.3 Mobile Services Switching Centre (MSC)

The MSC performs the telephony switching functions for the mobile network. It controls calls to and from other telephony and data systems such as Public Switched Telephone Network (PSTN), Integrated Services Digital Network (ISDN), public data networks, private networks and other mobile networks (Ericsson,2003). Its gateway functionality enables an MSC to interrogate a network's HLR in order to route a call to a Mobile Station (MS). Such an MSC is called Gateway MSC (G-MSC).

For example, if a person connected to a PSTN wants to make a call to a GSM mobile subscriber, then the PSTN exchange will access the GSM network by first connecting the call to a G-MSC. The same is true of a call from an MS to another MS on another GSM network (Ericsson.2003).

2.2.4 Home Location Register(HLR)

The HLR is the centralized network database that stores and manages all mobile subscriptions belonging to a specific operator. It acts as a permanent store for a person's subscription information until that subscription is canceled. The information stored include the following :

- Subscriber identity
- Subscriber supplementary services
- Subscriber location information
- Subscriber authentication information

The HLR sometimes can be implemented in the same network node as the MSC or as a stand-alone database (Ericsson,2003).

2.2.5 Visitor Location Register (VLR)

The VLR is a database that contains information about all mobile subscribers currently situated in an MSC service area. Hence, there is usually one MSC per network area. The VLR stores subscription information on a temporary basis, so that the MSC can service all the subscribers currently visiting that MSC service area. It can be seen as a distributed HLR since it holds a copy of the Home Location register (HLR) information stored about the subscriber (Ericsson, 2003).

Whenever a subscriber roams or moves into a new MSC service area, the VLR connected to that MSC usually requests information about the subscriber from the subscriber's HLR. The HLR sends a copy of the information to the VLR and updates its own location information. When the subscriber makes a call, the VLR will already have the same information required for successful call set-up (Ericsson,2003).

2.2.6 Authentication Centre (AUC)

The main role of the AUC is to authenticate or validate the identity of the subscribers attempting to use the network resources. In this way, it is used to protect network operators against fraud or potential hackers. The AUC is a database connected to the HLR which provides it with the

authentication parameters and ciphering keys used to ensure network security (Ericsson,2003).

2.2.7 Equipment Identity Register (EIR)

The EIR is also a database which contains the mobile equipment identity information which helps the operator to block calls from stolen, unauthorized, MSs or handsets.

2.2.8 The Network Monitoring Centres (NMC)

The network monitoring centres (NMC) is comprised of two main areas, namely, the Operation and Maintenance Centre (OMC) and the Network Management Centre (NMC).

2.2.9 Operation and Maintenance Centre (OMC)

The OMC performs all the operation and maintenance tasks for the mobile network such as monitoring network traffic and network alarms. The OMC has access to both the switching system (SS) and the Base Station System (BSS). An OMC is actually a computerized monitoring centre which is connected to other network components of the GSM network, such as MSCs, HLRs, VLRs, AUCs, BSCs, BTSs, etc via X.25 data network links. In the OMC, operations staff are presented with information regarding the status of the network and can monitor and

control a number of system parameters and performance indices. There are several OMCs within an operator's or service provider's network depending on the network size (Ericsson,2003).

2.2.10 Network Management Centre (NMC)

The NMC helps the telecommunication operator to perform centralized control of the network. Only one NMC is usually required for a network and this controls the subordinate OMCs.

2.2.11 Mobile Station (MS)

The mobile station (MS) is the handheld mobile phone at the subscriber or customer side of the network and it communicates with the Base Transceiver Station (BTS) via wireless frequencies or over the air. It is comprised of two parts, namely Mobile Equipment (ME) and Subscriber Identity Module (SIM).



Figure 2.5. The Mobile Station SubSystem of the GSM Mobile Network

Source: Ericsson @ 2008

An MS is used by the mobile subscriber to communicate with the mobile network. Several types of handsets or MSs exist from various vendors such as Nokia, Sony Ericsson, Samsung, etc each allowing a mobile subscriber to make and receive phone calls. The overall or summarised version of a GSM mobile network for an operator is as depicted below:

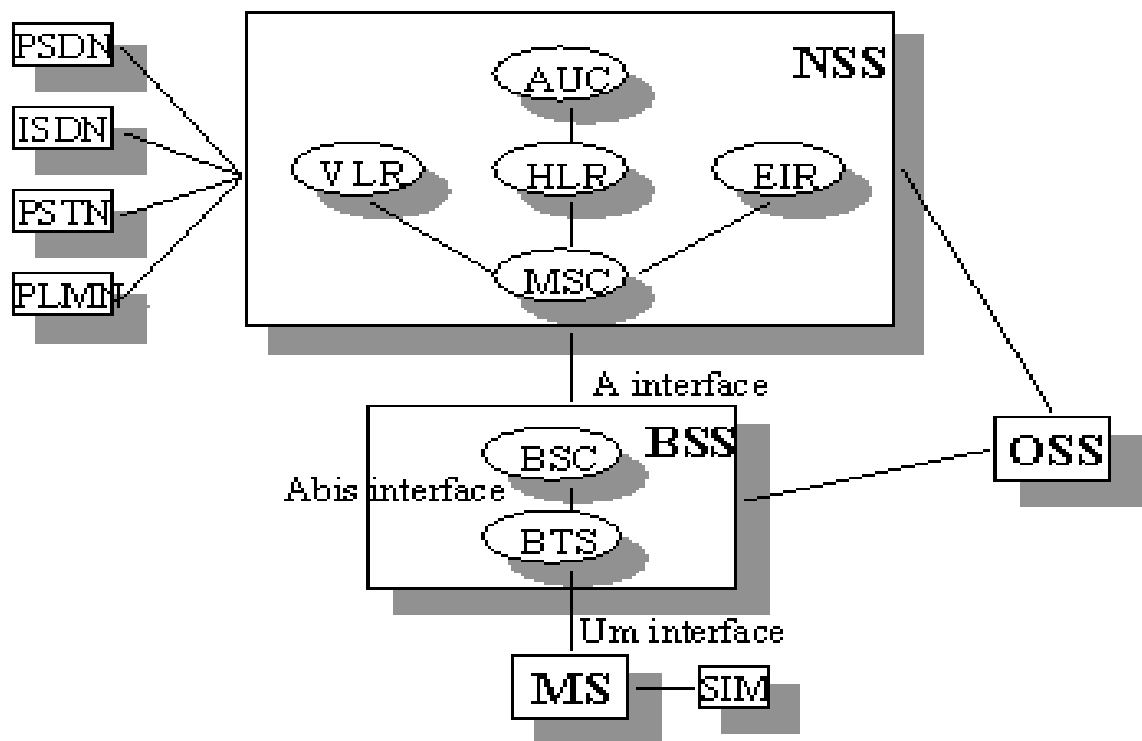


Figure 2.6. The GSM Mobile Network showing main components

Source: Ericsson @ 2003

2.2.12 GSM Geographical Network Structure

Every operator's telephone network usually employs a specific structure to route incoming calls to the correct exchange and then on to the destination subscriber. In a mobile network it is very important to have this structure since the subscribers who are mobile operator's customers are mobile. Hence, as these subscribers move through the network, these structures are used to monitor their location (Ericsson, 2003).

2.2.13 The Cell System

A cell is the basic unit of a cellular system and is defined as the area of coverage given by one Base station (BTS) antenna system. Each cell is usually assigned a unique identification number known as the Cell Global Identity in a specific GSM network. (Ericsson, 2003). It is a number of cell system that constitutes a base transceiver station (BTS) in a GSM network.

2.2.14 Location Area (LA)

A location Area (LA) is what defines a group of cells. Within the network a subscriber's location is normally linked to the LA in which he / she is currently located (Ericsson, 2003). The identity of the current LA is stored in the VLR (Visitor Location Register). Whenever a MS (Mobile Station) or handset or handheld device or GSM phone of a subscribers crosses the boundary between two cells belonging to different LAs in a particular GSM operator's network it reports its new Location Area to the network. Whenever there is a call for a subscriber's

MS, a paging message is usually broadcasted within all cells belonging to the relevant LA of the GSM network (Ericsson,2003).

2.2.15 Msc Service Area

In a GSM network, MSC service area is made up of a number of LAs (location areas) and represents the geographical part of the network controlled by a particular MSC. To be able to route a call to an MS, the subscriber's MSC service area is also recorded and monitored. This information is stored in the home location register (HLR) of the GSM network (Ericsson,2003).

2.2.16 PLMN Service Area

A Public Land Mobile Network (PLMN) service area is the entire set of cells served by one network operator and is defined as the area in which an operator offers radio coverage and access to its network services (Ericsson,2003). In Nigeria there are five(5) public mobile network areas belonging to MTN Nigeria, Airtel Nigeria, Glo Mobile, M-Tel and EMTS(aka Etisalat) network operators.

2.2.17 GSM Service Area

The GSM service area is defined as the entire geographical area or coverage in which any subscriber can gain access to a GSM network irrespective of the operator he/she is subscribed to. This area increases as more and more

operators sign contracts agreeing to work together (Ericsson,2003). International roaming is the term applied when an MS moves from one PLMN to another when abroad without having to officially register its SIM (subscriber identity module) at the operator abroad before accessing it network resources.

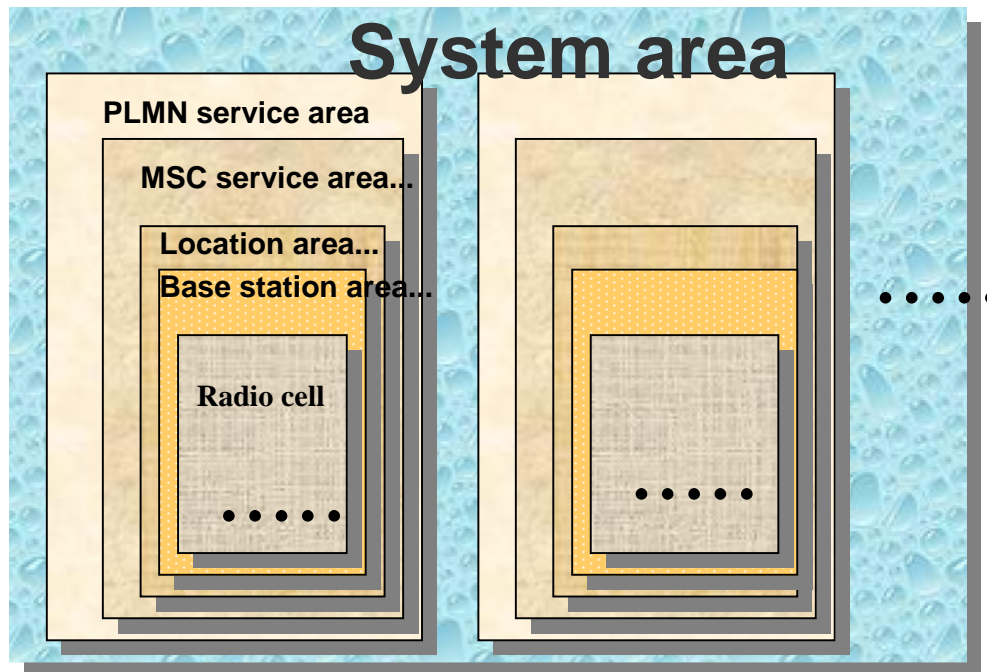


Figure 2.7. The GSM Service Area showing sub-areas

Source: Nokia GSM Presentation 2003

2.2.18 GSM Frequency Bands

The National Regulatory Authorities of every country or international region usually assigns to operators, from their available national frequency spectrum, operating frequency bands on lease basis. GSM has expanded world-wide to operate at four main frequency band categories as follows:

GSM 900

GSM 1800

GSM 1900

GSM 800 (Ericsson, 2003).

In Nigeria telecommunication industry (GSM) operators are allowed to operate only within the GSM 900 and GSM 1800 frequency bands.

2.2.19 GSM Operators' business Model

A business model describes the rationale of how an organisation creates, delivers, and captures value - economic, social, or other forms of value. The term business model is thus used for a broad range of informal and formal descriptions to represent core aspects of a business, including purpose, offerings, strategies, infrastructure, organizational structures, trading practices, and operational processes and policies (http://en.wikipedia.org/wiki/Business_model, accessed 2009-12-17).

Like every other business enterprise, the telecommunication operators in Nigeria operate with various types of business models which aim at giving their subscribers good telephony and data services at preset or otherwise tariff rates. These tariff rates as well as quality of service delivered to subscribers are regulated by the national regulatory authority, namely the Nigerian Communications Commission (NCC). According to Alexander Osterwalder's (2004) thesis a common reference model based on the similarities of a wide range

of business model conceptualizations exists as depicted below:

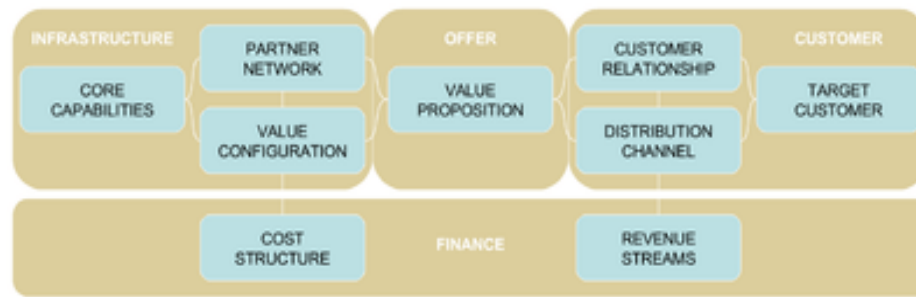


Figure 2.8. Alexander Osterwalder's Business Model design template

Source: Wikipedia.org 2004

According to his business model template nine building blocks and their relationship comprise to define a particular business model for any enterprise. These are as given below.

2.2.19.1 Infrastructure

This includes the business core capabilities, partner network and value configuration:

Core capabilities: The capabilities and competencies necessary to execute a company's business model.

Partner network: The business alliances which complement other aspects of the business model.

Value configuration: The Value Configuration describes the arrangement of activities and resources that are necessary to create value for the customer.

2.2.19.2 Offering

This has to do with the products and services a business offers. According to Osterwalder (2004), a value proposition "is an overall view of products and services that together represent value for a specific customer segment. It describes the way a firm differentiates itself from its competitors and is the reason why customers buy from a certain firm and not from another."

2.2.19.3 Customers

This consists of the target customers, distribution channels and customer relationship:

Target customer: This is the target audience for a business' products and services.

Distribution channel: This is the means by which the company delivers products and services to customers. It includes the company's marketing and distribution strategy.

Customer relationship: These are the links that a company establishes between itself and its different customer segments. The process of managing customer relationships is referred to as customer relationship management.

2.2.19.4 Finances

Cost structure: This is the monetary consequences of the means employed in the business model or strategy.

Revenue: This is the way a company makes money through a variety of revenue flows. In other words, this can be described as a company's income streams (Osterwalder, 2004).

2.2.19.5 Business Value Drivers Of GSM Operators

An organization's value has been defined as the present discounted worth of all net-cash flows occurring to security holders (both equity and debt holders). In theory, it is simply a figure that represents the entire cost of a company if someone was to acquire it (MTN, 2008).

Every telecommunication business will usually be comprised of investors in the form of shareholders and debenture holders who finance the business as a way of investing in the smooth and efficient running of the business with optimal returns on their investments in mind. They are often in a principal-agent relationship with the directors who make up top management and who are tasked with managing the affairs or operations or running of the company or business on their behalf.

Hence, they are seen as 'agents' of the business performing the managerial aspects of the business through effective corporate governance mechanisms. These directors are required by law to provide members of the business with yearly reports on the financial health and progress of the business on a going concern basis. Hence, shareholders as well as other security holders who own stakes in the business would analyse to see whether the enterprise is performing well or not since

positive return on investment is the main reason for investment of their hard earned money or capital.

2.2.19.6 Value Drivers

These are variables which significantly affects the value of an organization. These are the bases of a business' worth or overall performance. Value drivers could be qualitative or quantitative. Most value drivers of organizations are tied or linked up with the organization's key performance indicators (KPIs). Key performance indicators (KPIs) are indices through which an organization or enterprise defines and measures progress towards its goals and objectives. By studying the financial reports of most telecom companies the following key financial indicators are often regarded by telecom investors as primary or fundamental to their business successes.

Alfred Rappaport identified seven key drivers of value: • sales growth rate • operating profit margin • tax rate • fixed capital investment • working capital investment • planning period • cost of capital. However, since most GSM mobile operators are low margin and high volume companies in their sales strategy and hence are growth-driven, we will be looking mainly at the following key performance indicators as set out below:

Mobile subscriber growth

Operating profit margin

Revenue growth

Average revenue per user (ARPU)

EBITDA – Earnings before interest, tax, depreciation and amortization

Depreciation

Assets and Return on Assets

Expenditure - CAPEX

Expenditure - OPEX

Goodwill and other intangible assets like brands and registered trademarks

Cash flow

Cost of Capital

Human resource

2.2.19.7 Mobile Subscriber Growth

This index is usually compared with the previous year performance to assess or evaluate the company's penetration in the mobile market. This indicator is key since the figure represents the total revenue expected from subscribers of the mobile or GSM services. It also reflects the market share and sales effort of the marketing team of the telecommunication operator. This value can be affected by such factors as high tariff regime, poor quality of service, better offers by competitor networks leading to churn or high subscriber turnover rate meaning that subscribers are switching to other rivals for better GSM services.

It is also generally affected by increasing or decreasing demand for mobile services. An increase in this figure on the financial or operational review or report suggests that the business is losing revenue from subscriber churn on its network. Hence, most telecommunication operators would fight to gain more number in this variable. This is more so since the

nature of the business is low margin high volume and that means operators would battle for more subscribers by offering better quality or value added services to lure consumers to themselves.

2.2.19.8 Operating Profit Margin

The operating profit margin also known as return on sales is a ratio that relates the operating profit for the period to the sales revenue generated during the period under review (Atril and McLaney, 2008).

It is mathematically expressed as:

$$\text{Operating profit margin} = \frac{\text{Operating profit}}{\text{Sales revenue}} \times 100$$

The operating profit is derived as the net profit before interest and taxation and is used to represent the profit from trading operations before the interest payable expenses are taken into account on the income or profit and loss statement (Atril and McLaney, 2008). It is a ratio that compares one output of the business known as operating profit with another output known as sales revenue. This ratio varies from industry to industry and since the telecommunication industry has been identified as a low prices or low tariff business they would normally offer subscribers low prices or fees in order to stimulate demand and sales, therefore low profit margins.

Investors are likely to look seriously at this index as it gives an indication of how profitable the business has been in the period of review.

Factors such as degree of competition, the type of customer, economic climate and industry characteristics or features such as risk level are likely to affect this figure.

2.2.19.9 Revenue Growth

Revenue is simply a measure of the inflow of economic benefits resulting from the ordinary activities of the business. These benefits which accrue to the investors of the business, will result in either an increase in assets such as cash or infrastructure or a decrease in liabilities. Revenue streams for a mobile operator would usually be economic benefits due to more subscriptions, fees, etc as a result of more people using the telecommunication network services. Hence, owners of the business are likely to be evaluating the business in respect of past performance, business plans or projections and close rivals in respect of seeing a revenue growth.

2.2.19.10 Average Revenue Per User (ARPU)

The ARPU figure or index is a very key indicator used by telecommunication businesses to judge the profitability of their business or operational performances. This measure is most often used in the telecommunication sector to survey the amount of revenue generated per cell-phone user, for example. The values of the measures obtained can be used as a comparison between companies. Companies may also use this

information to determine which product lines are lagging
(<http://www.investopedia.com/terms/a/arpu.asp>, accessed 2009-12-17).

Mathematically, it can be expressed as :

$$\text{Average revenue per user} = \frac{\text{Sales revenue}}{\text{Total number of subscribers}} \times 100$$

Shareholders and other investors as well as telecomms management are usually in favour of increasing figure in this index since it represents the fact the the business is generating more money or profit or returns for investors and also proves that sales strategies employed by marketing management is yielding positive impacts from the targeted consumer or subscriber segments.

2.2.19.11 EBITDA – Earnings before interest, tax, depreciation and amortization

This is an indicator of a company's financial performance and it can be expressed mathematically as given below:

EBITDA

$$= \text{Revenue} - \text{Expenses (excluding tax, interest, depreciation and amortization)}$$

EBITDA is essentially net income with interest, taxes, depreciation, and amortization added back to it. EBITDA can be used to analyze and compare profitability between companies and industries because it eliminates the effects of

financing and accounting decisions. However, this is a non-GAAP measure that allows a greater amount of discretion as to what is (and is not) included in the calculation. This also means that companies often change the items included in their EBITDA calculation from one reporting period to the next (<http://www.investopedia.com/terms/e/ebitda.asp>, accessed 2009-12-19). Often, management of telecommunication companies often use this EBITDA metric though it is a non-GAAP measure to show how profitable their business had been in the period under review. Hence, they employ an EBITDA Valuation model in their financial reports. A positive growth in this figure indicates that the business is getting more financially beneficial to its security holders and other stakeholders.

2.2.19.12 Depreciation

A lot of telecommunication assets (plants, property and equipment) are non-current in nature and do not have a perpetual existence. They are used up in the process of generating revenue for the business. Hence, depreciation is an attempt to measure that portion of the cost (or fair value) of a non-current asset that has been used up in generating the revenue recognised during the period under review. The depreciation charge is normally considered as an expense and charged against the period to which it relates in the income or profit/Loss statement (Atril and McLaney, 2008).

Depreciation can be applied to both tangible non-current assets as well as intangible non-current assets. In order to properly calculate the depreciation charge for a period on a tangible non-current asset the

following factors are usually considered (Baumol, W. J, J. Panzer and R. Willig 1982):

The Cost (or fair value) of the assets

The useful life of the asset

The residual value of the asset

The depreciation method employed in the industry as required by GAAP (Atril and McLaney, 2008).

The cost of the asset will include all costs incurred by the telecom business to bring the asset to its required location and to make it ready for use. Hence, in addition to the costs of acquiring the asset, any delivery costs, installation costs (for instance, setting up a new MSC / VLR or switching system or Base transceiver Station (BTS)) and legal costs incurred in the transfer of legal title (e.g. in purchasing or leasing a property) will be included as part of the total cost of the asset (Atril and McLaney, 2008).

The historical cost method which uses the depreciation method by recording value of assets using their historical costs less any depreciation. The fair value in contrast to the historical cost method uses the current market value of the asset (i.e. the exchange value in an arm's-length transaction) for valuing non-current tangible assets. The useful life of a non-current tangible asset has both economic and physical life.

The physical life is usually exhausted through the effects of tear and wear that arises with use and passage of time. While the economic life is dependent on the technological progress and by changes in demand. For a telecom business environment, technological innovations changes very rapidly and hence this seems

to impact heavily on telecom non-current tangible assets as the rate of obsolescence of telecoms equipment is high caused by technological evolutions of the mobile network.

Residual value also known as disposal value is the payment received by a telecom business when it disposes of a tangible non-current asset such as obsolete MSCs, BSCs, multiplexers, etc that may still be of value to others. In order to calculate the total amount to be depreciated, the residual value must be deducted from the cost of the asset (Atril and McLaney, 2008).

Selecting the depreciation method to use for a particular asset depends on which one matches the depreciation expense to the pattern of economic benefits that the assets provides. There are two main types of depreciation methods employed by accountants, namely the straight-line method and the reducing balance method (Atril and McLaney, 2008).

The straight-line asset depreciation methods simply allocates the amount to be depreciated evenly over the useful life of the asset. In other-words, it uses an equal amount of depreciation charge per year that the asset is held. The annual depreciation charge appears on the income statement in relation to the particular asset and will be accumulated for as long as the asset continues to be owned by the telecom business (Atril and McLaney, 2008).

The balance left after the annual depreciation charge is deducted from the historical cost of the asset is referred to as the carrying amount or written-down value or net book value of the tangible non-current asset. The reducing-balance method of asset depreciation applies a fixed percentage rate of depreciation to the carrying amount of an asset each year.

2.2.19.13 Assets and Return on Assets

An asset is simply a resource held by the business (Atril and McLaney, 2008). Assets are bought to increase the value of a firm or benefit the firm's operations (<http://www.investopedia.com/terms/a/asset.asp>, accessed 2009-12-18). It can be considered as anything that can generate cash flow for the business such as the switching equipment (MSC, BSC, MGW, routers, etc), multiplexers, transmission equipment, base transceiver stations, etc that constitutes the capital expenditure (CAPEX) of telecommunication business. This includes all telecom infrastructure ranging from the BTS shelters, roof-tops, fibre ducts, satellite systems etc that enables the operator efficiently deliver service to its customers.

In the realm of accounting, assets are either current or fixed (non-current). Current means that the asset will be consumed within one year. Generally, this includes things like cash, accounts receivable and inventory. Fixed assets are those that are expected to keep providing benefit for more than one year, such as equipment, buildings and real estate, BTS, MSCs, Fibre trunks and other fixed telecommunication infrastructure. For accounting purposes for an item to be considered or recorded as an asset in the business balance sheet, it should have the following characteristics:

Probable future benefit

Exclusive right by the telecommunication business to control the benefit

The benefit must arise from some past transaction or event

The asset must be capable of measurement in monetary terms (Atril and McLaney, 2008).

Telecom infrastructure has the characteristic of yielding future monetary value through its use. For instance, a BTS (base transceiver system) on the GSM network on a 222 / 444 configuration would serve approximately 296 subscribers

connected at the same time in one hour. Let's assume that these subscribers use the MTN Family and Friends subscription and these calls are outbound to other GSM networks like Airtel. From MTN tariff plan it will cost a subscriber 70k (seventy kobo) per second. Hence, per hour MTN would charge its subscribers $70 \times 3600 = 252000\text{kobo} = 2,520 \text{ naira}$ per hour per subscriber. This would amount to one BTS on a 222/444 transceiver configuration yielding for MTN an approximate $2,520 \times 296 \text{ NGN} = \text{NGN}745,920 = \text{USD } 4,972.80$. Hence, one can see that a BTS will be regarded as a valuable non-current tangible asset that would appear under property, plant and equipment row of MTN annual balance sheet.

However, the telecom business must have exclusive rights of ownership or control of the asset or infrastructure such as BTS or fibre trunk for it to be regarded by accountants as an asset. Hence, such things as tower, shelter, BTS, BSC which are all housed or homed within technical premises of the operator are all assets by exclusivity of control or access to them. The operator would also obtain the right to the premises from original landlord on freehold or leasehold basis and all these would be recorded on a historical cost less depreciation basis in the balance sheet of the company annual reports.

Finally, these assets would with a reasonable degree of reliability be measured in monetary terms before they can be regarded as assets. For instance, to record the historical cost of a BTS would involve accumulating all costs such as cost of acquiring the premises from original landlord, cost of purchasing and installing the tower or masts, cost of civil works, and cost of BTS equipment itself. From research the average BTS site build cost in Nigeria is 14,000,000 NGN(naira) or approximately USD90,000! However, this value is depreciated every year due to wear and tear and obsolescence of technology.

2.2.19.14 Asset Performance

Asset performance has been defined as a business's ability to take productive resources and manage them within its operations to produce subsequent returns. Asset performance is typically used to compare one company's performance over time or against its competition. Possessing strong asset performance is one of the criteria for determining whether a company is considered a good investment (<http://www.investopedia.com/terms/a/assetperformance.asp>, accessed 2009-12-18). Analysts use metrics like the cash conversion cycle, the return on assets ratio and the fixed asset turnover ratio to compare and assess a company's annual asset performance. Typically, an improvement in asset performance means that a company can either earn a higher return using the same amount of assets or is efficient enough to create the same amount of return using less assets (<http://www.investopedia.com/terms/a/assetperformance.asp>, accessed 2009-12-18).

2.2.19.15 Return on Assets (ROA)

An indicator of how profitable a company is relative to its total assets. ROA gives an idea as to how efficient management is at using its assets to generate earnings. Calculated by dividing a company's annual earnings by its total assets, ROA is displayed as a percentage. It is also sometimes referred to as "return on investment" (<http://www.investopedia.com/terms/r/returnonassets.asp>, accessed 2009-12-18). Mathematically, it can be represented as the equation or formula below:

$$ROA = \frac{Net\ income}{Total\ assets} \times 100$$

ROA tells investors what earnings were generated from invested capital (assets). ROA for public companies can vary substantially and will be highly dependent on the industry. This is why when using ROA as a comparative measure, it is best to compare it against a company's previous ROA numbers hence, the figure is expected to be high or higher compared to previous year performances.

2.2.19.16 Capital Expenditure (CAPEX)

Capital expenditure is regarded as funds used by a company to acquire or upgrade physical assets such as property, industrial buildings or equipment. This type of outlay is made by companies to maintain or increase the scope of their operations(<http://www.investopedia.com/terms/c/capitalexpenditure.asp>, accessed 2009-12-18). These expenditures for a telecom business would include expenditure on telecom infrastructure and distribution.

Most telecom company expand their networks to improve capacity, quality and coverage; modernise the network and make it more efficient; stimulate and support the development and launch of new products. Usually big telecommunication operators would undertake to rollout more new 2G base transceiver station (BTS's) and new 3G BTS's to expand their coverages. They also undertake in capital intensive project like providing additional capacity to both the circuit switch (voice) and packet switch (data), and rolling out fibre optic metropolitan network in the high-traffic zones.

2.2.19.17 Core Network Expenses

This is usually driven by heated competition in the market as well as by subscribers demand pushing the operators to seek new locations where their network needs to reach. This index is of major concern to operators of telecom business as it must be justified for shareholders through efficient return on asset performance on a yearly basis.

Hence, telecommunication is seen as a capital intensive industry. In accounting terms, an expense is considered to be a capital expenditure when the asset is a newly purchased capital asset or an investment that improves the useful life of an existing capital asset. If an expense is a capital expenditure, it needs to be capitalized; this requires the company to spread the cost of the expenditure over the useful life of the asset. If, however, the expense is one that maintains the asset at its current condition, the cost is deducted fully in the year of the expense (<http://www.investopedia.com/terms/c/capitalexpenditure.asp> accessed 2009-12-18).

Usually, the managers and analysts of telecom business would like to have this figure optimised in such a way as to justify expenditure through measuring the asset usage performance. Therefore, metrics like return on assets are major tools used to evaluate this cost expenditure in relation to returns to shareholders and other stakeholders of the telecommunication business. Typical capital expenditure for a telecommunication business would be the following:

- cost of purchasing new BTS equipment from their vendors

- cost of buying or leasing buildings, landed properties or shelters and towers for their telecommunication equipment

- cost of buying or procuring new Base Station controllers (BSC)

cost of purchasing new switches or MSC (Mobile switching centre)

cost of purchasing new transmission equipment like microwave radio and antennas

cost of procuring and installing fibre metropolitan networks

cost of procuring intelligent network equipment

2.2.19.18 Operating Expenses (OPEX)

OPEX (operating expenses) is a category of expenditure that a business incurs as a result of performing its normal business operations. One of the typical responsibilities that management must contend with is determining how low operating expenses can be reduced without significantly affecting the firm's ability to compete with its competitors (http://www.investopedia.com/terms/o/operating_expense.asp,2009-12-18).

For example, the payment of employees' wages and funds allocated toward research and development are operating expenses. In the absence of raising prices or finding new markets or product channels in order to raise profits, some businesses attempt to increase the bottom line purely by cutting expenses(http://www.investopedia.com/terms/o/operating_expense.asp,2009-12-18). Typical opex costs for a telecommunication operator would be as such below:

engineering staff salaries and allowances

staff relocation fees

staff recruitment

general staff welfare

BTS rent and taxes

Other buildings and technical premises rent and taxes
engineering offices rents
rent of switches
rent due to accommodation Contractors
utilities such as water, electricity and fuel

2.2.19.19 Goodwill and other intangible Assets

Goodwill is seen as an intangible asset on the balance sheet because it is not a physical asset such as buildings and equipment. Goodwill typically reflects the value of intangible assets such as a strong brand name, good customer relations, good employee relations and any patents or proprietary technology. Goodwill can often arise when one company is purchased by another company. In an acquisition, the amount paid for the company over book value usually accounts for the target firms's intangible assets (<http://www.investopedia.com/terms/g/goodwill.asp>,2009-12-18).

These are regarded as intangible non-current assets and are similar to non-current assets in that they have a clear and separate identity and the cost of acquiring them can be reliably measured (Atril and McLaney, 2008). Examples of these are technology patents, trademarks, copyrights, software patents and licenses.

2.2.19.20 Cash flow

Cash is the life blood of every telecommunication business since its nature is primarily capital intensive requiring heavy financing of its operations through

capital investments or expenditures. Cash flow is regarded as a revenue or expense stream that changes a cash account over a given period. Cash inflows usually arise from one of three activities - financing, operations or investing. Cash outflows result from expenses or investments (<http://www.investopedia.com/terms/c/cashflow.asp>, 2009-12-18). The net cash flow of a telecommunication business is used by investors and analysts to judge its financial performance and competitive advantage in the industry.

2.2.19.21 Cost of Capital

Cost of capital is defined as the required return necessary to make a capital budgeting project decision. Cost of capital is an aggregate of both the cost of debt and the cost of equity. The cost of capital determines how a company can raise money (through a stock issue, borrowing, or a mix of the two). This is the rate of return that a firm would receive if it invested in a different vehicle/venture/project with similar risk (<http://www.investopedia.com/terms/c/costofcapital.asp>, 2009-12-18).

A typical telecom business decision might be whether to build a new switching centre in a new location or not. Hence, investment analysts and accountants would ensure that the returns expected from such venture would exceed the investment cost of capital. In order to maintain or adjust the capital structure, most telecoms company may adjust the amount of dividends paid to shareholders, return capital to shareholders, or issue new shares or sell assets to reduce debt. Consistent with others in the industry, the company would monitor capital on the basis of its gearing ratio. This ratio is calculated as net debt divided

by total capital. Net debt is calculated as total borrowings less cash and cash equivalents. Total capital is calculated as equity and will be reflected the balance sheet, plus net debt. The following are factors that drive the cost of capital for a telecommunication business:

Leverage

Risks such as exchange ratios, political stability or instability, industrial sector, project and commercial terms

Guarantee

Structure

Regulation (World Bank, 2008)

Based on studies carried out by the Nigerian Communications Commission (NCC) the WACC (weighted average cost of capital) for fixed services is 29% while the WACC for mobile services is 27% in relation with interconnection among operators.

2.2.19.22 Human resource

Though not reflected in the balance sheet of a telecom business, most telecommunication operators regard their employees as their most important or most valuable assets in respect of the telecom business. Telecommunication business is specialized and hence always require human capital that is highly trained and developed to manage telecom services for the operators. Since they recognise them as source of their competitive resource and advantage, telecom companies or businesses often invest a lot in the training and development of

their engineers to enable them acquire proficiency in the core set of telecom management skills. Some of the human resource skills and competencies are reflected in the job roles and responsibilities obtainable in a typical telecom operator business as outlined below:

- Radio frequency engineers and specialists
- Transmission engineers and specialist
- Core network engineers and specialist
- Power system engineers and specialists
- Fibre network engineers and specialists
- Switch engineers
- Project Managers
- Accountants and financial controls
- Safety health and environment (SHE) officers
- Revenue assurance staff
- Marketing and Sales staff
- Business Intelligence specialist
- Business Analysts
- Quality control and assurance experts
- GIS (Geographic Information System) specialists
- Datacommunication specialist
- Project Accountants
- Vendor relations and procurement staff

2.2.19.23 Telecommunication Infrastructure Categories

Telecommunication infrastructure for the purpose of this research thesis will be limited to mobile infrastructure. This is in order to manage scope properly

and effectively utilize time since the scope of telecommunication infrastructure is very broad covering fixed-line, wireless and mobile infrastructure. Basically, a cell site for a mobile operator will consist of the following components:

Active infrastructure which consists of the electronic infrastructure or elements such as base station transceivers (BTS), microwave radio equipment, switches, antennas, transceivers for signal processing and transmission and all other electronic systems and components of the mobile network

Passive infrastructure which comprises the non-electronic infrastructure including, but not limited to, towers, shelters, air conditioning equipment, diesel generators, battery banks, electrical supply, technical premises and easements and pylons that account for almost 60 percent of network rollout costs (http://en.wikipedia.org/wiki/Telecommunication_infrastructure_sharing, accessed 2009-08-20).

2.2.19.24 Infrastructure Sharing Models

The type or form of infrastructure sharing prevalent in a particular country can take multiple options amongst telecom service providers and the model adopted depends on the telecom regulation and legislation or policy in place in that country or economy. Countries like the United Kingdom and Sweden have witnessed the structural separation between infrastructure and service provisioning whereby fixed line operators can leverage infrastructure sharing to optimize the use of their networks. However, it was the mobile sector that paved the way towards mature infrastructure sharing models worldwide (Chanab et al, 2007).

Table 2.1 Examples of mobile infrastructure components

Source : Booz Allen Hamilton 2007

Active Components	Passive Components
-------------------	--------------------

1.Base Stations	1.Towers
2.Microwave Radio Equipment	2. Shelters
3.Switches	3. Electric Supply
4. Antennas	4. Easements
5. Transreceivers	5. Ducts

2.2.20 Passive Infrastructure Sharing(aka Site Sharing)

This is the sharing of the non-electronic 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 et al,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 et al, 2007). Enforcing such cooperation is a major challenge to regulatory authorities.

2.2.21 Active Infrastrcuture Sharing (aka 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 et al, 2007). In this model, operators typically share the RBS, RNC, mobile services swithcing centre / Visiting location register (MSC / VLR), and serving GPRS support node (SGSN). Each operator, however, has its own individual home network that contains the independent subscriber databases (such as HLR, AUC, etc) services, subscriber billing and connections to external networks. Network sharing (aka active sharing) requires additional planning and deployment efforts to accomodate each participating operator's capacity needs (Chanab et al, 2007).

2.2.22 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 (http://en.wikipedia.org/wiki/Telecommunication_infrastructure_sharing, accessed 2009-08-20). Since spectrum is a scarce is scarce that is often under-utilized by

one operator in a given location, sharing proves a viable option for two or more operators (Chanab et al,2007).

2.2.23 MVNO (Mobile Virtual Network Operator)

MVNO typically have no network and spectrum rights of their own though some advanced MVNOs will build parts of their core network needs, they basically rely on infrastructure sharing to get access to subscribers and offer services (Chanab et al, 2007).

2.2.24 National Roaming (aka 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. While national roaming is generally introduced with a sunset caluse, 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 et al,2007; Bhanu, 2007; David, 1995; Ghemawal, 1986).

2.2.25 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. The economics are strongly

driven by colocation of operators on sites. Tower management companies 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 infrastructure and managing it, hence lowering operating expenses in the long run (Chanab et al,2007; Godfrey, 1995; Frost, 2008; Coyne 1986, Gray, 1982).

An example of this is Helio Towers Nigeria (www.heliostowers.com), a company that provides wireless operators in Nigeria with fully-managed tower sites on a lease basis.

2.2.26 The Driver For Infrastructure Sharing

The growth in wireless mobile subscribers in Nigeria in the last twelve (12) years have been phenomenal and now reaching above 70.1 million subscribers today. Due to this intensive growth, combined with heated competition among rivals, there has been a rising trend in the cost of capital expenditure dispensed by telecommunication operators in their bids to reach more subscribers.

Hence, more and more operators now resort to sharing infrastructure or colocation as a strategy for reducing this heavy cost burden in network rollouts or deployments as well as network expansions and upgrades. Given that such investments in technology and network deployment are fixed, sunk and irreversible, they represent a high risk factor. This risk is further compounded by

the need, for both fixed and mobile operators, to continuously adopt new technologies and upgrade infrastructure. Therefore, infrastructure sharing has been seen as a means of reducing this risk for operators by spreading it among several players (Chanab et al,2007, Fahy, 1996; Collis, 1991, Darch, 2004; Gunther, 1995). Other motivations for sharing of infrastructure among telecommunication service providers include the following:

- Sharp rising site rentals: Site acquisition is a key aspect of mobile telecommunication site build and many operators are challenged by the rising cost of real-estate prices, as site rentals have also seen a sharp increase. Site owners are now aware of more players desiring to rollout in urban and rural areas and hence the demand for tower sites and rentals are expected to rise sharply (Aggarwal, 2009; Fahin, 2009; Estache, 2004; Chamberlin, 1933; Davidson, 1989).
- New Tower Restrictions: Both the Urban Planning Ministries and Local Government Authorities, as well as State governments are beginning to place restrictions on new tower constructions on the grounds that they pose health hazards and congest the skyline (Aggarwal, 2009; Day, 1994; Girbert, 1989).

2.2.27 The Regulatory Perspective

Many National Regulatory Agencies around the world are driven to favour infrastructure sharing as a way of stimulating competition and hence they are beginning to formulate policies that would regulate and encourage sharing of infrastructure among telecommunication companies as a key lever to foster competition and optimize telecommunication investments (Chanab et al,2007;

Cave, 1980; Floyd; Booz, 2007 1990). For these NRAs, infrastructure sharing limits duplication and gears investments towards underserved areas, product innovation, and improved customer service (Chanab et al,2007).

The Nigerian regulatory authority, NCC (Nigerian Communications Commission) favours infrastructure sharing and has developed what it calls "Guidelines on Colocation and Infrastructure Sharing" as a framework for infrastructure sharing among telecommunication operators in Nigeria. The following were given as the objectives of these guidelines:

To ensure that the incidence of unnecessary duplication of infrastructure is minimized or completely avoided;

To protect the environment by reducing the proliferation of infrastructure and facilities installations;

To ensure that the economic advantages derivable from the sharing of facilities are harnessed for the overall benefit of all telecommunication stakeholders;

To minimize operators' capital expenditure on supporting infrastructures and to free more funds for investment in core network equipment;

To encourage operators to pursue a cost-oriented policy with the added effect of a reduction in the tariffs chargeable to customers.('Guidelines on Colocation and Infrastructure Sharing', NCC).

According to the NCC, infrastructures amenable to sharing are those that can be shared without an attendant risk of lessening of competition. The Commission (NCC) also encourages and promotes the sharing of the following infrastructures:

Rights of Way
Masts
Poles
Antenna masts and tower structures
Ducts
Trenches
Space in buildings
Electric power (public and private source)

2.2.28 The Competition Perspective

From the operators perspective, infrastructure sharing is seen as a means of reducing capital and operational expenditures as well as quick rollouts of their networks allowing inflow of revenues. Infrastructure sharing is also viewed as a means of achieving optimum utilization of resources or assets and hence improved economic efficiency.

New entrants view telecommunication infrastructure sharing as a means of rolling out their networks cheaper and faster and hence optimize investment in the telecommunication sector. Some incumbents view it as a new source of revenue creation from new entrants while other incumbents criticize it as not favouring facilities-based competition since, in their arguments, the new players are given the undue advantage of saving capital expenditures while they 'parasite' on incumbents sunk investments.

Yet another school argues that infrastructure sharing creates forms of collusion among the bigger incumbents and prevents real competition. However, this collusive behaviour can be properly managed through regulatory policy-making, enforcements, inducements or incentivisation (Chanab et al, 2007; Erisson, 2004; Emeka, 2008).

2.3 Hinderances to Infrastructure Sharing in Nigeria

Some experts and analysts have argued the following as major deterrent or factors that often discourage operators in Nigeria from sharing infrastructure with other operators

2.3.1 Use of Different Suppliers in Value Chains

Many operators often complain of incompatibility of equipment and systems employed by other operators as major deterrents to infrastructure sharing. This hinders interoperability which is the ability of systems or equipments from both sides to operate without problems of mis-matched configurations. This is due to the fact that many operators often employ different suppliers or vendors in their value chains as a source of competitive advantage (CIPESA,2006)

2.3.2 Use of Inferior Equipment

Some operators deploy systems of inferior quality and so others that deem to have superior systems might not be willing to share with these in order to maintain their competitive advantage (CIPESA, 2006).

2.3.3 Monopolistic Behaviour Among Big Players

Often new entrants into some telecommunication markets in Nigeria often complain of anti-competitive or unfair monopolistic behaviours adopted by dominant incumbent players who would have established wide network coverage before the entry of the new players. Hence, these monopolistic players create barriers of entry by showing unwillingness to share infrastructure.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Research Methodology

This research work is based on a well structured method using standard empirical tools. The Research design provides the framework for data collection and analysis. It reveals the type of research whether exploratory, descriptive or causal and with respect to the priorities of the researcher (Ghauri and Gronhaug, 2005). The research design will comprise of combination of descriptive, exploratory and causal approaches. This is because the concept of telecom infrastructure needs to be clarified, and existing models explored in order to investigate the causal relationships that exist among the variables under study.

It consist of both qualitative and quantitative methods of data collection and empirical analysis will be employed. Again, this is due to the nature of variables and context being investigated. The researcher has employed a case research approach as the method is particularly well suited for this research thesis since the phenomenon under investigation is difficult to study outside its natural context and also the concepts and variables under scrutiny are difficult to a large extent to quantify (Ghauri and Gronhaug, 2005).

The researcher make use of standard model and assumptions based on previously tested theories in Western and other telecommunication market, the research will involve a deductive approach to drawing or making conclusions based on hypotheses drawn from studying existing literature (Ghauri and Gronhaug, 2005). This research work refers to the use qualitative and field-based

construction techniques; and analysis of business cases (Ghauri and Gronhaug, 2005). The case study research will hence, involve data collection through multiples sources such as questionnaires, verbal reports, personal interviews, focus groups, electronic observations as primary data sources (Ghauri and Gronhaug, 2005).

The research approach adopted in this research thesis is basically a deductive one in which the researcher have built hypotheses drawn from existing body of knowledge (literature review) and hence will have to be subjected to empirical scrutiny / testing leading to acceptance or rejection of prior hypothesis (Ghauri and Gronhaug, 2005).

Chapter three also deals with the plan for investigation that specifies the sources and type of data relevant to research question(s). It is a framework specifying the approach to be used for gathering and analyzing of data in responds to administered questionnaire. It presents the methods, tools and techniques adapted to measure the effect of colocation arrangement on cost efficiency of selected GSM firms in Nigeria. It identifies the various aspects of colocation that affects cost efficiency of GSM firms in Nigeria. It covers the data-type used; the procedure for selection; instrument used; population, and sample size. It also specifies the techniques used for the data analysis.

3.2 Research Design

Kermere and Taylor (1983) emphasized that a good research design will ensure that collected data is consistent with the study of the objectives in addition to being accurate and economical. Functions of the research design include:

- a. Demand for answers to questions among relationship among variables
- b. Increased certainty and generalization of results.

As a field of survey, this research work focus on the colocation arrangement among GSM firms in Nigeria and see how such arrangement affect cost efficiency. Data for analysis for this work is exclusive primary data with no attempt is made to include secondary data. The study followed objectivity in the identification of aspect of colocation that affects cost efficiency on the basis of literature review. The above imply that some aspect of colocation (variables or factors) are identified through literature review and analyzed to see how it affect (whether positive or negative) cost efficiency of GSM firms in Nigeria. The field survey approach was adapted for data collection based on specific application area such as:

- a. Core Network
- b. Network operations
- c. Human Resource
- d. Spectral sharing
- e. Security

In this study, the researcher developed a well-structured and standardized questionnaire on perceived aspect of colocation that affect cost efficiency of GSM firms in Nigeria based on the Likert five-point ordinal scale and they were administered to staff, experts, users, systems analysts, programmers and other stakeholder in the domain of study. The respondents possess technical skills, academic qualification and experience in colocation arrangement of GSM operations in Nigeria. A total two hundred (200) copies were distributed.

3.3 Sources of Data

The sources of data for this research work were exclusive primary data sources. Primary data sources for this research work were obtained from structured and standardized copies of questionnaire targeted to 200 respondents. The respondents are professionals or stakeholders in the area of the research interest. When funding permits, primary data gives credibility to the research result for the following reasons:

- a. It reduces the interviewer's biases and interpretations of questions.
- b. It allows the respondent(s) to think twice before answering a question.
- c. It allows some privacy for some sensitive questions
- d. It is a fair fast method of collecting data.

The major sources of secondary data include: textbook, conference and workshop papers and they were used mainly in literature review.

3.4 Method of Data Collection

This section deals with means and techniques through which data was collected for this research thesis. The primary data (copies of questionnaire) collected here were meant for testing and validating the prior hypotheses postulated through literature review which is the secondary source of data. The Nigerian telecommunication sector is made up more than twelve (12) telecommunication operators constituting of mobile and fixed private operators. The mobile GSM sector is made up of five (5) operators of which colocation relationship exists mainly between two (2) dominant operators namely, MTN and Airtel. Hence, this colocation arrangement between these two have been selected as a case study.

A random sampling strategy was employed, the researcher visited the operators (MTN and AIRTEL). This sampling method is representative of the

entire population of GSM mobile operators in Nigeria seeing that MTN has 49.19% of the mobile market share, while Airtel has 24.74%. This research thesis is case study based and the single case reviewed is the colocation / infrastructure sharing pact that is being currently undertaken by MTN Nigeria and Airtel Nigeria. Both companies constitute 40% of the total number of mobile operators in Nigeria. Both telecommunication companies have undertaken to share infrastructure under a mutual agreement called colocation 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.

3.4.1 Method of Primary Data Collection

Primary data collection tools will be used for this thesis. One form captures information concerning the respondent(s) and his experience in GSM colocation arrangement in Nigeria and the other form captures detail identification of the several aspects of colocation arrangement that affect cost efficiency. This form that captured data on aspect of colocation 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 (Osuala, 1982).

The respondents are required to indicate the degree of agreement or disagreement with each of the statements. A numerical score is assigned to each degree of agreement / disagreement. The scores from the statement are added up to obtain the total score for each respondent. Example:

Table 3.1: Likert five-point table

Source : Booz Allen Hamilton 2007

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

The use of Likert five-point as an attitude measuring scale is well justified for this study and is rigidly followed as described by Banker et al (1994) as listed below:

- i. Responses were selected and subjected to scoring based on the judgmental assessment on the degree of how the various aspects of colocation affect cost efficiency of GSM firms in Nigeria.
- ii. Favorable and unfavorable statements of how the aspects of colocation affect cost efficiency of GSM firms in Nigeria were compiled.
- iii. Collected statements in the form of a questionnaire were administered to a sample deemed to be reasonably representing the population being studied.
- iv. Each respondent's score is obtained by adding up the scores of the responses to each statement.

These steps have been followed rigidly in obtaining data and opinion of respondents regarding aspect of colocation arrangement that affect cost efficiency of GSM firms in Nigeria. Kauffman et al (1993) argue that attitudes are complex and difficult to measure, and that individuals tend 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 attitudes vary

respondents may obtain exactly the same score from agreeing with quite different items (Osuala 1982).

3.4.2 Population of Study and Sample Survey

In this research work the concept of population is the aggregate or totality in the universe of study. Population could be finite or infinite. The study of the entire population is known as enumeration, the researcher has chosen his population as all staff, experts in the field of GSM colocation in Nigeria. The result of this study will be of interest to entire population. It will determine how the various aspect of GSM colocation affect cost efficiency of GSM firms in Nigeria.

Due to limitation in resource(s) the researcher might find it difficult to conduct total enumeration (studying the whole population). The option is to limit the study to some of the objects selected from the population sample with a view to extending the findings to the entire population. Basic to all statistical inferences and decision based upon them is the uncertainty introduced by the use of a sample instead of entire population of interest. For example, in experimentation where the population of observations might be infinite, man's inability to observe "all nature" is obvious. In the social and behavioral science or other applications involving a finite population, the large size of this finite population still dictates that samples be taken from the population. In this research, the researcher has taken an approach, which ensures that the sample is representative of the population and at the same time uses an economically feasible subset of it.

There are many companies involved in GSM operations located in various parts of Nigeria. These companies have professionals with several years of experience in GSM colocation contract and related jobs in their corporate bodies. Instead of getting responses from all professional in all the companies, the researcher has selected a few to represent the entire population. This decision was made due to resource constraints. About 200 copies of questionnaires were distributed to the experts who are knowledgeable in the selected areas. The approach used in this survey is the simple random sampling.

3.4.3 Questionnaire Distributions

The distribution of the copies of questionnaire was purely exclusive because the respondents are expected to be highly skilled and educated in GSM colocation practice-related fields. The following will guide the researcher in distributing the questionnaire:

- a. The respondent must be educated, at least possess WAEC/ GCE or higher qualification in computer, telecommunication and ICT related discipline and must be skilled employee of the selected companies.
- b. He must be willing to respond.
- c. The respondent must not be less than 16 years of age and not less than five (5) years of experience in the practice of the GSM Firms.

The above requirements were satisfied.

3.5 Method of Data Analysis

3.5.1 Multiple Regression Analysis

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 value is dependent on the other variables variously referred to as the independent variables. In multiple regressions, the model describing the relationship between the dependent variable and independent variables is as given in the equation 3.1 below:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon_i \quad \text{equation 3.1}$$

Y = the dependent variable

Where X_1, X_2, \dots, X_n = independent variables

β_0 = a constant value of Y when all X values are 0.

$\beta_1 + \beta_2 + \dots + \beta_n =$ net regression coefficients. For instance, β_0 measures the change in $X_{1, \dots, n}$ while holding the other variables constant.

ε_i = independent and normally distributed random error term with mean zero.

For the purpose of this study, our

- Y = Cost Efficiency
- X₁ = Core Network aspect
- X₂ = Network operations aspect
- X₃ = Human Resource aspect
- X₄ = Spectrum sharing aspect
- X₅ = Security aspect

3.5.1.1 Test of Hypotheses (Ho₁ and Ho₂)

Hypotheses Ho₁ and Ho₂ are to be tested using multiple regressions. Y represents cost efficiency (dependent variable) while the independent variables (X₁...X₅) will be:

- X₁ = Core Network aspect
- X₂ = Network operations aspect
- X₃ = Human Resource aspect
- X₄ = Spectrum sharing aspect
- X₅ = Security aspect

F-test is to be employed in testing the overall significance of the Model (independent variables taken together), while the T-test will be employed in testing the significances of each of the independent variables.

3.5.1.2 Test of model (ANOVA).

Very often we are interested in testing whether more than two population means are equal. The procedure for the equality of three or more means is provided by a statistical technique known as the analysis of variance (ANOVA). This method is based on the F-distribution (or F-test). This method uses real scores collected from the survey. ANOVA measures whether or not the equation represents a set of regression coefficients. In multiple-regression, the total deviation on each observation Y_i from the mean ($Y_i - \bar{Y}$) can be expressed as the sum of its explained and unexplained variations:

$$(Y_i - \bar{Y})^2 = (\bar{Y}_i - \bar{Y})^2 + (Y_i - \bar{Y}_i)^2 \dots \dots \dots \text{equation 3.2}$$

$$\text{SST} = \text{SSR} + \text{SSE}$$

$$\text{Where } \bar{Y}_i - \bar{Y} = \text{Explained variables}$$

$$Y_i - \bar{Y}_i = \text{Unexplained variables}$$

$$\text{SST} = \sum (\bar{Y}_i - \bar{Y})^2 / n \dots \dots \dots \text{equation 3.3}$$

$$\text{SSE} = \sum (Y_i - \bar{Y}_i)^2 = \text{SST} - \text{SSR} \dots \dots \dots \text{equation 3.4}$$

$$\text{Where SST} = \text{Sum of square total}$$

$$\text{SSR} = \text{Sum of square due to regression}$$

$$\text{SSE} = \text{Sum of square due to error}$$

The necessary sum of squares, degree of freedom, mean squares and variance ratio for multiple regression are summarized in the ANOVA table below Table 3.2: ANOVA

Table 3.2: The ANOVA Analysis table

Source of variation	Sum of squares (SS)	Degree of Freedom (df)	Mean Squares (MS)	Variance Ratio (F-ratio)
Regression	SSR	K	MSR = SSR/K	F* = MSR/MSE
Error	SSE	n – k – 1	MSE = SSE/n-k-1	
Total	SST	N – 1		

3.5.1.3 Test of the model (Coefficient of Determination and the F-test approach)

One method to test statistical significance of estimated model is through the coefficient of determination (R^2), calculated from the Regression. R^2 gives the proportion of the total variation in the dependent variable (cost efficiency). The value for R^2 ranges from 0 to 1. In setting up the test, the following Hypothesis is tested:

$H_{01}: B_1 = B_2 = 0$ (i.e. the collective aspects of colocation arrangement among GSM firms in Nigeria have no significant effect on cost efficiency).

$H_{02}: B_1 = B_2 = 0$ (i.e. the individual aspects of colocation arrangement among GSM firms in Nigeria have no significant effect on cost efficiency).

Decision Rule

The researcher should reject H_0 if the probability of obtaining a value of the test statistics of a given or more extreme magnitude, when H_0 is true, is equal or less than some small number. The common practice among researchers is to set the level of significance at 0.05 or 0.01

If F-Ratio (calculated) is greater than F-ratio (tabulated), at alpha level of significance, and (K-1), (N-K) degrees of freedom, then we reject H_0 and

accept H_A and then conclude that there is some truth in the estimated model (i.e. the regression model is significant since the independent variables significantly accounts for the variation in the dependent variables. Test for specific strength of independent variables: T-Ratio. Having established the significances of the estimated model, we now proceed to test the specific strengths of the various independent variables. This we can achieve by conducting a T-test statistics.

$$T\text{-Ratio} = \frac{\hat{\beta}_k}{\varepsilon_i(\hat{\beta}_k)} \dots\dots\dots \text{equation 3.5 for } k = 1 \dots\dots 8$$

Where $\hat{\beta}_k$ = Estimate of population parameter
 ε_i = Standard error of the estimate
 K = Number of variables
 N = Number of observation

Decision Rule

If $\hat{\beta}_k / \varepsilon_i(\hat{\beta}_k) > t_{n-k; \alpha/2}$ level of significance, we reject H_0 and accept H_A and therefore conclude that the variable belongs to the model.

3.5.2 Discriminant Function Analysis

Discriminant function analysis is a multivariate statistical technique used commonly to classify persons or objects into various groups. It is also used to analyze known groups to determine the relative influence of specific factors for deciding into which group various cases fall. Discriminant analysis joins a nominally scaled criterion or dependent variables that are interval or ratio scaled. If a discriminant equation is formed, it can be used to predict the classification of a new observation. The linear function representation is of the form:

$$Z_i = d_0 + d_1X_1 + d_2X_2 + \dots + d_pX_p \dots\dots\dots \text{equation 3.6}$$

Where Z_i = score or discriminant function i

$d_{(1,...,n)}$ = weighting coefficient;

d_0 = constant

$X_{s(1,...,n)}$ = values of the discriminating variables as listed below:

X_1 = Core Network aspect

Core Network aspect deal with:

- Capability of Analysis by experts in GSM Colocation
- The various experience(s) and technology use in GSM colocation arrangement
- Colocation intelligence and hardware maintenance

X_2 = Network Operations aspect

- Employment of modern hardware and software tools for data analysis.
- To determine how taxes, rate and rents affect cost efficiency and development when GSM firms colocate.
- To determine how utilities such as water, electricity and fuel etc. affect cost efficiency and development when GSM firms colocate

X_3 = Human Resources aspect

Human Resource aspect include

- Size of the skilled and unskilled staff involve in the colocation arrangement
- Growth and service coverage
- Masts, towers and telecommunication equipment arrangement
- Environment factors in GSM colocation arrangement

- Recognition of staff input
- Existence of structure for performance reward in my organization
- Constant review of salary, bonuses, etc.
- Steady power supply
- Nigeria laws on software and hardware development
- Sourcing of qualified personnel outside the country
- Accountability in office
- Activities of extremist

$X_4 =$ Spectrum sharing aspect

Spectrum sharing aspect includes:

- Interfacing and roaming
- Efficiency and effectiveness
- Usage, fault detection and recovering
- Interoperability, sustainability and asset capabilities

$X_5 =$ Security aspect

Security aspect deals with:

- Security of Base Station, Towers and GSM equipment.
- Security of Policies and agreement
- Security of investment
- Staff welfare

- Strongly held organizational culture
- Resource sharing in the organization
- Decision-making based on consensus or majority

3.5.3 Formulation of model for analyzing effects.

The analysis in this research was carried out using well-structured questionnaire. The statistical application software was use to analyze data collected. The method of independent variable and stepwise methods of discriminant function analysis was also applied.

3.5.4 Stepwise Discriminant function of analysis

In this method, variables are added to the discriminant function one after the other until it is found that adding extra variables does not give significant better discrimination.

3.5.5 Validity of Research Instrument

Selitz (1979) opined all data measuring instruments particularly in the social sciences contain some degree of errors no matter how precise and careful the efforts of the observation. Our research instrument (via questionnaires) was duly evaluated by my erudite supervisor and its administration in the selected organizations (Olatokun, 2009; Onwurah, 2008). Besides, the instrument was given to professionals outside the pressure audience, and the result also confirms its genuineness and authenticity both in framing and content. Validity and reliability of findings and results will be key issues in this research. Validity has to do with whether the results obtained within the study are true (i.e. internal validity) as well

as whether findings can be generalized in other cases and/or contexts whereas reliability has to do with the stability or consistency of the measure employed (Ghauri and Gronhaug, 2005; Pakistan, 2007).

Since, this is a single case involving two major players in the Nigerian telecommunication industry, the researcher has ensured that the sample size drawn from respondents in the interview are representative of the Nigerian mobile telecommunication market and hence can claim the generalizability of the results obtained. The validity of the findings or results is highly dependent on the truthfulness of the answers and opinions given by respondents from both sides in the colocation arrangement. The validity of the findings or results will also depend on the truthfulness of the answers and opinions given by respondents when filling the questionnaires. However, this to some extent might not reflect the reality on ground accurately as both parties are bound by non-disclosure and confidentiality clauses and issues. Hence, the researcher was limited in this regard.

CHAPTER FOUR

RESEARCH FINDINGS AND INTERPRETATION

4.1 Research Findings

Chapter four (4) section deals with the results / findings using empirical quantitative and qualitative analysis performed on the feedbacks obtained from the copies of questionnaire distributed. The data analysis techniques had to be a mixture or a variety of quantitative and qualitative methods due to the nature of phenomenon or variable(s) under study. Some variables are absolute and very easy to measure empirically while others such as service quality were more relative and hence the researcher relied on statistical tools for its analysis.

4.2 Data Collection and Analysis

Out of 200 copies of questionnaire distributed, 186 copies were returned. The researcher screened the copies returned for incomplete or missing data. Copies of questionnaires with mostly unanswered questions were discarded. After which we had 176 useable survey forms, which is equivalent to 88% response rate. Statistical Package (SPSS) was used to summarize and analyze the data. Frequencies for each demographic variable(s) were computed. Reliability of the data was assessed by using Cronbach's Alpha (Cronbach, 1951; Hayes, 1998). Higher Alpha coefficients indicate higher scale reliability (Santos, 1999). Specifically, Nunnally (1978) suggests that scales with 0.70 Alpha coefficients and above are considered acceptable. In addition, construct validity was assessed by using Factor Analysis to discover the underlying structure of variables.

4.3 Questionnaire Analysis

The copies of questionnaires were divided into two parts (A and B). Out of 200 copies of questionnaires distributed, 186 copies were returned. The researcher screened the copies returned for incomplete or missing data. Copies of questionnaires with mostly unanswered questions were discarded. After which the researcher had 176 useable survey forms, which is equivalent to 88% response rate. The structures of the answers in part A are as follows:

Q1: Gender

Table 4.1: showing the gender of the respondents

Source: questionnaire

RESPONDENTS	RESPONSE	PERCENTAGE %
Male	125	71
Female	51	29
Total	176	100

Table 4.1 shows the gender of the respondents. It shows that 125 males representing 71% filled and returned the questionnaires. 51 female respondents also filled the questionnaires representing 29%. Therefore, the majority of respondents were male.

Q2: Age Group

Table 4.2: showing the Age groupings of the respondents

Source: questionnaire

RESPONDENTS	RESPONSE	PERCENTAGE %
Under 20	2	1
20-29	133	76
30-39	25	14
40-49	12	7
50-59	4	2
Over 59	0	0
Total	176	100

Table 4.2 shows the age group of the respondents. Those under 20 were 2 in number Representing 1% of the responses. Age group between 20-29 were 133 representing 76%; those between 30-39 were 25 representing 14%; ages between 40-49 were 12 representing 7%; those between 50-59 representing were 4 in number representing 2%; over record zero percent. Table 4.2 indicates that the majority of the respondents were between the ages brackets 20-29.

Q3: Nationality

Table 4.3: showing the nationality of the respondents

Source: questionnaire

RESPONDENTS	RESPONSES	PERCENTAGES %
Nigerian	173	98
Others	1	0.6
Unfilled space	2	1.4
Total	176	100

Table 4.3 shows the nationality of the respondents. 173 indicated that they were Nigerians representing 98%. Others also indicated that they were non-Nigerian representing 0.6 %; 2 blanks spaces were recorded. The table shows that the majority of the respondents were Nigerians.

Q4 Race

Table 4.4: shows the race of the respondents

Source: questionnaire

RESPONDENTS	RESPONSES	PERCENTAGES %
Ibo	121	69
Cross river	1	0.6
Hausa	6	3.3
Yoruba	13	7.4
Rivers	5	2.6
Ijaw	11	6.3
Bayelsa	1	0.6
Delta	11	6.3
Akwa ibom	1	0.6
Edo	1	0.6
Ibibio	3	1.7
Urhobo	2	1.1
Total	176	100

Table 4.4 shows the race of the respondents. 121 were Ibo; cross rivers was 1; Hausa were 6; Yoruba 13; rivers 5; jaw were 11; Bayelsa was 1; deltans were 11; akwa ibom were 1; Edo was 1; Ibibio were 3; Urhobo were 2 representing 69%, 0.6%, 3.3%, 7.4%, 2.6%, 6.3%, 0.6%, 6.3%, 0.6%, 0.6%, 1.7% and 1.1% respectively. Table 4.4 shows that the majority of the respondents were Ibos.

Q5 Educational Background

Table 4.5: shows the educational background of the respondents

Source: questionnaire

RESPONDENTS	RESPONSES	PERCENTAGES %
Pry / Secondary	6	3.4
Undergraduate	55	31.3
OND/NCE	13	7.4
HND/B.Sc	77	43.7
PhD/M.Sc	25	14.2
Total	176	100

Table 4.5 shows the educational background of the respondents. Holders of pry/ school certificates were 6; 55 were undergraduates; OND/NCE were 13; 77 holds a B.Sc/HND qualification; PhD/MSc were 25 representing 3.4%, 31.3%, 7.4%, 43.7%, and 14.2% respectively. This shows that the majority of the respondents hold B.Sc/HND results.

Q6: How you aware of Mobile phone/GSM Firms sharing resources?

Table 4.6: shows the responses to question 6 above

Source: questionnaire

RESPONDENTS	RESPONSES	PERCENTAGES %
YES	151	85.8
NO	23	13.1
BLANK	2	2.1
TOTAL	176	100

Table 4.6 shows the responses to question 6. 151 respondents agreed that they are aware that GSM firms share resources representing 85.8%. 23 respondents are not aware representing 13.1%. 2 representing 2.1% left the space blank. Table 4.6 shows that the majority of the respondents are aware of the fact that GSM firms do share resources.

Q7 If yes, what kind of resources do they share?

Table 4.7: showing the response to question 7

Source: questionnaire

RESPONDENTS	RESPONSES	PERCENTAGES %
Hardware	50	28.4
Software	51	29
Both	48	27.3
Others specify	7	4
Blank	20	26.3
Total	176	100

Table 4.7 shows the responses to question 7. Those who agreed that GSM firms share hardware resources were 50 representing 28.4%; software were 51 representing 29%; both were 48 representing 27.3%; others were 7 representing 4% and 20 respondents left it blank. This shows that those that agreed to software share were in the majority.

Q8 Do you think colocation of GSM facilities will reduce cost?

Table 4.8: shows the responses to question 8

Source: questionnaire

RESPONDENTS	RESPONSES	PERCENTAGES %
Yes	149	84.7
No	24	13.6
Blank space	3	1.7
Total	176	100

Table 4.8 shows that 149 agreed that colocation of GSM resources will reduce cost representing 84.7%; 24 respondents say No representing 13.6% while 3 abstained. This shows that the majority of the respondents agreed that it will reduce cost of operations when GDM firms colocate their resources.

Q9: Do you think colocation of GSM facilities will enhance efficiency?

Table 4.9: showing the responses of question 9

Source: questionnaire

RESPONDENTS	RESPONSES	PERCENTAGES %
Yes	152	86.4
No	22	12.5
Blank space	2	1.1
Total	176	100

Table 4.9 shows the responses to question 9. 152 representing 86.4% say yes to question 9 while 22 respondents say No representing 12.5%. 2 respondents skip the questions. This shows that the majority agreed to question 9.

Q10 Based on question 9; will colocation of GSM facilities improve quality of service, reliability?

Table 4.10: showing the responses of question 10

Source: questionnaire

RESPONDENTS	RESPONSES	PERCENTAGES %
Yes	152	86.4
No	20	11.4
Others	0	0
Blank space	4	3.2
Total	176	100

Table 4.10 shows the responses to question 10. 152 representing 86.4% say yes to question 10 while 20 respondents say No representing 11.4%. 4 respondents skip the question. This shows that the majority agreed to question 10.

Q11: How would you describe the security of GSM operations in Nigeria?

Table 4.11: showing the responses of question 11

Source: questionnaire

RESPONDENTS	RESPONSES	PERCENTAGES
Secured	73	41.5
Not secured	100	56.8
Blank space	3	2.7
Total	176	100

Table 4.11 shows the responses to question 11. 73 respondents representing 41.5% agreed that the GSM operation in Nigeria is secured while 100 respondents disagreed representing 56.8%. 3 respondents skip the question. This shows that the majority agreed that GSM Network and its operations are not secured. Statistical tools will be used to analyze part B of the questionnaire.

4.4 Model Estimation and Hypothesis Testing

The researcher conducted multiple regression analysis to examine the following hypothesis:

Ho₁: the collective aspects of colocation have no significant effect on cost efficiency of GSM firms in Nigeria

Ho₂: the individual aspect of colocation has no significant effect on cost efficiency of GSM firms in Nigeria

The research seeks how well the individual and collective aspects of colocation arrangement affect cost efficiency of GSM firms in Nigeria. Cost efficiency is an aggregation of cost on core network aspect, network operations aspect, human resources aspect, spectrum sharing aspect and security aspect of colocation arrangement. Table 4.12 presents the multiple regression analysis between aspects of colocation arrangement of GSM Firms in Nigeria and cost efficiency.

Table 4.12: Model Summary of the Constructs

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.659 ^a	.435	.418	2.51576	.435	26.168	5	170	.000	1.863

The overall predictability of the model is shown in Table 4.12 above, it can be seen that the R-Square value for the model showed that 43.5 percent ($R^2 = 0.435$) of the variance in the cost efficiency can be predicted from the independent variables (core network aspect, network operations aspect, human resources aspect, spectrum sharing aspect and security aspect). Table 4.12 shows that the collective aspects of colocation have significant effect on cost efficiency of GSM firms in Nigeria

Table 4.13: ANOVA for the Constructs

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	828.105	5	165.621	26.168	.000 ^a
	Residual	1075.934	170	6.329		
	Total	1904.040	175			

Table 4.13 presents the ANOVA report on the general significance of the model. As p is less than 0.05, the model is significant. Thus, the combination of the variables significantly predicts the dependent variable ($F = 26.168$; $p < 0.05$). Table 16 shows that the collective aspects of GSM firms: core network aspect, network operations aspect, human resources aspect, spectrum sharing aspect and security aspect when colocated together have significant effect on cost efficiency. It indicates that the model and data are well fit in explaining the effect of colocation arrangement on cost efficiency of selected GSM firms in Nigeria.

Table 4.14: T-test for the Constructs

Model		Un-standardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	Cost efficiency	5.872	1.323		4.438	.000		
	Core network aspect	.242	.048	.394	10.804	.000	1.000	1.000
	Network operations aspect	.203	.042	.394	2.982	.000	1.000	1.000
	Human resources aspect	.290	.051	.393	8.456	.000	1.000	1.000
	Spectrum sharing aspect	.326	.048	.461	6.844	.000	1.000	1.000
	Security aspect	.398	.048	.603	8.932	.000	1.000	1.000

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon_i$$

Y = OVERALL COST EFFICIENCY

Overall COST EFFICIENCY

$$= 5.872 + .394 \text{ Core network aspect} \\ + .394 \text{ Network operations aspect} + .393 \text{ Human resources Aspect} \\ + .416 \text{ Spectrum sharing aspect} + .603 \text{ Security Aspect}$$

4.4.1 Relationship Model and Interpretation

Table 4.15 shows the results of the hypothesis tested against the p-values that were obtained from the results above. These values were summarily shown.

Table 4.15: Summary of Values for the Constructs

<i>Variables</i>	<i>Beta</i>	<i>P</i>
<i>Core network Aspect</i>	.394	$P=0.000<0.05^*$
<i>Network operations Aspect</i>	.394	$P=0.000<0.05^*$
<i>Human resources Aspect</i>	.393	$P=0.000<0.05^*$
<i>Spectrum sharing Aspect</i>	.461	$P=0.000<0.05^*$
<i>Security Aspect</i>	.603	$P=0.000<0.05^*$

Table 4.16: The table shows the results of the hypothesis

	Hypothesis	Results
H ₀	Core Network Aspect is positively related to Cost efficiency	Significant
H ₀	Network operations Aspect is positively related to Cost efficiency	Significant
H ₀	Human resources Aspect is positive related to Cost efficiency	Significant
H ₀	Spectrum sharing Aspect is positively related to Cost efficiency	Significant
H ₀	Security is positively related to Cost efficiency	Significant

4.5 Result Discussion

4.5.1 Hypotheses Result Discussion

After careful analysis of the statement of the problem, objectives of the study and research questions the following were discovered:

Ho₁: the collective aspects of colocation arrangement among GSM firms in Nigeria have no significant effect on cost efficiency.

Table 4.15 and 4.16 show the ANOVA reports on the general significance of the model. It shows that ($R = 0.659$; $R^2 = 0.435$; Standard error of estimation = 2.51576; $p = 0.000$; adjusted $R^2 = 0.418$). As p is less than 0.05, the model is significant. Thus, the combination of the variables significantly predicts the dependent variable ($F = 26.168$; $p < 0.05$). It indicates that the model and data are well fit in explaining the effect of colocation arrangement on cost efficiency of selected GSM firms in Nigeria. Therefore, Ho₁ is rejected and H_{A1} is accepted.

Ho₂: the Individual aspect of colocation arrangement among GSM firms in Nigeria has no significant effect on cost efficiency

Table 4.15 shows the T-test report of the individual aspect of colocation when regressed with cost efficiency. It shows that Core Network Aspect as ($B = 0.242$; Beta = 0.394; $p = 0.000$; tolerance = 1.000). As p is less than 0.05, the model is significant. Thus, this combination of the variables significantly predicts the dependent variable ($t = 10.804$; $p < 0.05$). It indicates that Core Network Aspect has significant effect on cost efficiency. Therefore, Ho₁ is rejected and H_{A1} is accepted.

It also shows that Network Operations Aspect as ($B = 0.203$; $Beta = 0.394$; $p = 0.000$; tolerance = 1.000). As p is less than 0.05, the model is significant. Thus, this combination of the variables significantly predicts the dependent variable ($t = 2.982$; $p < 0.05$). It indicates that Network Operations Aspect as significant effect on cost efficiency. Therefore, H_{01} is rejected and H_{A1} is accepted.

It also shows that Human Resource Aspect as ($B = 0.290$; $Beta = 0.393$; $p = 0.000$; tolerance = 1.000). As p is less than 0.05, the model is significant. Thus, this combination of the variables significantly predicts the dependent variable ($t = 8.465$; $p < 0.05$). It indicates that Human Resources Aspect as significant effect on cost efficiency. Therefore, H_{01} is rejected and H_{A1} is accepted.

It also shows that Spectrum Sharing Aspect as ($B = 0.326$; $Beta = 0.461$; $p = 0.000$; tolerance = 1.000). As p is less than 0.05, the model is significant. Thus, this combination of the variables significantly predicts the dependent variable ($t = 6.844$; $p < 0.05$). It indicates that Spectrum Sharing Aspect as significant effect on cost efficiency. Therefore, H_{01} is rejected and H_{A1} is accepted.

It also shows that Security Aspect as ($B = 0.398$; $Beta = 0.603$; $p = 0.000$; tolerance = 1.000). As p is less than 0.05, the model is significant. Thus, this combination of the variables significantly predicts the dependent variable ($t = 8.932$; $p < 0.05$). It indicates that Security Aspect as significant effect on cost efficiency. Therefore, H_{01} is rejected and H_{A1} is accepted.

4.5.2 Result Discussion of Research Questions

The standardized beta coefficients in Table 4.16 can be interpreted that the independent random variables (individual colocated aspect) and collective random variables (collective colocated aspects) have strong effect on cost efficiency and improved efficiency. Here, 100% change in Core network Aspect, Human Resources Aspect, Security Aspect, Spectrum Sharing Aspect, and Network Operations Aspect leads to over 74% change in the level of cost efficiency.

4.6 Cost Implications of Colocating GSM Resources

The high infrastructure content of mobile communications technology has a direct and indirect impact on both the quality of service and tariffs charged by the operators. The capital expenses in mobile communications is classified to include cost of hardware, which comprises of the radio equipment, site acquisition and tower installation, generator acquisition and the cost of the license. The capital expenses (CAPEX) comprises of all the cost incurred from the bidding process up to the commissioning of the site. The operational expenses (OPEX) on the other hand, involve costs incurred in keeping the site up, running and profitable. This cost includes customer acquisition and retention cost (advertisements), cost of system upgrades, and staff training with a critical component being amount spent on fuel acquisition for the generators. This is because every cell site is powered by at least two 20KVA generator sets running alternately all year round.

The process of setting up a cell site for mobile communications, after the license has been won and paid for, involves the site survey, site acquisition,

system planning, and frequency planning. These processes have to be completed, before the actual construction and civil works can start. The construction/civil works phase is another time consuming phase and before it starts, the various levies and taxes to the different tiers of government and government agencies, unreceivable fees to the local landowners (even after proper / legal acquisition of the land) must be paid. The construction/civil works phase is then followed by the actual installation of the site equipment. This includes the delivery to site and assembling of the towers, the shelters, the generating sets, the earthing processes, and the radio equipment up to the final commissioning.

All these phases could span from one month to one year, depending on the logistic arrangement utilized by the operator. This leads to longer time to market and an increase in cost incurred in the form of interest on loans and the inactivity of capital. This processes described above are mandatory for initial deployment of telecom services anywhere, but when the technology has attained some level of maturity in any market, it becomes a very ineffective approach for any new operator entering the market, both in terms of cost, security, logistics, and time to market. Infrastructure sharing or colocation is a process where two or more operators share different infrastructure in a particular site. The infrastructure shared could range from the site, to towers, shelter, generators, and even the air conditioning. New operators can lease antenna space on the tower, install their own shelters within the site of an existing operator, and share the cost of running and securing the site, thus reducing OPEX and CAPEX for both operators.

4.6.1 Results Implications and Strategies of Colocation in Nigeria

The major challenge facing colocation or infrastructure sharing in Nigeria is the stiff competition between the operators in Nigeria. The operators are in frantic race to capture the market and as such, they try to out do each other in customer attraction and attention. Another major challenge facing colocation in Nigeria is the absence of enforceable legislation / regulation in favor of colocation. This challenge is capitalized upon by established operators and thus they make difficult demands on other operators who may have to share their infrastructure. This often leads to the suffocation of new entrants and smaller operators by the large and established operators.

4.6.1.1 Proposed Colocation Strategies

The mobile communications service is operated at licensed frequencies and this makes the issue of interference very minimal. As such, the different component parts of the infrastructure can be shared by the operators without affecting the service of each other. The colocation strategies include:

4.6.1.2 Sharing the Electrical Energy Supply

Based on approximate figures, a typical Base Station costs nearly \$100,000 and requires 3000 Watts to run, excluding the Base Station Controller (BSC) and Mobile Switching Center (MSC). The use of diesel generators as a source of energy supply for cell sites requires regular and costly refueling, high levels of maintenance, and they are susceptible to theft. These factors consume up to 66% of the total OPEX cost for cell sites. A typical cell site in Nigeria is

powered by two (2) 20KVA generators running alternately and the generators can be shared by two or more operators in a single site. The electrical energy source is required to provide energy for the following:

- (a) Antenna tower lighting
- (b) BTS security lighting
- (c) Shelter external lighting
- (d) Shelter internal lighting
- (e) Radio equipment

The sharing of electrical energy source by two operators on one site by the addition of a separate shelter will lead to the addition of the shelter and radio equipment load to the overall load of the site. This increase in load can be accommodated by the generators currently utilized on cell sites as the generators are usually installed with excess capacity. This will reduce the site footprint and reduce the required number of generators from four to two. This will also reduce the required fuel consumption by 100% and reduce the fuel tanks from four to two. This strategy will not only reduce the CAPEX in terms of generator and tank acquisition costs; it will also reduce the fuel consumption costs by 100% and the cell site footprint.

4.6.1.3 Sharing of the Air Conditioning

The air condition sets of a typical BTS cell site consumes 54% of the total energy supplied. This consumption rate is due to the fact that the radio equipment generates heat which increases the cooling required from the air conditioning units. The use of ducts which transmit this heat to the external environment has been found to reduce the air conditioning load by 20%. This reduction can be used to provide cooling for another shelter by the use of a central cooling system

between the shelters. This approach will reduce the number of air conditioning sets required and reduce by up to 75% the air conditioning sets per shelter.

4.6.1.4 Sharing of Towers

The band structure of the GSM frequencies and the presence of guard bands between the bands reduce the possibility of interference between two communication systems and also the interference possibilities within a single band. These features enable the deployment of two or more antennas close to each other without the antennas negatively affecting each other's systems. The Nigerian Communication Commission guidelines stipulate that towers above 25m in height are not to be sited within residential areas.

The guidelines also specify that towers over 25m should be designed and constructed so as to accommodate a minimum of three service providers using the same structure. A minimum spacing between two towers in the excess of 55m in height shall be one kilometer. In view of these provisions and the fact that the farther away from the residential area the tower is placed, the greater the path loss the transmitted signal will experience leading to an increase in the BTS transmitted power, the sharing of the few optimal locations in the residential areas becomes very necessary. Towers are expensive to design and construct and so much time is spent in the construction and testing phases. This coupled with the life span of 25 years after which more funds would be required to disassemble justifies the fact that a shared approach is not only efficient but very economical and timely.

4.6.1.5 Sharing of Links

The links which include microwave relay, optical, and satellite links are designed to be of high capacity with high reliability and extra redundancies built into the design to cater for the event of a link failure. These links require a lot of resource both in terms of cost of acquisition and deployment, and are designed to function continuously if not deliberately tampered with, either by man or by nature. The current situation in Nigeria where operators build their own links leads to the cost being indirectly transferred to the consumers who are made to pay through high tariffs for under-utilized network capacity.

The sharing of this links will be very effective if the regulators and operators agree on a code of conduct between the link owners and leasers such that a breach by any part is appropriately sanctioned in a timely manner. In that way the link owners will not exercise undue advantage over the leasers and the issues of monopoly will not arise.

4.7 **Cost Implications of Colocation of the Nigerian Telecom Space**

The major challenge facing colocation in Nigeria as described above is the stiff competition between the operators fueled by a lack of trust between them and the lack of enforced legislation governing colocation. A solution to this problem will involve the sharing of infrastructure in such a manner that the integrity and safety of each operator's equipment is assured on each site, regardless of whose staff is on the site per time. It involves the sharing of cell facilities on the site except for the shelter.

The storied construction of shelters or the side by side placement of shelter with a central cooling arrangement where individual operators are solely in charge

of access to their shelters and radio equipment coupled with the installation of antennas in conformity with regulator-approved and enforced best practices will reduce the CAPEX and OPEX incurred by operators and ultimately lead to a lower tariff structure. The regulating body can also locate optimal sites for tower installation in urban areas and acquire the same for leasing to operators with colocation as a precondition for lease acceptance. This provision will eliminate the cases of harassment by local land owners and provide a level playing ground for all the operators on the site.

Other advantages of colocation include:

- (a) Reduced CAPEX cost (generator, tower, site acquisition, fueling, etc)
- (b) Reduced OPEX cost (security and fuel cost)
- (c) Reduced installation and deployment cost
- (d) Reduced distortion of the skyline and environmental pollution due to generator set fumes.
- (e) Reduced damage to roads due to cable laying.
- (f) Reduced taxation and other site associated costs.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This research explored the effect of colocation arrangement on cost efficiency of GSM firms in Nigeria. It show that collective and individual aspects: Core network Aspect, Human Resources Aspect, Security Aspect, Spectrum Sharing Aspect, and Network Operations Aspect leads to over 74% change in the level of cost efficiency. The results of the research also provided evidence that fears of network performance degradation due to telecommunication site sharing will not be necessary since major issues of network degradation can be handled by simply synchronizing site maintenance schedules and each party taking responsibility for the other's equipment fault resolutions. It also proved that operators are able to achieve better competitive advantage through wider coverage in faster and cheaper ways by adopting infrastructure sharing in their business strategies.

Infrastructure sharing in telecommunication was also seen as a catalyst for better product/service innovations and new product developement depending on the company's marketing or sales strategy. However, many experts have wondered at the trend of unwillingness to share infrastructure by some telecommunication operators in Africa (CIPESA, 2006). Hence, in Africa it is not uncommon to find three similar masts belonging to three different operators all crammed in the same 200 square metre area. It is also uncommon to find different telecommunication operators digging up roads in cities and along highways, each

laying similar infrastructure, like fibre, to that of the other companies (CIPESA,2006). This does not auger well with the environment for the African people as these several cutting of roads and plenty of masts or towers make the government spend more on road budgets as well as making the skyline very untidy.

Colocation or infrastructure sharing can also help regulators achieve improved customer service as the financial gains achieved by operators can be used to maintain their good employees, and add value to their services. Hence, the following recommendations would be made using MTN-Airtel Colocation case study for policy makers and other operators as a way of encouraging the infrastructure sharing trend in Nigeria.

Table 4.15 and 4.16 show the ANOVA reports on the general significance of the model. It shows that ($R = 0.659$; $R^2 = 0.435$; Standard error of estimation = 2.51576; $p = 0.000$; adjusted $R^2 = 0.418$). As p is less than 0.05, the model is significant. Thus, the combination of the variables significantly predicts the dependent variable ($F = 26.168$; $p < 0.05$). It indicates that the model and data are well fit in explaining the effect of colocation arrangement on cost efficiency of selected GSM firms in Nigeria. Therefore, H_{01} is rejected and H_{A1} is accepted.

Table 4.15 shows the T-test report of the individual aspect of colocation when regressed with cost efficiency. It shows that Core Network Aspect as ($B = 0.242$; Beta = 0.394; $p = 0.000$; tolerance = 1.000). As p is less than 0.05, the model is significant. Thus, this combination of the variables significantly predicts the dependent variable ($t = 10.804$; $p < 0.05$). It indicates that Core Network Aspect has significant effect on cost efficiency. Therefore, H_{01} is rejected and H_{A1}

is accepted. It also shows that Network Operations Aspect as ($B = 0.203$; $Beta = 0.394$; $p = 0.000$; tolerance = 1.000). As p is less than 0.05, the model is significant. Thus, this combination of the variables significantly predicts the dependent variable ($t = 2.982$; $p < 0.05$). It indicates that Network Operations Aspect as significant effect on cost efficiency. Therefore, H_{o1} is rejected and H_{A1} is accepted.

It also shows that Human Resource Aspect as ($B = 0.290$; $Beta = 0.393$; $p = 0.000$; tolerance = 1.000). As p is less than 0.05, the model is significant. Thus, this combination of the variables significantly predicts the dependent variable ($t = 8.465$; $p < 0.05$). It indicates that Human Resources Aspect as significant effect on cost efficiency. Therefore, H_{o1} is rejected and H_{A1} is accepted.

It also shows that Spectrum Sharing Aspect as ($B = 0.326$; $Beta = 0.461$; $p = 0.000$; tolerance = 1.000). As p is less than 0.05, the model is significant. Thus, this combination of the variables significantly predicts the dependent variable ($t = 6.844$; $p < 0.05$). It indicates that Spectrum Sharing Aspect as significant effect on cost efficiency. Therefore, H_{o1} is rejected and H_{A1} is accepted.

It also shows that Security Aspect as ($B = 0.398$; $Beta = 0.603$; $p = 0.000$; tolerance = 1.000). As p is less than 0.05, the model is significant. Thus, this combination of the variables significantly predicts the dependent variable ($t = 8.932$; $p < 0.05$). It indicates that Security Aspect as significant effect on cost efficiency. Therefore, H_{o1} is rejected and H_{A1} is accepted.

The results imply that increasing the quality of Core network aspect, Network operations aspect, Human resources aspect, Spectrum sharing aspect and Security aspect in colocated GSM environment will inherently improve and enhance Cost efficiency.

5.2 Recommendations

5.2.1 Increase in Commitment from the Regulators

Some respondents expressed concerns about the lack of commitment shown by the regulatory body towards their infrastructure sharing arrangements. The telecommunication regulatory body in Nigeria, NCC can encourage infrastructure sharing trends by ensuring that terms of agreement are adhered to by both parties and ensuring that defaulting parties are penalized in forms of fines. This would ensure better commitments by the collocating parties.

Also, seeing that different operators set varying infrastructure rollout targets, it has also become necessary for the NCC to ensure that colocation plans are made by operators ahead of time to avoid such issues as unavailability of sharing resources when the desiring party approaches the host party. This would ensure that operators make capacity available to other network operators as they rollout their private networks (Emeka, 2009).

5.2.2 Standardization of the Telecommunication System Platforms

There is the argument by respondents or surveyed of different operators employing different suppliers and vendors in their value chains as a source of competitive advantage. This leads to disparate systems specifications making it

difficult to share infrastructure with other operators willing to share. Some perceive the others as using equipment of inferior quality and grade and since they feel this might bring down their competitive advantage they often refrain from sharing infrastructure.

This also can be reduced if the NCC begins to lay out policies that would ensure proper quality control and assurance on infrastructure deployed by all operators and also set quality standards for all vendors supplying telecommunication equipment to Nigeria. This can be efficiently done via standards bodies such as the ISO (International Standards Organization) or SON (Standards Organization of Nigeria). This would ensure that there is near equality of system specifications and quality and this fear is eliminated or reduced to a bare minimum.

5.2.3 Elimination of the Monopolistic Behaviours by the Regulator

Some respondents believe that infrastructure sharing has also been discouraged in situations where a dominant or monopolistic player establishes a wide network and then is unwilling to share infrastructure with new entrants. Therefore, in order to break this anti-competition spirit among such big players the regulatory body such as the NCC will have to employ regulatory enforcements through penalties etc. Also, the Federal government can help remove these barriers by insisting through national policies that there should be no duplication of infrastructure in order to encourage operators to minimize waste and deploy infrastructure in underserved areas instead.

5.2.4 Granting of More Colocation Licences to Third Party Companies

The National Regulatory Authorities can also eliminate the issues of non-harmonization of standards in specifications among telecoms operators through issuing colocation licenses to third party companies who would be allowed to maintain or build infrastructure as separate companies for 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.

Increasingly, organizations are recognizing the benefits of colocating their mission-critical equipment within a data centre. Colocation is becoming popular because of the time and cost savings a company can realize as result of using shared data centre infrastructure. Significant benefits of scale (large power and mechanical systems) result in large colocation facilities, typically 4500 to 9500 square meters (roughly 50000 to 100000 square feet). With IT and communications facilities in safe, secure hands, telecommunication, internet, ASP and content providers, as well as enterprises, enjoy less latency and the freedom to focus on their core business. The researcher is also recommending the following:

- a. That the regulatory body and concerned agencies should reduce their traffic back-haul costs on customers/ users and free up their internal networks for other users by effectively embrace the concept of colocation of their resources
- b. In addition, the regulator of GSM firms in Nigeria should outsource network traffic to a colocation service provider with greater bandwidth capacity, web site access speeds.
- c. In colocation sites, Fire protection systems, including passive and active design elements, as well as implementation of fire prevention programmes in

operations. The researcher advised that smoke detectors are to be installed to provide early warning of a developing fire by detecting particles generated by smoldering components prior to the development of flame. This will allow investigation, interruption of power, and manual fire suppression using hand held fire extinguishers before the fire grows to a large size.

A fire sprinkler system is often provided to control a full scale fire if it develops. Clean agent fire suppression gaseous systems are sometimes installed to suppress a fire earlier than the fire sprinkler system. Passive fire protection elements include the installation of fire walls around the space, so a fire can be restricted to a portion of the facility for a limited time in the event of the failure of the active fire protection systems, or if they are not installed.

- d. The researcher advised that training and re-training programmes should be organized for their staff.
- e. The collocatees should purchase effective and efficient equipments in order to effectively practice colocation.
- f. Standard racks for data equipment and servers for telecommunication equipment must be provided for effective switching at colocation sites.
- g. Cabinets and cages for physical access control over tenants' equipment must be provided at colocated site.
- h. Overhead cable rack (tray) and fibre guide, power cables usually on separate rack from data.
- i. The provision and maintenance of Air conditioning should be used to control the temperature and humidity in the space at sites. The researcher recommends a temperature range and humidity range for optimal electronic equipment

conditions versus environmental issues. Air conditioning systems help control space humidity within acceptable parameters by cooling the return space air below the dew point. Too much humidity and water may begin to condense on internal components. In case of a dry atmosphere, ancillary humidification systems may add water vapor to the space if the space humidity is too low which can result in static electricity discharge problems which may damage components.

- j. Low-impedance electrical ground.
- k. Few, if any, windows.

5.2 Conclusion

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

- 5. Colocation of GSM facilities leads to significant reduction in cost of network infrastructure rollout and capacity expansions for telecom operators in Nigeria.
- 6. Colocation of GSM facilities leads to an improvement in the usage efficiency of telecom infrastructure for telecomm operators in Nigeria.
- 7. Colocation of GSM facilities leads to significant savings in the operational expenditures (OPEX) dissipated by telecom operators in Nigeria.
- 8. Colocation of GSM facilities does not affect quality of service very adversely when properly managed by telecom operators in Nigeria.
- 9. Colocation of GSM facilities will enable telecom operators in Nigeria achieve and sustain competitive advantage through wider coverage and capacity at less costs.

10. Colocation of GSM facilities would lead to improved service delivery by telecommunication providers in Nigeria.
11. Colocation of GSM facilities can help telecommunication operators in Nigeria achieve better competitive advantage through new product development and service innovations (Emeka, 2008).

5.3 Further Research Areas

This research explored the effect of colocation arrangement of selected GSM firms in Nigeria and its effect on cost efficiency. It dived into the financial benefits that accrue from two major mobile operators in the Nigerian telecoms industry and there is strong evidence that there are huge benefits resulting from the colocation arrangement by both companies. The results imply that increasing the quality of Core network aspect, Network operations aspect, Human resources aspect, Spectrum sharing aspect and Security aspect in colocated GSM environment will inherently reduce Cost efficiency.

Further research can be conducted to see whether there can also be a beneficial relationship in a situation where one party in the colocation deal is a new entrant. In this situation, there is the challenge that the new entrant has no existing infrastructure for a site sharing or exchange system with the incumbent and hence there will be need to explore what models of sharing to adopt by both parties in such a business situation.

REFERENCES

- Academy of Marketing Science Review Volume (1999) no.10 Available:
<http://www.amsreview.org/articles/fahy10-1999.pdf> Copyright © 1999 –
 Academy of Marketing Science. Fahy, Smithee / Strategic Marketing and the
 Resource Based View of the Firms 16, 10, 20
- Amit, R.; Schoemaker, P.J.H. (1993), Strategic Assets and Organizational Rent.
 Arabian Business. Com. (2010). “Powering GSM growth”. 2/26/10.
www.arabianbusiness.com/6593?tmp1=component&page
- Arthur Andersen report (2000), Mergers and Acquisitions in the Logistics Industry.
- Ayadi O. F., and Hyman L, (2006) "Financial Liberalization and Price Rigidity in the
 Banking, Finance, and Microeconomics, Financial Structure Section, Division of
 Research and Statistics, Board of Governors of the Federal Reserve System. No.
 86-5, business.com/6593?tmp1=componentandpage Nigerian banking system",
 Managerial Finance, Vol. 32 Iss: 7, pp.557 – 568 Pearson Education: London.
- Badir Y., Stricker C., Bourquin V. (2001) “Obstacles and Challenges Facing B2B
 Market places: Switzerland Experience”, Unpublished Paper.
- Bala-Gbogbo, E (2009) ‘Telecommunication Industry Operators Opt for Infrastructure
 Sharing’. Available fro <http://www.234next.com/csp/cms/sites/Next/Money/Business/5418647/story.csp> (accessed 2009-08-20)
- Barney, J.B., (2001), Is the Resource-Based Theory a Useful Perspective for Strategic
 Management Research? Yes. Academy of Management Review; 26, (1), pp. 41–56.
- Barney, J.B.; Wright, M.; Ketchen Jr., D.J. (2001), The Resource-Based View of the
 firms: Ten years after 1991. Journal of Management; 27 (6), pp. 625–641.
- Barney, Jay B. and Edward J. Zajac. (1994). ‘Competitive Organisational Behaviour:
 Toward an Organisationally-Based Theory of Competitive Advantage.’ Strategic
 Management Journal, 15 (Winter): 5-9.
- Barney, Jay B. (1991). "Firms Resources and Sustained Competitive Advantage." Journal
 of Management 17 (March): 99-120.
- Barney, J.B., (1991), Firms Resources and Sustained Competitive Advantage. Journal of
 Capability Views of Rent Creation. Strategic Management Journal; 22, (5), pp.
 387–401
- Barney, Jay B. (1986). "Strategic Factor Markets: Expectations, Luck and Business
 Strategy." Management Science 32 (October): 1231-1241.
- Barney, J.B., (1986a), Strategic Factor Markets: Expectations, Luck and Business
- Barney, J.B., (1986b), Organizational Culture: Can It be a Source of Sustained
 Competitive Advantage? Academy of Management Review; 11, (3), pp. 656–665.
- Barney J. (1986) “Organizational Culture: Can it be a Source of Sustained Competitive
 Advantage?”, Academy of Management Review, 11 (3), pp. 656-665.
- Bartels, R. (1988). The History of Marketing Thought, 3rd edition. Columbus, OH:
 Publishing Horizons.
- Bardhan, P. K. 'On Optimum Subsidy to a Learning Industry (1974): An Aspect of the
 Theory of Infant Industry Protection', International Economic Review, 12, 1971,
 pp. 54-70. BIC Pen Corporation (.A). Intercollegiate Case Clearing Hotise, I-
 .374-305, 1974.
- Batiz-Lazo, B., and Barrie, A. (2005). The Business and Technological History of
 Automated Teller Machines in the UK, 1967-2005, a Primer. Conference
 Abstracts, 16-17th June. Queen Mary, University of London.

- Benjamin R, Rockart J., Morton M.S. and Wyman J. (1984) "Information Technology: A Strategic Opportunity", Sloan Management Review, Spring, pp. 27-34.
- Benjamin, R and E. Levinson (1993) "A Framework for Managing IT-Enabled Change", Sloan Management Review, Summer, pp. 23-33.
- Baumol, W. J., J. Panzer and R. Willig. (1982). Contestable Markets and the Theory of Industry Structure New York: Har-court, Brace and Jovanovich.
- Bharadwaj, Sundar, P. Varadarajan and John Fahy (1993). "Sustainable Competitive Advantage in Services Industries: A Conceptual Model and Research Propositions." Journal of Marketing, 57 (October): 83-99.
- Bhide, Amar. (1986). "Hustle as Strategy." Harvard Business Review, 64 (September-October): 59-65.
- Biggadike, E. R. (1981). "The Contributions of Marketing to Strategic Management," Academy of Management Review 6 (October): 621-632.
- Booz Allen Hamilton (2007) 'Infrastructure Sharing: Opportunities and Threats for MENA Telecommunication Operators', Booz Allen Hamilton Consulting. Available from <http://www.boozallen.com/news/29537171>
- Brownlie, Douglas T. 1989. "The Migration of Ideas from Strategic Management to Marketing on The Subject of Competition." European Journal of Marketing. 23 (August): 7-20.
- Boston Consulting Group. Perspectives on Experience, Boston Consulting Group (1981), Boston, 1972. Business Week, 14 December 1981.
- Bot, Girardin, Goulmy (2001), First-Class Returns from Transportation, Mc Kinsey Quarterly 2001 Number 3.
- Buzzell, Robert D. and Bradley T. Gale. (1987). The PIMS Principles: Linking Strategy to Performance. New York: The Free Press.
- Bhanu (2007) 'Sharing of Telecommunication Infrastructure: Passive, Backhaul and Active', November 2007, pp. 1 – 10.
- Castanias, Richard P. and Constance E. Helfat. (1991). "Managerial Resources and Rents." Journal Of Management, 17 (March): 155-171.
- Carson, S., C. Frieberg, A. Kilegran, and J. Norrby. (2006). "Reducing TCO with the New RBS 2x16". Ericsson Review. No 2.
- Chamberlin, Edward H. (1933). The Theory of Monopolistic Competition. Cambridge, MA: Harvard University Press.
- Chatterjee, Sayan and Birger Wernerfelt. (1991). 'The Link between Resources and Type of Diversification: Theory and evidence.' Strategic Management Journal. 12 (January): 33-48.
- Collis, David J. (1994). "Research note: How Valuable are Organisational Capabilities." Strategic Management Journal. 15 (Winter): 143-152.
- Collis, David J., and Cynthia A. Montgomery. (1995). "Competing on Resources: Strategy in the 1990s." Harvard Business Review, 73 (July-August): 118-128.
- Collis, David J. (1991). "A Resource-Based Analysis of Global Competition: The Case of the Bearings Industry." Strategic Management Journal. 12 (Summer): 49-68.
- Conner, Kathleen R. (1991). "A Historical Comparison of Resource-Based Theory and Five Schools of thought within Industrial Organisation Economics: Do we have a New Theory of the Firms." Journal of Management, 17 (March): 121-154.
- Cool, Karel and Dan Schendel. (1988). "Performance Differences among Strategic Group Members." Strategic Management Journal. 9 (May-June): 207-233.

- Coyne, Kevin P. (1986). "Sustainable Competitive Advantage-What it is and what it isn't." *Business Horizons*. 29 (January-February): 54-61.
- Cubbin, John. (1988). "Is it better to be a Weak Firms in a Strong Industry or a Strong Firms in Weak Industry?." London: Lon-don Business School, Centre for Business Strategy. No. 49.
- Cash J. And Konsynski B. (1985) "IS Redraws Competitive Boundaries", *Harvard Business Review*, 63 (2), pp. 134-142.
- Champy (1995), *Reengineering Management*, Harper Business.
- Clemons e. (1986) "Information Systems for Sustainable Competitive Advantage", *Information and Management*, 11, pp. 131-136.
- Clemons e. And row m. (1991). "Sustaining IT Advantage: The Role of Structural Differences", *MIS Quarterly*, September, pp. 275-292.
- Cooper, Browne and Petter, (1991), *European Logistics, Markets, Management And Strategy*, Blackwell Publishers, Oxford, UK.
- Council of Logistics Management (1998), Oak Brook, Il: Coucil of Logisitcs Management.
- Caves, R. E. 'Industrial Organizaaiion, Corporate Strategy and .Structure'. *Journal of Economic Literature*, 58, 1980, pp. 64-92.
- Chaudhry S (2007) 'Infrastructure Sharing in Telecommunication Networks – Indian Perspective', *Telecommunication Regulatory Authority of India*, New Delhi, June 2006, pp. 1 -27.
- CIPESA (2006) 'The Case for Infrastructure Sharing in Africa', *Collaboration on International ICT Policy for East and Southern Africa*. Available from <http://www.cipesa.org/163> (accessed 2009-04-14)
- Chandler, A.D. Jr. (1962), *Strategy and Structure*; Cambridge: The MIT Press.
- Chandler, A.D. Jr. (1977), *The Visible Hand*; Harvard University Press.
- Coase, R.H., (1952[1937]), *The Nature of the Firms*. In G.J. Stigler and K.E. Boulding (Eds.), *Readings in Price Theory*; pp. 331–351. Chicago: Irwin. (Reprinted from *Econometrica*, (1937), 4, pp. 386–405.
- Collins, David J. (1994), *Research Note: How Valuable Are Organizational Capabilities?*, *Strategic Management Journal*, Winter 1994, pp. 143–152.
- Conner, K.R. (1991), *A Historical Comparison of Resource-Based View and Five Schools of Thought within Industrial Organization Economics: Do We Have a New Theory of the Firms?* *Journal of Management*; 17, (1), pp. 121–154.
- Conner, K.R.; Prahalad, C.K. (1996), *A Resource-Based Theory of the Firms: Knowledge versus Opportunism*. *Organization Science*; 7, (5), pp. 477–501.
- Carson, S., C. Frieberg, A. Kilegran, and J. Norrby. (2006). "Reducing TCO with the New RBS 2x16". *Ericsson Review*. No 2.
- Crook, T.R.; Ketchen, D.K.; Combs, J.G.; Todd, S.Y. (2008). *Strategic Resources and Performance: A Meta-Analysis*. *Strategic Management Journal*; Vol. 29, No. 11, pp. 1141–1154.
- Capgemini (2009) 'Quest for Margins: Operational Cost Strategies for Mobile Operators in Europe', *Telecommunication and Media Insights*(Issue 42), October 2009, pp. 1 – 15.
- Chanab L A et al (2007) 'Telecommunication Infrastructure Sharing: Regulatory Enablers and Economic Benefits', *Booz Allen Hamilton Consulting*, December 2007, pp. 1 – 12.

- Davidson, William H. (1980). 'The Location of Foreign Direct Investment Activity: Country Characteristics and Experience Effects.' *Journal of International Business Studies*. 12 (Fall): 9-22.
- Davidson, William H. (1989). 'Ecostructures and International Competitiveness.' In *International Strategic Management*. Eds. Anant R. Negandhi and Arun Savara. Lexington, MA: Lexington Books, 3-27.
- Day, George S. (1992). "Marketing's Contribution to the Strategy Dialogue." *Journal of the Academy of Marketing Science*. 10 (May): 323-329.
- Day, George S. (1994). "The Capabilities of Market-Driven Organisations." *Journal of Marketing*. 58 (October): 37-52.
- Day, George S. and Robin Wensley. (1988). "Assessing Advantage: A Framework for Diagnosing Competitive Superiority." *Journal of Marketing*. 52 (April): 1-20.
- Deligonul, Z. Seyda and S. Tamer Cavusgil. (1997). "Does the Comparative Advantage Theory of Competition really replace the Neoclassical Theory of Competition?" *Journal of Marketing*. 61 (October): 65-73.
- Dickson, Peter R. (1992). "Toward a General Theory of Competitive Rationality." *Journal of Marketing*. 56 (January): 69-83.
- Dickson, Peter R. (1996). "The Statics and Mechanics of Competition: A Comment on Hunt and Morgan's Comparative Advantage Theory." *Journal of Marketing*. 60 (October): 102-106.
- Dierickx, Ingemar and Karel Cool. (1989). "Asset Stock Accumulation and Sustainability of Competitive Advantage." *Management Science*. 35 (December): 1504-1511.
- Dunning, John H. (1977). 'Trade, Location of Economic Activity and the MNE: A Search for an Eclectic Approach.' In *The International Allocation of Economic Activity*. Ed. B. Ohlin et al. London: Holmes and Meier, 395-418.
- Dunning, John H. (1981). *International Production and the Multinational Enterprise*. London: Allen and Unwin.
- Dunning, John H. (1988). *Explaining International Production*. London, Unwin Hyman.
- De Wit B. and Meyer R. (1999), *Strategy Synthesis: Resolving Strategy Paradoxes to Create Competitive Advantage*, International Thomson Business Press, London.
- Dwyer F.R., Schurr P.H. and Oh S. (1987) Developing Buyer-Seller Relationships, *Journal of Marketing* (April 1987), p 11-27.
- David J. Collis and Cynthia A. Montgomery (1995), *Competing on Resources: Strategy in the 1990s*, Harvard Business Review, July-August
- Darch, U., and Caltabiano, N. J. (2004). Investigation of Automatic Teller Machine Banking in a Sample of Older Adults. *Australasian Journal on Ageing*, 23(2), 100-103.
- Di Angeli, A., Coventry, L., and Johnson, G. I. (2002). *ATM's Adoption in Developing Countries: Déjà vu or not? Advanced Technology and Research*, Dundee, UK: NCR Financial Solutions Division.
- Dorward, L. A (2008) 'Business Impact of Infrastructure Sharing', Zain Government and Regulatory Affairs, October 2008, pp. 1 - 7.
- David J. Collis and Cynthia A. Montgomery (1995), *Competing on Resources: Strategy in the 1990s*, Harvard Business Review, July-August
- Daft, L.R., (1983), *Organizational Theory and Designs*, West Pub. Co. , St. Paul
- Dierickx, I.; Cool, K. (1989), *Asset Stock Accumulation and Sustainability of Competitive Advantage*. *Management Science*; 35, (12), pp. 1504-1511.
- David J. Collis and Cynthia A. Montgomery (1995), *Competing on Resources: Strategy in the 1990s*, Harvard Business Review, July-August

- Daft, R. (1983). *Organizational Theory and Design*. New York: West
- Environments to Create Value: Looking Inside the Black Box," *The Academy of Management Review*, 32 (1), 273-292
- "Achieving a sustainable competitive advantage in the IT industry through hybrid business strategy: A contemporary perspective" - Tharinda Jagathsiri (MBA-University of East London)
- El-Haddan, A., and Almahmeed, M. (1992). ATM Banking Behaviour in Kuwait: A Consumer Survey. *International Journal of Bank Marketing*, 10(3), 250-232.
- Ericsson(2004) 'The Beauty of Network Sharing', Ericsson. Available from <http://www.ericsson.com/solutions/news/2004/q1/20040202-network.shtml>(accessed 2009-10-26)
- Emeka Onuzuruike (2008) *Telecommunication Infrastructure Sharing as a Strategy for Cost Optimization and Revenue Generation: A Case Study of MTN Nigeria/Zain Nigeria Colocation*. MSc dissertation
- Estache, A et al (2004) 'An Introduction to Financial and Economic Modeling for Regulators of Transport Infrastructures', World Bank, April 2004, pp. 13 – 25.
- Fahy, John. (1996). "A Resource-Based Perspective on Global Competition: Conceptual Model and Research Hypotheses." In *International Business: Taking Stock and Moving Forward*. Aston Business School: Academy of International Business Conference Proceedings, 449.
- Fabbe-Costes N. (2000) le rôle transformatif des systèmes d'information sur les interfaces Multiacteurs de la distribution logistique, in *faire de la recherche en logistique et distribution*, mai 2000, vuibert fnge, paris.
- Fahim, R.M. (2009). "Sun running the cells". *The Pakistani Spectator*. 2/19/09. www.pakspectator.com
- Floyd S. And Wooldridge B. (1990) "Path analysis of the relationship between Competitive strategy, Information Technology, and Financial performance", *Journal of Management Information Systems*, 7, pp. 47-64.
- Fahim, R.M. 2009. "Sun running the cells". *The Pakistani Spectator*. 2/19/09. www.pakspectator.com
- FGN(2004) 'National Policy on Telecommunication', Federal Government of Nigeria, January 2004, pp. 1 – 35.
- Frost and Sullivan (2008) 'CAPEX in the African Telecommunication Market to Skyrocket'. Available from <http://telecommunication.tekrati.com/research/9963> (accessed 2009-10-26)
- Frances (2007) *Telecommunication Cost Reduction in Nigeria through Infrastructure Sharing between Operators*. Francis E. Idachaba, Ph.D. Department of Electrical and Information Engineering, Covenant University, Ota, Ogun State, Nigeria. E-mail: idachabafe@yahoo.com Unpublished thesis
- Ghemawat, Pankaj. (1986). "Sustainable advantage." *Harvard Business Review*. 64 (September-October): 53-58.
- Ghoshal, Sumantra. (1987). 'Global strategy: An Organising Framework.' *Strategic Management Journal*. 8 (September-October): 425-440.
- Gilbert, Xavier and Paul Strebel. (1989). "Developing Competitive Advantage." In *The Strategy Process, Concepts, Contexts, Cases* 2nd edition. Eds. Henry Mintzberg and James Brian Quinn. London: Prentice-Hall, 82-93.
- General Electric—Strategic Position. Intercollegiate Case Clearing House, 1-381-174, 1981.
- Godfrey, Paul C. and Charles W. Hill. (1995). "The Problem of Unobservables in Strategic Management Research." *Strategic Management Journal*. 16 (October): 519-533.

- Grant, Robert M. (1991). "The Resource-Based Theory of Competitive Advantage: Implications for Strategy Formulation." *California Management Review*. 33 (Spring): 114-135.
- Gray, H. Peter. (1982). 'Macroeconomic Theories of Foreign Direct Investment: An Assessment,' In *New Theories of the Multinational Enterprise*. Ed. Alan M. Rugman. London: Croom-Helm, 172-195.
- Gunther McGrath, Rita, Ian C. MacMillan and S. Venkataraman. 1995. "Defining and Developing Competence: A Strategic Process Paradigm." *Strategic Management Journal*, 16 (May): 251-275.
- Getty, J.M., and Getty, R.L. (2003), Lodging Quality Index (LQI): "Assessing Hotel Guests' Perceptions of Quality Delivery". *International Journal of Contemporary Hospitality Management*, Volume 15, Issue 2, pp. 94–104.
- Gupta, A., and Chen, I. (1995), Service Quality: "Implications for Management Development". *International Journal of Quality and Reliability Management*, Volume 12, Issue 7, pp. 28–35.
- Ghuari, P and Gronhaug K (2008) *Research Methods in Business Studies*, Pearson Education, London.
- Grant, R.M., (1991), *The Resource-Based Theory of Competitive Advantage: Implications for Strategy Formulation*. *California Management Review*; 33, (3), pp. 114–135.
- Häcki R. And Lighton J. "The Future of the Networked Company", *The McKinsey Quarterly*, 2001 number 3
- Hakansson H (1989) *Corporate Technological Behavior: Cooperation and Network Approach*. Croom Helm, London.
- Hall R. (1993) "A Framework Linking Intangible Resources and Capabilities to Sustainable Competitive Advantage", *Strategic Management Journal*, 14 (8) pp. 607-618.
- Hammer M. And Champy (1993) : *le reengineering*, dunod.
- Henderson, J. And Venkatraman N. (1993) "Strategic Alignment: Leveraging Information technology for transforming organization", *ibm systems journal*, 32, pp. 4-16.
- Henderson, B. D. *Henderson on Corporate Strategy*, Abt Books, Cambridge, Mass., 1979.
- Hoopes, D.G.; Madsen, T.L.; Walker, G. (2003) Guest Editors' Introduction to the Special Issue: Why is There a Resource-Based View? Toward a Theory of Competitive Heterogeneity. *Strategic Management Journal*; 24, pp. 889–902.
- Ho, C., Wu, W. (1999), "Antecedents of Customer satisfaction on the Internet: An Empirical Study of Online Shopping," *Proceedings of the 32nd Hawaii International Conference on Systems Sciences*.
- Hone, K. S., Graham, R., Maguire, M. C., Baber, C., and Johnson, G. I. (1998). Speech Technology for Automatic Teller Machines: An Investigation of User attitude and Performance. *Ergonomics*, 41(7) 962-981.
- Hoopes, D.G.; Madsen, T.L.; Walker, G. (2003) Guest Editors' Introduction to the Special Issue: Why is There a Resource-Based View? Toward a Theory of Competitive Heterogeneity. *Strategic Management Journal*; 24, pp. 889–902.
- Hussain F (2009) 'Examining the Benefits of Infrastructure Sharing and How to Apply it Successfully', *HeliosTowers.com*, June 2009, pp. 1 -18.
- Hall, Richard. (1989). "The Management of Intellectual Assets: A New Corporate Perspective." *Journal of General Management*. 15 (Autumn): 53-68.

- Hall, Richard. (1992). "The Strategic Analysis of Intangible Resources." *Strategic Management Journal*. 13 (February): 135-144.
- Hall, Richard. (1993). "A Framework linking Intangible Resources and Capabilities to Sustainable Competitive Advantage." *Strategic Management Journal*. 14 (November): 607-618.
- Hansen, Gary S. and Birger Wernerfelt. (1989). "Determinants of Firms Performance: The Relative importance of Economic and Organisational factors." *Strategic Management Journal*. 10 (September-October): 399-411.
- Hartley, Robert F. (1998). *Marketing Mistakes and Successes*. 7ed., New York: John Wiley and Sons.
- Helfat, Constance E. (1994). "Firms-specificity in corporate applied RandD." *Organisation Science*. 5 (May): 173-184.
- Henderson, Rebecca and Iain Cockburn. (1994). "Measuring Competence? Exploring Firms Effects in Pharmaceutical Research." *Strategic Management Journal*. 15 (Winter Special Issue): 63-84.
- Henderson, Rebecca and Will Mitchell. (1997). "The Interactions of Organisational and Competitive influences on Strategy and Performance." *Strategic Management Journal*. 18 (Summer Special Issue): 5-14.
- Hill, Charles W. and David L. Deeds. (1996). "The Importance of Industry structure for the Determination of firms profitability: A Neo-Austrian Perspective." *Journal of Management Studies*. 33 (July): 429-451.
- Hill, Charles W. and Gareth R. Jones. (1998). *Strategic Management: An Integrated Approach*. Boston, MA: Houghton Mifflin.
- Hill, T. and Roy Westbrook. (1997). "SWOT Analysis: It's time for a Product recall." *Long Range Planning*. 30: 46-52.
- Hitt, Michael A. and R. Duane Ireland. (1985). "Corporate Distinctive Competence, strategy, industry and performance." *Strategic Management Journal*. 6 (July-September): 273-293.
- Hofer, Charles W. and Dan Schendel. (1978). *Strategy Formulation: Analytical Concepts*. St. Paul, MN: West Publishing Co.
- Hood, Neil and Stephen Young. (1979). *The Economics of the Multinational Enterprise*. London: Longman.
- Hooley, Graham (1988). 'Competitive positioning.' in *The CIM Handbook of Strategic Marketing*. Oxford: Butterworth-Heinemann. 121-139.
- Hooley, Graham, David Shipley, John Fahy, Tony Cox, Jozsef Beracs and Kristina Kolos. 1996. "Foreign direct investment in Hungary: Resource acquisition and domestic competitive advantage. *Journal of International Business Studies*. 27 (Fourth Quarter): 683-710.
- Hooley, Graham, Kristian Moller and Amanda Broderick (1997). "Competitive positioning and the Resource-Based View of the Firms. *Aston Business School Research Paper Series*. RP9726.
- Hoskisson, Robert E., Michael A. Hitt, William P. Wan and Daphne Yiu. (1999). 'Theory and Research in Strategic Management: Swings of a pendulum.' *Journal of Management*. 25 (May-June): 417-439.
- Hu, Yao-Su. (1995). "The International Transferability of the Firms's advantages." *California Management Review*. 37 (Summer): 73-88.
- Hunt, Shelby D. and Robert M. Morgan. (1995). "The Comparative Advantage Theory of Competition." *Journal of Marketing*. 59 (April): 1-15.

- Hunt, Shelby D. and Robert M. Morgan. (1996). "The Resource-Advantage Theory of Competition: Dynamics, Path Depend-encies, and Evolutionary dimensions." *Journal of Marketing*. 60 (October): 107-114.
- Kuropatwa, H (2009) 'Network Sharing in LTE Deployment. It's a no brainer. Isn't it?', Ventura Partners, October 2009, pp. 1 – 15.
- Hoopes, D.G.; Madsen, T.L.; Walker, G. (2003) Guest Editors' Introduction to the Special Issue: Why is There a Resource-Based View? Toward a Theory of Competitive Heterogeneity. *Strategic Management Journal*; 24, pp. 889–902.
- Hoopes, D.G.; Madsen, T.L.; Walker, G. (2003) Guest Editors' Introduction to the Special Issue: Why is There a Resource-Based View? Toward a Theory of Competitive Heterogeneity. *Strategic Management Journal*; 24, pp. 889–902.
- Irvin, Robert A. and Edward G. Michaels. (1989). "Core skills: Doing the right things right." *The McKinsey Quarterly*. (Summer): 4-19.
- Itami, H. (1987). *Mobilising Invisible Assets*. Cambridge, MA: Harvard University Press.
- Jacobsen, Robert and David A. Aaker. 1985. 'Is market share all it's cracked up to be?' *Journal of Marketing*. 48 (Fall): 11-22.
- Jacobsen, Robert. (1988). 'Distinguishing among the Competing Theories of the Market Share effect.' *Journal of Marketing*. 52 (October): 68-80.
- Johanson, Jan and Finn Wiedersheim-Paul. (1975). 'The Internationalisation of the Firms: Four Swedish cases.' *Journal of Management Studies*. 12 (October): 305-322.
- Johanson, Jan and Jan-Erik Vahlne. (1977). 'The Internationalisation Process of the Firms– A Model of Knowledge Develop-ment and Increasing Foreign Market Commitments.' *Journal of International Business Studies*. 8 (Spring): 23-32.
- Kay, John. (1993). "The Structure of Strategy." *Business Strategy Review*. 4: 17-37.
- Kogut, Bruce. (1991). 'Country Capabilities and The Permeability of Borders.' *Strategic Management Journal*. 12 (Summer Special Issue): 33-47.
- Kohli, Ajay K. and Bernard J. Jaworski. (1990). "Market orientation: The Construct, Research Propositions and Managerial Implications. *Journal of Marketing*. 54 (April): 1-18.
- Kotler, Philip. (1994). *Marketing Management: Analysis, Planning, Implementation and Control*. Engelwood Cliffs, NJ: Prentice-Hall.
- Lado, Augustine A., Nancy G. Boyd and Peter Wright. (1992). "A Competency-Based Model of Sustainable Competitive Ad-vantage: Toward a Conceptual Integration." *Journal of Management*. 18 (March): 77-91.
- Learned, Edmund P., C. Roland Christensen, Kenneth R. Andrews and William D. Guth. 1969. *Business Policy*. Home-wood, IL: Irwin.
- Lei, David, Michael A. Hitt and Richard Bettis. (1996). 'Dynamic Core Competences through meta-learning and Strategic context.' *Journal of Management*. 22 (July): 549-569.
- Levinthal, Daniel and Jennifer Myatt. (1994). "Co-evolution of Capabilities and Industry: The Evolution of Mutual Fund Processing." *Strategic Management Journal*. 15 (Winter Special Issue): 45-62.
- Lewis, Pam and Howard Thomas. (1990). "The Linkage between Strategy, Strategic groups and Performance in the UK Retail Grocery Industry." *Strategic Management Journal*. 11 (September): 385-397.
- Lewis, William W., Hans Gersbach, Tom Jansen and Koji Sakate. 1993. 'The Secret to Competitiveness – competition.' *McKinsey Quarterly*. 4: 29-43.
- Lippman, S. A. and Richard P. Rumelt. (1982). "Uncertain Imitability: An Analysis of Inter Firms Differences in Efficiency under Competition." *Bell Journal of Economics*. 13 (Autumn): 418-438.

- Lodge, G. C. and E. F. Vogel. (1986). *Ideology and National Competitiveness*. Boston MA:
- Kraemer k. And dedrick j. (2002) "Strategic use of the Internet and e-commerce: Cisco systems", *Journal of Strategic Information Systems* 11 pp. 5-29.
- Kenova, V. and Jonasson, P. (2006). *Quality Online Banking Services: Bachelor's Thesis in Business Administration*, Submitted to Jonkoping University .
- Kennickell, A. B., and Kwast, M. L. (1997). Who uses Electronic Banking? Results from the 1995 survey of consumer finances. Presented at the Annual Meeting of the Western Economic Association, July, Seattle, Washington.
- Lee, E. and Lee, J. (2000). Haven't adopted Electronic Financial services yet? The Acceptance and Diffusion of Electronic Banking Technologies. *Financial Counselling and Planning*, 11(1), 49-60.
- Loiacono, E.T., Watson, R.T. and Hoodhue, D.L. (2002), "WEBQUAL: Measure of web site quality, Marketing Educators Conference: Marketing Theory and Applications," Volume 13, pp. 432-437.
- Lippman, S.A.; Rumelt, D.P., (1982), Uncertain Imitability: An Analysis of Inter firms Differences in Efficiency under Competition. *The Bell Journal of Economics*; 13, (2), pp. 418-438.
- Lowe, A.J., R.P. Blackwell, S.M. Mann, S.G Allen, and T.G. Cooper. (2000) "Exposure To Radio Waves Near Mobile Phone Base Stations". National Radiological Protection Board: Oxon, UK.
- Maijoor, Steven and Argen van Witteloostuijn. (1996). "An Empirical Test of the Resource-Based Theory: Strategic Regulation in the Dutch Audit Industry." *Strategic Management Journal*. 17 (July): 549-569.
- Markides, Constantinos and Peter J. Williamson. (1996). 'Corporate Diversification and Organisational Structure: A Re-source-Based View.' *Academy of Management Journal*, 39 (April): 340-367.
- Malone T., Yates J. And Benjamin R. (1987) "Electronic Markets and Electronic Hierarchies", *Communications of the ACM*, 30 (6), pp.484-497.
- Mentzer J, De witt W, Keebler J, Min S, Nix N, Smith C, Zacharia Z (2001), "Defining Supply Chain Management", *Journal of Business Logistics*, vol 22 n°2, pp.1-25.
- Marshall, J., and Heslop, L. (1988). Technology acceptance in Canadian Retail Banking. *International Journal of Bank Marketing*, 6(4), 31. Harvard Business School Press.
- Mahoney, Joseph T. and J. Rajendran Pandian. (1992). "The Resource-Based View within the Conversation of Strategic Man-agement." *Strategic Management Journal*. 13 (June): 363-380.
- Mahoney, J.T.; Pandian, J.R. (1992), The Resource-Based View Within the Conversation of Strategic Management. *Strategic Management Journal*; 15, (5), pp. 363-380.
- Makadok, R. (2001), Toward a Synthesis of the Resource-Based View and Dynamic-Capability Views of Rent Creation. *Strategic Management Journal*; 22, (5), pp. 387-401
- Makadok, R. (2001), Toward a Synthesis of the Resource-Based View and Dynamic-Management; 17, (1), pp.99-120.
- Meru (2008) 'A Cost Efficiency of Ownership Analysis of the Meru Virtual Cell Wireless LAN Architecture', Network Strategy Partners, LLC, March 2008, pp. 1 - 12.
- Motorola. 2006. "Achieving Highly Effective Coverage in GSM Networks". Motorola Reach White Paper. www.motorola.com/networkoperators.

- MCI.(2009) . “Vodafone and Telefonica Announce Wide Ranging Network Sharing Formular Deal for Europe”. 2009. Mobile communications International. Issue 158. April 2009.
- MTN (2008) ‘MTN Group 2008 Final Audited Results for the Year ended 31 December 2008’, MTN Group, South Africa, pp. 1-22.
- Narver, John C. and Stanley Slater. (1990). "The Effect of Market Orientation on Business Profitability." *Journal of Market-ing*. 54 (October): 20-35.
- Nelson, Richard R. 1991. ‘Why do Firms differ, and How does it matter?’, *Strategic Management Journal*. 12 (Winter Special Issue): 61-74.
- Nelson, Richard R. and Sidney G. Winter. 1982. *An Evolutionary Theory of Economic Change*. Cambridge, MA: Belknap Press.
- Neo B.S. (1988) “Factors facilitating the use of Information Technology for Competitive Advantage: an exploratory study” *Information and Management*, 15, pp. 191-201.
- Neff, W., and Cabrera, E. F. (1996). Training older adults to use Automatic Teller Machines. *Human Factors*, 38. Retrieved June 18, 2011 from <http://www.questia.com>
- Nigerian Communications Commission (NCC). 2008. “Guidelines for Colocation and Infrastructure Sharing. Nigerian Communications Commission: Lagos, Nigeria.
- Nunnaly, J. (1978). *Psychometric Theory*, 2nd Ed. New York: McCraw-Hill.
- Nworuh G.E (2004). *Basic Research Methodolgy for Researcher Trainers and Trainers in Management Sciences*. Second edition.Ambix, Owerri
- NCC (2004) ‘Trends in telecommunication Markets in Nigeria: 2003 -2004’, Nigerian Communications Commission. Available from <http://www.ncc.gov.ng> (accessed 2009-10-20).
- Nigerian Communications Commission (NCC). 2008. “Guidelines for Colocation and Infrastructure Sharing. Nigerian Communications Commission: Lagos, Nigeria.
- NCC(2006) ‘Determination of Interconnect Rate – Issued by Nigerian Communications Commission’, Nigerian Communications Commission, June 2006, pp. 1 – 31.
- NCC(2006) ‘Guidelines on Colocation and Infrastructure Sharing’ , Nigerian Communications Commission, pp.1-13.
- Oliver, Christine. 1997. "Sustainable Competitive Advantage: Combining Institutional and Resource-Based views." *Strate-gic Management Journal*. 18 (October): 697-713.
- Onwurah, C(2008) ’ Infrastructure Sharing – Promoting Competition In Next Generation Fixed Access’, OFCOM, pp. 1 -33.
- Olatokun W. M and Igbinedion L. J (2009). The Adoption of Automatic Teller Machines in Nigeria: An Application of the Theory of Diffusion of Innovation. *Issues in Information Science and Information Technology*, Vol. 6 ,374-392
- Pakistan Regulatory Authority. (2007). “Consultation Paper on Infrastructure Sharing of Mobile Companies”. Pakistan Regulatory Authority: Islamabad, Pakistan.
- Pascale, Richard T. and Anthony G. Athos. (1982). *The Art of Japanese Management*. London: Allen Lane.
- Panzar, J. C. and R. D. Willis;. 'Economies of Seope', .*American Economic Review*, 71 2, 1981, pp.268-272.
- Pento, E. G. *The Theory of the Growth of the Firms*, Wiley, New York, 1959.
- Penrose, Edith. 1959. *The Theory of Growth of the Firms*. Oxford: Blackwell.
- Peteraf, Margaret A. 1993. "The Cornerstones of Competitive Advantage: A Resource-Based View." *Strategic Management Journal*. 14 (March): 179-191.
- Peteraf M. (1993) “The Cornerstones of Competitive Advantage: A Resource-Based View”, *Strategic Management Journal*, 14 (3), pp. 179-191.

- Polanyi, Michael. (1967). *The Tacit Dimension*. Garden City, NY: Anchor.
- Porter, Michael E. (1980). *Competitive Strategy*. New York: The Free Press.
- Porter, Michael E. (1985). *Competitive Advantage*. New York: The Free Press.
- Porter, Michael E. (1990). *The Competitive Advantage of Nations*. London: The MacMillan Press Ltd.
- Porter M and Millar, (1985) "How Information gives you Competitive Advantage", *Harvard Business Review*, 65 (4), pp. 149-160.
- Porter M. (1980) *Competitive Strategy: Techniques for Analyzing Industries and Competitors*, the Free Press, New York.
- Porter M. (1985) *Competitive Advantage: Creating and Sustaining Superior Performance*, The Free press, New York.
- Porter M. (2001) *Strategy and the Internet* – *Harvard Business Review* – March 2001. Volume 79, number 3. P. 62-78.
- Prahalad, C. K. and Gary Hamel. (1990). "The Core Competence of the Corporation." *Harvard Business Review*. 68 (May-June): 79-91.
- Polzin D.W. And Lindemann M.A. (1999) "Evolution Elektronischer Märkte in Güterverkehr und logistik", *wirtschaftsinformatik*, 41, 6, pp. 526-537.
- Powell T.C. And dent-micaleff a.(1997) "Information Technology as Competitive advantage: The Role of Human, Business and Technology Resources", *Strategic Management Journal*, vol 18:5, 375-405.
- Prahalad c.k. And hamel g. (1990) "The Core Competence of the Corporation", *Harvard Business Review*, May/June, pp. 79-91.
- Porter, M. E. *Competitive Strategy*, Ereo Press, New York, 1980.
- Parasuraman, A., and Grewal, D. (2000), "The Impact of Technology on the Quality-Value Loyalty Chain: A Research Agenda, *Journal of the Academy of Marketing Science*," Volume 28, Issue 1, pp 168-174.
- Pitt, L.F., Watson, R.T., and Kavan, C.B., (1995)," Service Quality: A Measure Of Information Systems Effectiveness," *MIS Quarterly*. Rogers, A., Fisk, A. D., Mead, S. E., 21. Rugimbana, R. (1995). Predicting automated teller machine usage: The relative importance of perceptual and demographic factors. *International Journal of Bank Marketing*, 13(4), 26-32.
- Penrose, E.T., (1959), *The Theory of the Growth of the Firms*, New York: Wiley.
- Peteraf, M. A. (1993), "The Cornerstones of Competitive Advantage: A Resource-Based View". *Strategic Management Journal*, Vol. 14, No. 3, pp. 179–191
- Porter, M. E. (1980), "Competitive Strategy: Techniques for Analyzing Industries and Competitors", New York, NY: Free Press
- Porter, M.E. (2004 [1985]), *Competitive Advantage: Creating and Sustaining Superior Performance*, Free Press, reprinted in abridged form in: De Wit, Bob and Meyer, Ron, *Strategy. Process, Content, Context. An international perspective*, 3rd edition, London: Thomson, p. 258-267.
- Parker, J (2004) ' Planning a Cost Effective 3G Base Station Strategy', Coleago Consulting Ltd, March 2007, pp. 1 – 32.
- Pakistan Regulatory Authority. 2007. "Consultation Paper on Infrastructure Sharing of Mobile Companies". Pakistan Regulatory Authority: Islamabad, Pakistan.
- Priem, R.L., Butler, J.E. (2001b), Tautology in the Resource-Based View and Implications of Externally Determined Resource Value: Further Comments. *Academy of Management Review*; 26, (1), pp. 57–66.
- Ramamurthy, H. and B. Karandikar. 2008. "B-Hive: A Cell Planning Tool for Urban Wireless Networks". Department of Electrical Engineering IIT: Bombay, India.

- Rackoff N.C., Wiseman C. And Ulrich W. (1985) "Is is for Competitive Advantage: Implementation of a Planning process", MIS quaterly, 9, pp. 285-294.
- Rao, Haregeevu. 1994. 'The social construction of reputation: Certification contests, legitimation, and the survival of or-ganisations in the American automobile industry: 1895-1912.' Strategic Management Journal. 15 (Winter Special Is-sue): 29-44.
- Reed, Richard and Robert J. DeFillippi. 1990. "Causal ambiguity, barriers to imitation and sustainable competitive advan-tage." Academy of Management Review. 15 (January): 88-102.
- Reich, Robert B. 1991. The Work of Nations. New York: Vintage Books.
- Ries, A. and Jack Trout. 1982. Positioning: The Battle for Your Mind. Maidenhead: McGraw-Hill.
- Robins, James and Margarethe F. Wiersema. 1995. 'A Resource-Based Approach to the Multi-Business Firms: Empirical Analysis of Portfolio Interrelationships and Corporate Financial performance.' Strategic Management Journal. 16 (May): 277-299.
- Robinson, Joan. 1933. The Economics of Imperfect Competition. London: MacMillan Press.
- Rumelt, Richard P. 1984. "Towards a Strategic Theory of the Firms." In Competitive Strategic Management. Ed. Richard B. Lamb. Engelwood Cliffs, NJ: Prentice-Hall, 566-570.
- Rumelt, Richard P. 1987. "Theory, Strategy and Entrepreneurship." In The Competitive Challenge. Ed. David J. Teece. New York: Harper and Row, 137-158.
- Rumelt, Richard P., Dan Schendel and David J. Teece. 1991. 'Strategic Management and Economics. Strategic Manage-ment Journal. 12 (Winter Special Issue): 5-29.
- Roberts R. Eichler B. (2000) "e-global Logistic: The Engine Powering Globalization", Industry Report, November 2000, Stephens inc.
- Robeson J.F. and Copacino W.C. (1994) The Logistics Handbook -Andersen Consulting - (Editors in chief).
- Rumelt r. (1980) "The Evaluation of a Business Strategy", in Glueck, W.F., Business Policy and Strategic Management, 3rd ed., Mcgraw-hill, New york.
- Rics, A. and J. Trout. Positioning: The Battle for Your Mind, .VlcGraw-Hill, .New York, 1981.
- Rubin, P. H. 'The Expansion o! Firms'. Journal of Political Economy, 81, 1973, pp. 936-949.
- Rugman A.M.; Verbeke, A. (2002), Edith Penrose's Contribution to the Resource-Based Views of Strategic Management. Strategic Management Journal; 23, pp. 769-780.
- Rumelt, D.P., (1984), Towards a Strategic Theory of the Firms. Alternative theories of the Firms; 2002, (2) pp. 286-300, Elgar Reference Collection. International Library of Critical Writings in Economics, vol. 154. Cheltenham, U.K. and Northampton, Mass.: Elgar; distributed by American International Distribution Corporation, Williston, Vt.,
- Rumelt, R. P. (1991), "How much does Industry matter?". Strategic Management Journal, Vol. 12, No. 3, pp. 167-185
- Ramamurthy, H. and B. Karandikar. 2008. "B-Hive: A Cell Planning Tool for Urban Wireless Networks". Department of Electrical Engineering IIT: Bombay, India.
- Salter, .M. and W. Weinhold. Diversification by Acquisition, Eree Press, New York, 1980. Spence, .\, M. 'Investment strategy and growth in a new market'. Bell Journal of Economics, 10, 1979, pp. 1-19. Strategic Management Journal; 14, (1), pp. 33-46.

- Samii A.K. (2001) *Stratégie Logistique: Fondements. Méthodes.applications*, dunod, Paris.
- Santos, J. (2003), "Eservice Quality: A Model of Virtual Service Quality Dimensions." *Managing Service Quality*, Volume 13, Issue 3, pp.233-246.
- Sanchez, R., Heene, A. (2004), *The New Strategic Management: Organizations, Competition and Competence*, John Wiley and Sons
- Schendel, Dan. 1985. "Strategic Management and Strategic Marketing: What's Strategic about either one." In *Strategic Marketing and Management*. Eds. Howard Thomas and David Gardner. New York: John Wiley and Sons, 41-63.
- Schneider, S. and De Meyer, A. 1991. "Interpreting and Responding to Strategic Issues." *Strategic Management Journal*. 12 (July): 307-320.
- Schoemaker, Paul J. (1990). "Strategy, Complexity and Economic Rent." *Management Science*. 36 (October): 1178-1192.
- Schoemaker, Paul J. (1992). 'How to Link strategic vision to Core capabilities.' *Sloan Management Review*. 34 (Fall): 67-81.
- Selznick, Philip. (1957). *Leadership in Administration*. New York: Harper and Row.
- Shan, Weijan and William Hamilton. (1991). 'Country-specific Advantage and International Cooperation.' *Strategic Management Journal*. 12 (September): 419-432.
- Stalk, George, Philip Evans and Lawrence E. Schulman. (1992). "Competing on capabilities: The New rules of Corporate Strategy." *Harvard Business Review*. 70 (March-April): 57-69.
- Sirmon, D.G., M.A. Hitt, and R.D. Ireland (2007). "Managing FirmsResources in Dynamic Strategy. *Management Science*; 32, (10), pp. 1231–1241.
- Stevenson, H. 1976. "Defining Corporate Strengths and Weaknesses." *Sloan Management Review*. 17 (Spring): 51-68.
- Stigler, G.K., (1961), *The Economics of Information*, *Journal of Political Economy*, pp. 213–225.
- Snow, C. C., Miles, R. E., and Coleman, H. J. 1992. *Managing 21st Century Network Organizations*. *Organizational Dynamics*, 20(3): 5–20.
- Song, J., Almeida, P., and Wu, G. 2003. Learning-by-Hiring: When is Mobility more likely to facilitate inter Firms Knowledge transfer? *Organization Science*, 49: 351–365.
- Spender, J.-C. (1996). Making knowledge: The Basis of a Dynamic Theory of the Firms. *Strategic Management Journal*, 17(Supplement): 45–62.
- Starbuck, W. H. (1992). Learning by Knowledge-Intensive Firms. *Journal of Management Studies*, 29: 713–739.
- Snell, S. A. (1992). Control Theory in Strategic Human Resource Management: The Mediating Effect of Administrative Information. *Academy of Management Journal*, 35: 467– 504.
- Snell, S. A., and Youndt, M. A. (1995). Human Resource Management and Firms performance: Testing a Contingency Model of Executive Controls. *Journal of Management*, 21: 711–737.
- Swinyard, W. R., and Ghee, L. (1987) Adoption Patterns of new Banking Technology in South-east Asia. *International Journal of Bank Marketing*, 5(4), 35-48.
- Szulanski, G. 1995. Unpacking Stickiness: An Empirical Investigation of the Barriers to Transfer best Practices inside the Firms. *Academy of Management Journal*, 1: 437–442.

- Tallman, Stephen B. and Karin Fladmoe-Lindquist. (1997). "Resource-Based Strategy and Competitive Advantage among Multinationals." In *Strategic Management in a Global Economy* 3rd edition. Ed. Heidi Vernon-Wortzel and Lawrence H. Wortzel. New York: John Wiley and Sons, 149-167.
- Taube, P. M. (1988). The Influence of Selected Factors on the Frequency of ATM usage. *Journal of Retail Banking*, 10(1), 47-52.
- Teece, David J. (1986). 'Firms Boundaries, Technological innovation and Strategic Management.' In *The Economics of Strategic Planning*. Ed. L. G. Thomas. Lexington, MA: Lexington Books, 187-199.
- Teece, D., Pisano, G. and Shuen, A. (1997), "Dynamic Capabilities and Strategic Management". *Strategic Management Journal*, Vol. 18, No. 7, pp. 509–533
- Teece, David J., Gary Pisano and Amy Shuen. 1997. "Dynamic Capabilities and Strategic Management." *Strategic Management Journal*. 18 (August): 509-533.
- Texas Instruments—Management Systems. Intetcollegiate Case Clearing House, 9-172-54, 1971. Telecommunication Regulatory Authority of India. 2007. "Recommendations on Infrastructure Sharing". Telecommunication Regulatory Authority of India: Delhi, India.
- Timmers P. (2000) *Electronic Commerce: Strategies and Models for Business-to-Business Trading*, John Wiley and Sons, Chichester.
- Tsang, N., and Qu, H.L. (2000), "Service quality in China's hotel industry: A perspective from tourists and hotel managers." *International Journal of Contemporary Hospitality Management*, Volume 12, Issue 5, pp. 316–326.
- The Hindu (2007) TRAI proposes sharing of telecommunication infrastructure - The Hindu, April 12, 2007
- Van Wolferen, Karl. (1989). *The Enigma of Japanese Power*. Tokyo: Charles E. Tuttle Co.
- Venkatagivi, K.S. and K. Sivaram. (2007). "Installation of Hot Air Direct Ducting System at Base Receiver Station". *Energy Efficiency Bulletin*. Case study of bulletins from C11. Sohrabji Godrej Green Business Center. Confederation of Indian Industry.
- Wernerfelt, B. 'An Information Based Theory of Microeconomics and its Consequences for Corporate Strategy'. Unpublished Dissertation, Harvard University, Graduate School of Business Administration, 1977.
- Wernerfelt, Birger. (1984). "A Resource-Based View of the Firms." *Strategic Management Journal*. 5 (April-June):171-180.
- Wernerfelt, Birger. 1989. "From Critical Resources to Corporate Strategy." *Journal of General Management*. 14 (Spring): 4-12.
- Wernerfelt, Birger. 1995. 'The Resource-Based View of the Firms: Ten years after.' *Strategic Management Journal*. 16 (March): 171-174.
- Whiteing T. (2000) "Partnerships and Long Term Relationships in Logistics: the UK Situation", *in faire de la recherche en logistique et distribution*, mai 2000, vuibert fnge, paris.
- Williams, Jeffrey R. (1992). "How Sustainable is your Competitive Advantage." *California Management Review* 34 (Spring): 29-51.
- Williamson, Oliver E. (1975). *Markets and Hierarchies*. New York: The Free Press.
- Williamson, Oliver E. (1985). *The Economic Institutions of Capitalism*. New York: The Free Press.
- World Bank (2008) 'A Brief Introduction to Modeling for the Regulation of Transport Infrastructure', World Bank, pp. 10 -15.
- Wright, P. M., and Snell, S. A. 1991. Toward an integrative view of strategic human resource management. *Human Resource Management Review*, 1: 203–225.

- Yang, Z. and Fang, X. (2004), "Online Service Quality Dimensions and Their Relationships With Satisfaction: A Content Analysis Of Customer Reviews Of Securities Brokerage Services". *International Journal Of Service Industry Management*, Volume 15, Issue 3, pp. 302-326.
- Yli-Renko, H., Autio, E., and Sapienza, H. J. 2001. Social capital, knowledge acquisition, and knowledge exploitation in young technology-based firms. *Strategic Management Journal*, 22: 587–613.
- Zain(2008) ' Zain MTC Group 2008 Annual Report', Zain MTC Group, pp.1-94
- Zajac, Edward. 1995. "SMJ 1994 best paper prize to Birger Wernerfelt." *Strategic Management Journal*. 16 (March): 169-170.
- Zeithaml, V.A., Parasuraman, A. and Molhotra, A. (2000), "A Conceptual Framework for Understanding E-Service Quality: Implications For Future Research And Managerial Practice." Working Paper, Report No. 00-115 Marketing Science Institute, Cambridge, MA.

Appendix A

```
REGRESSION
/DESCRIPTIVES MEAN STDDEV CORR SIG N
/MISSING LISTWISE
/STATISTICS COEFF OUTS BCOV R ANOVA COLLIN TOL CHANGE
/CRITERIA=PIN(.05) POUT(.10)
/NOORIGIN
/DEPENDENT Cost efficiency
/METHOD=ENTER core network aspect, network operations aspect, human resources
Aspect, spectrum sharing aspect and security aspect
/RESIDUALS DURBIN.
```

Table 5: Table showing the properties of the software used for regression analysis

Regression

		Notes
Output Created		31-Oct-2011 03:50:25
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data	176
	File	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /DESCRIPTIVES MEAN STDDEV CORR SIG N /MISSING LISTWISE /STATISTICS COEFF OUTS BCOV R ANOVA COLLIN TOL CHANGE /CRITERIA=PIN(.05) POUT(.10) /NOORIGIN /DEPENDENT Cost efficiency /METHOD=ENTER Core network Aspect, Network operations Aspect, Human resources Aspect, Spectrum sharing Aspect, Security Aspect /RESIDUALS DURBIN.
Resources	Processor Time	00:00:00.078
	Elapsed Time	00:00:00.109
	Memory Required	2676 bytes
	Additional Memory Required for Residual Plots	0 bytes

Appendix B

Descriptive Statistics

Table 6: Mean and Std. deviation descriptive statistics results

	Mean	Std. Deviation	N
Cost efficiency	18.8011	3.29852	176
Core network Aspect	26.3239	5.36792	176
Network operations Aspect	24.5795	5.56257	176
Human resources Aspect	25.6932	4.46794	176
Spectrum sharing Aspect	26.3295	4.66285	176
Security Aspect	25.8068	5.22709	176

Appendix C

Correlations

Table 7: This table shoes result of correlations

		Cost efficiency	Core network Aspect	Network operations Aspect	Human resource Aspect	Spectrum sharing Aspect	Security Aspect
Pearson Correlation	Cost efficiency	1.000	.394	.342	.393	.461	.630
	Core network Aspect	.394	1.000	.472	.378	.349	.441
	Network operations Aspect	.342	.472	1.000	.476	.435	.343
	Human resources Aspect	.393	.378	.476	1.000	.647	.525
	Spectrum sharing Aspect	.461	.349	.435	.647	1.000	.532
	Security Aspect	.630	.441	.343	.525	.532	1.000
Sig. (1-tailed)	Cost efficiency	.	.000	.000	.000	.000	.000
	Core network Aspect	.000	.	.000	.000	.000	.000
	Network operations Aspect	.000	.000	.	.000	.000	.000
	Human resources Aspect	.000	.000	.000	.	.000	.000
	Spectrum sharing Aspect	.000	.000	.000	.000	.	.000
	Security Aspect	.000	.000	.000	.000	.000	.
N	Cost efficiency	176	176	176	176	176	176
	Core network Aspect	176	176	176	176	176	176
	Network operations Aspect	176	176	176	176	176	176
	Human resources Aspect	176	176	176	176	176	176
	Spectrum sharing Aspect	176	176	176	176	176	176
	Security Aspect	176	176	176	176	176	176

Appendix D

Variables Entered/ Removed

Table 8: The table showing how the variables were entered / removed

Model	Variables Entered	Variables Removed	Method
1	Security Aspect, Network operations Aspect, Core network Aspect, Spectrum sharing Aspect, Human resources Aspect		. Enter

Appendix E

Model Summary

Table 9: The table shows the model summary of the F-test

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.659 ^a	.435	.418	2.51576	.435	26.168	5	170	.000	1.863

Appendix F

ANOVA^b

Table 10: This table shows the ANOVA table

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	828.105	5	165.621	26.168	.000 ^a
	Residual	1075.934	170	6.329		
	Total	1904.040	175			

Appendix G

Coefficients^a

Table 11: showing Total cost when regressed with Core Network Aspect

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
Total cost	12.425	1.150		10.804	.000	10.155	14.695					
Core network aspect	.242	.043	.394	5.657	.000	.158	.327	.394	.394	.394	1.000	1.000

Table 12: showing Total cost when regressed with Network Operations Aspect

Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
Total cost	13.820	1.065		12.982	.000	11.719	15.921					
Network Operations Aspect	.203	.042	.342	4.797	.000	.119	.286	.342	.342	.342	1.000	1.000

Table13 : showing Total cost when regressed with Human Resources Aspect

Coefficients ^a												
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
Total cost	11.349	1.342		8.456	.000	8.700	13.998					
Human resources Aspect	.290	.051	.393	5.636	.000	.188	.392	.393	.393	.393	1.000	1.000

Table 14: showing Total cost when regressed with Spectrum Sharing Aspect

Coefficients ^a												
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
Total cost	10.224	1.273		8.033	.000	7.712	12.736					
Spectrum sharing Aspect	.326	.048	.461	6.844	.000	.232	.420	.461	.461	.461	1.000	1.000

Table 15: showing Total cost when regressed with Security Aspect

Coefficients ^a												
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1 Total cost	8.540	.978		8.732	.000	6.609	10.470					
Security Aspect	.398	.037	.630	10.704	.000	.324	.471	.630	.630	.630	1.000	1.000

Appendix H

Table 16: Table showing Collinearity diagnostics

Collinearity Diagnostics

		Eigen value	Condition Index	Variance Proportions					
				(Cost efficiency)	Core network Aspect	Network operations Aspect	Human resources Aspect	Spectrum sharing Aspect	Security Aspect
1	1	5.900	1.000	.00	.00	.00	.00	.00	.00
	2	.031	13.719	.02	.08	.58	.02	.04	.15
	3	.025	15.375	.00	.66	.18	.05	.07	.05
	4	.019	17.504	.53	.01	.10	.00	.00	.53
	5	.014	20.479	.45	.25	.13	.15	.22	.27
	6	.010	23.804	.00	.00	.01	.77	.67	.00

Appendix I

Table 17: table showing the result of Residual Statistics

Residuals Statistics					
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	11.6028	23.3573	18.8011	2.17532	176
Residual	-8.65390	14.14448	.00000	2.47956	176
Std. Predicted Value	-3.309	2.094	.000	1.000	176
Std. Residual	-3.440	5.622	.000	.986	176

APPENDIX J

Questionnaire Federal University of Technology, Owerri FUTO

Dear respondent,

This questionnaire is part of my Research-paper in partial fulfillment of my Postgraduate study in IT (MSc) in the Department of Information Management Technology, Federal University of Technology Owerri. The purpose of this research is to analyze the colocation (sharing of telecommunication' facilities) arrangement among GSM operators in Nigeria; analyzing how such arrangement affect cost efficiency. The information and response gathered will be used for academic purposes only, and will be kept strictly confidential. The survey will take about 10 to 15 minutes to complete. Your participation in this survey is appreciated.

Thank you

Yours faithfully,

Dawodu B.F

For further clarification and inquiries please contact:

dele4yemisi@yahoo.com

Colocation: this is the means / process of sharing facilities among competitors of the same business / services

Part A: Please tick the item below that best describes you.

1. Gender: Male ☐ Female ☐
2. Age Group
Under – 20 ☐ 20 – 29 ☐ 30 – 39 ☐ 40 – 49 ☐ 50 – 59 ☐ Over 59 ☐
3. Nationality: Nigerian ☐ others (please specify) _____
4. Race: Ibo ☐ Hausa ☐ Yoruba ☐ Others (please specify) _____
5. Educational Background:
Primary/secondary ☐ Undergraduate ☐ OND/NCE ☐ HND/B.Sc ☐
PhD/MSc ☐
6. Are you aware of Mobile Phone (GSM) firms sharing resources? Yes ☐ No ☐
7. If yes, what kind of resources do they share? Hardware ☐ Software ☐ both ☐
others specify _____
7. Do you think colocation of GSM facilities will reduce cost? Yes ☐ No ☐
8. Do you think colocation of GSM facilities will enhance efficiency? Yes ☐ No ☐
9. Based on question (8), will colocation of GSM facilities improve quality of service, reliability?
Yes ☐ No ☐ others (please specify) _____
10. How would you describe the security of GSM operations in Nigeria? Secured ☐ not secure ☐
11. Name of your GSM operator (please specify) _____

PART B

This section is to measure *the effect of colocation arrangement on cost efficiency of selected GSM firms in Nigeria*. There is no right or wrong answer. Please choose your answers by ticking the corresponding box using the scale from 1 to 5 as shown below:

<i>Strongly disagree (SD)</i>	<i>Disagree (D)</i>	<i>Neither agree nor disagree (N)</i>	<i>Agree (A)</i>	<i>Strongly Agree (SA)</i>
1	2	3	4	5

X ₁	CORE NETWORK ASPECT					
		SD	D	N	A	SA
1	Core network sharing brings about reduction in cost of purchase of new Base station equipment and maintenance					
2	Core network sharing reduces the cost of buying landed properties or shelters, towers etc.					
3	Core network sharing reduces the cost of procurement of New Station controllers					
4	Core network sharing reduces the cost of purchase of New Switches in Mobile station (MSC)					
5	Core network sharing reduces the cost of purchase of Transmission equipment (Microwave radio and antennas)					
6	Core network sharing brings about cost reduction in installation of Fibre Metropolitan Network					
7	Core network sharing reduces cost of procurement of Intelligent Network equipment and services					

X ₂	NETWORK OPERATIONS ASPECT					
		SD	D	N	A	SA
1	Sharing of Network operations brings about cost reduction of utilities such as water, electricity, vehicles and fuel etc.					
2	Sharing of Network operations brings about cost reduction of engaging experts operation on sites					
3	Sharing of Network operations brings about cost reduction in taxes, rate and rents					
4	Sharing of Network operations brings about cost reduction of hiring buildings, technical premises					
5	Sharing of Network operations brings about reduction of cost of GSM operations in Nigeria					
6	Sharing of Network operations brings about reduction of the cost of hiring contractors					
7	Sharing of Network operations brings about reduction in cost of patents, trademark, copy rights, software patents and license					

X ₃	HUMAN RESOURCES (HR) ASPECT					
		SD	D	N	A	SA
1	Sharing of HR reduces the cost of employment of competent staff					
2	Sharing of HR promote considerable growth and quality service coverage at reduce cost.					
3	Sharing of HR brings about efficiency and effectiveness to subscribers at reduce cost					
4	Sharing of HR brings about better land usage, better reforms and policies in the GSM environment in Nigeria					
5	Sharing of HR promote anti-competitive practices among GSM operators at reduce cost					
6	Sharing of HR decrease barriers for new entrants into GSM operations in Nigeria					
7	Sharing of HR brings about faster faults recovering					

X ₄	SPECTRUM SHARING ASPECT					
		SD	D	N	A	SA
1	Spectrum sharing brings about reduction in obtaining spectral space / bandwidth at reduce cost					
2	It promote faster spectral space/ bandwidth roaming at reduce cost					
3	It enhance easy spectral interfacing at reduce cost					
4	It enhances better spectral policies at reduce cost					
5	It improves the quality of spectral services at reduce cost					
6	It brings about effective and efficient usage of spectral space at reduce cost					
7	It promote easy detection and recovering of spectral faults at reduce cost					

X ₅	SECURITY ASPECT					
		SD	D	N	A	SA
1	Security sharing brings about better and effective security at Base station and Switching centre					
2	Security sharing brings about secured Telecommunication legislature and policy					
3	Security sharing brings about secured Microwave radio equipment at reduce cost					
4	It brings about secured National frequency and usage					
5	It brings about secured capital expenditure and operational cost at reduce cost					
6	It provides better security of staff and subscribers at reduce cost					
7	It provides security to GSM operations in Nigeria at reduce cost					

Y	Cost efficiency					
		SD	D	N	A	SA
1	Cost efficiency is reduced by sharing and controlled of core network of GSM Firms in Nigeria					
2	Cost efficiency is reduced by sharing and controlled of Network operations of GSM Firms					
3	Cost efficiency is reduced by sharing and controlled of Human resource of GSM Firms in Nigeria					
4	Cost efficiency is reduced by sharing and controlled of spectrum / bandwidth of GSM Firms in Nigeria					
5	Cost efficiency is reduced by sharing and controlled of security of GSM Firms in Nigeria					

APPENDIX K
DATA USED FOR ANALYSIS

S/N	Y	X1	X2	X3	X4	X5
1	17	18	18	20	25	21
2	20	27	23	25	26	27
3	18	23	21	22	30	26
4	13	7	7	19	23	11
5	21	28	26	31	27	31
6	22	17	31	30	31	30
7	22	26	28	27	27	25
8	25	7	12	35	31	35
9	21	27	23	29	33	31
10	21	29	28	30	31	26
11	20	20	22	25	22	26
12	18	31	13	29	25	22
13	20	35	16	20	7	35
14	23	27	21	24	26	28
15	17	26	18	15	21	19
16	20	21	21	21	21	27
17	20	26	20	22	24	24
18	21	26	29	30	29	30
19	20	33	10	26	30	30
20	25	35	35	35	35	35
21	19	24	23	23	22	28
22	22	31	34	32	32	31
23	18	22	22	27	25	27
24	19	23	23	24	27	22
25	19	24	11	27	24	22
26	10	14	22	20	19	12
27	25	35	35	25	35	32
28	25	35	35	27	35	25
29	12	25	16	26	24	34
30	13	35	35	31	22	16
31	20	35	28	24	34	24
32	8	20	10	21	16	17
33	15	28	28	11	23	24
34	14	18	25	20	19	16
35	17	21	24	21	21	23
36	23	34	31	31	29	29
37	20	28	28	28	28	28
38	18	21	26	23	21	19
39	20	28	27	21	27	26
40	20	20	16	17	29	22
41	17	31	25	28	26	18

S/N	Y	X1	X2	X3	X4	X5
43	17	31	25	28	26	18
44	19	32	26	29	27	28
46	12	18	18	22	18	20
47	12	20	18	21	18	21
48	20	17	21	24	19	16
49	14	25	25	24	21	18
50	10	21	21	21	21	17
51	17	30	23	24	24	23
52	21	28	21	22	27	27
53	20	28	16	14	16	18
54	17	32	29	25	25	23
55	18	35	31	19	24	15
56	20	27	28	19	28	28
57	20	22	22	23	21	20
58	20	27	24	29	30	25
59	13	10	23	19	14	10
60	15	15	17	19	18	26
61	15	29	27	21	24	23
62	21	27	19	28	28	28
63	20	25	27	24	25	28
64	21	27	20	29	28	28
65	19	29	29	23	27	27
66	18	31	27	27	26	27
67	16	30	31	29	30	25
68	24	34	31	30	28	30
69	18	27	29	24	28	28
70	22	31	28	30	31	27
71	20	31	23	24	26	24
72	9	14	22	18	19	12
73	21	29	28	30	27	26
74	31	28	20	17	15	23
75	19	28	21	12	15	24
76	19	30	22	19	19	26
77	18	25	28	26	28	24
78	14	30	29	23	23	24
79	19	32	26	29	27	28
80	19	32	29	31	30	30
81	21	28	26	29	31	30
82	19	29	19	28	28	28
83	19	25	17	26	27	29
84	19	26	17	26	26	29
85	21	26	33	27	30	29
86	16	29	11	16	19	20

S/N	Y	X1	X2	X3	X4	X5
87	16	19	22	20	23	20
88	15	22	18	21	21	24
89	16	24	17	22	21	20
91	15	25	17	22	24	25
92	16	18	19	23	26	21
93	21	31	24	33	27	30
94	20	28	29	28	30	28
95	22	24	27	29	28	29
96	18	17	30	26	29	26
97	17	29	33	30	26	23
98	19	31	27	23	27	25
99	20	29	31	28	28	30
100	19	30	31	30	28	31
101	19	30	23	29	30	30
102	16	27	23	27	28	30
103	23	22	25	29	31	34
104	19	28	19	28	32	32
105	21	27	23	27	28	30
106	21	27	23	29	33	31
107	21	27	23	28	31	30
108	19	30	23	29	30	30
109	19	30	23	29	30	30
110	20	27	23	27	28	30
111	20	27	23	27	28	30
112	18	32	30	28	30	29
113	19	24	27	27	25	25
114	21	26	27	26	29	26
115	21	26	24	29	29	29
116	18	28	26	26	30	25
117	19	28	19	23	21	17
118	18	17	19	18	28	18
119	19	23	30	32	31	31
120	20	24	27	28	31	29
121	21	27	24	27	25	30
122	21	23	24	26	22	28
123	23	30	27	25	29	35
124	19	21	31	27	23	15
125	21	31	23	26	30	30
126	22	31	30	32	30	31
127	21	27	32	27	28	33
128	20	27	28	27	30	34
129	19	22	21	25	34	24

S/N	Y	X1	X2	X3	X4	X5
130	21	27	31	26	33	29
131	20	31	30	29	25	29
132	18	22	20	22	19	24
133	20	24	28	27	27	25
134	19	28	29	25	29	26
136	18	28	27	29	28	25
137	20	28	28	24	23	28
138	14	22	25	23	14	22
139	19	28	25	29	30	27
140	18	25	15	25	28	25
141	24	31	32	31	30	31
142	16	35	28	29	27	28
143	18	29	30	26	24	25
144	18	30	24	23	24	25
145	11	16	17	15	23	24
146	18	28	17	20	24	25
147	21	29	32	32	33	34
148	15	21	21	26	28	25
149	17	24	15	18	26	27
150	15	17	27	22	27	21
151	24	29	26	31	29	31
152	23	32	29	29	25	31
153	17	34	25	26	31	18
154	21	28	31	29	33	32
155	22	23	24	30	28	26
156	25	30	28	26	31	31
157	7	22	17	33	28	10
158	20	22	30	23	23	30
159	19	22	18	24	31	23
160	22	29	27	31	33	29
161	18	31	31	30	29	30
162	21	27	24	29	23	26
163	18	31	31	30	28	30
164	20	29	29	30	30	24
165	19	32	29	31	31	30
166	21	29	27	30	27	30
167	20	23	30	31	24	28
168	18	15	21	24	28	18
169	20	28	29	29	30	31
170	19	31	32	31	30	30
171	21	28	29	29	29	29
172	19	31	32	31	30	30

S/N	Y	X1	X2	X3	X4	X5
173	21	27	26	27	31	27
174	19	28	32	29	29	30
175	15	29	28	26	26	27
176	19	31	30	31	30	30