RELATIONSHIP BETWEEN NETWORK COVERAGE AND TELEDENSITY GROWTH – CASE OF GIANT TELECOMMUNICATION COMPANIES OF TANZANIA

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Abstract

This study examined the relationship between network coverage and Teledensity level in Tanzania. The study adopted cross-sectional explanatory survey where questionnaire was used to collect data from five out of 26 regional headquarters of Tanzania namely: Arusha, Dar es Salaam, Dodoma, Mbeya and Mwanza. The target population of the study was the mobile phone subscribers from the four giant incumbent mobile phone network operators namely, Vodacom, Zain (Airtel), Tigo and Zantel. The study found out that; there is significant association between Network coverage and status of Teledensity level. It has further been found out that financial problems, unavailability of network coverage and regulatory barriers to telecommunications industry are fundamental factors leading to low Teledensity level in Tanzania. With regard to the findings; the study concludes that infrastructural development in rural areas and policy amendments that will lead to tariffs and costs reduction are among the important aspects that have to be considered for improving Teledensity level in Tanzania. The study recommends feasible and economical network extension in rural areas where most population is staying. It is also recommended to adopt reasonable and affordable prices for services provided by mobile phone network operators.

Key Words: Network coverage, customer base, teledensity, telecommunication, mobile phone

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1.0   Introduction

Cellular operators in Tanzania are monitored and licensed by Tanzania Communications Regulatory Authority (TCRA) that came into operation on 1st November 2003 as a result of TCRA Act no. 12 of 2003. Historically, mobile cellular networks operations in the country started way back in 1994 when MIC (Tanzania) Ltd popularly known as Mobitel (now Tigo) operated a cellular mobile network in few regions namely Dar-es-Salaam, Zanzibar, Arusha, and Mwanza. Tritel-Tanzania Ltd launched its cellular mobile network in 1995 in two regions namely Dar-es-Salaam and Zanzibar. In 1998, Zantel started to serve the same on Zanzibar side. In July 1999, the Tanzanian Government through TCRA approved an application by South Africa's Vodacom to operate a mobile phone network in Tanzania. Vodacom started to operate in 2000 followed by Celtel that changed to Zain and now Airtel in 2001. Zantel moved onto the Tanzania mainland in July 2005 and improved her coverage by entering into a national roaming agreement with Vodacom Tanzania.

Network coverage and other factors for example Value added services (VAS) were slowly emerging and continually remained to be determinants of choices for potential customers for the available mobile operators in Tanzania. While competition continuously grew, Tritel operations came to an end in year 2003 due to insolvency. This led Tanzania to remain with four operators from which potential customers could make choice using their preference factors including Network coverage, network capacity, Network availability, promotions, tariffs, advertisement, Network quality, customer's loyalty, new Technologies and others from the remaining four operators. Between 2005 and 2006 other mobile operators namely, Tanzania Telecommunication Company Limited (TTCL) Mobile and Benson on Line (BoL) entered into mobile operations in the country.

Beside the number of operators for mobile business in Tanzania; number of people having/owning a voice telephone line(s) (Teledensity) is still very low compared to current population of Tanzania. Teledensity may be defined as number of main telephone lines for every one hundred inhabitants and is a leading measure of the telecommunications infrastructures within a country (McCoy and Mbarika, 2005). TCRA report of March 2008 shows that trend of population growth and that of voice telephone subscribers are growing at the rate of 3.3% and

48% annually respectively. Though the subscription rate growth is higher than that of population; there is still an enormous gap between the two groups. Actually, Teledensity figures for Tanzania are low when compared to developed countries. According to TCRA (2009 and 2012), Tanzania had a teledensity of 25% and 58% respectively. One of the suspected reasons for this outcome is that, most rural areas where the big portion of the population resides has no access to telephone facilities. According to the International Telecommunications Union – ITU (2007; 2008), teledensity levels in most African countries is low ranging between 2.44 for Burundi to 96.41 for South Africa. Similar levels for developed countries are quite impressive, ranging between 88.17 for Turkey to 182.85 for Bermuda. These figures demonstrate significant variations in mobile services between developed and developing countries. Cellular operations technology is changing at remarkably high speed worldwide. If these changes are fully and well utilized, they can be the most affordable and practical solution to most developing countries to widen coverage of mobile networks to rural areas. Tanzania has not been left behind in these technological changes. Mobile phone operators in Tanzania have been extending their networks both in urban and rural areas and hence customer base has been increasing (TCRA, 2009; 2012).

Previous studies in other countries have proved that there is a high correlation between the level of Teledensity and per capita Gross Domestic Product (GDP) (Mbarika et al., 2003; Saunders et al., 1994; Gille, 1986). Studies done by (Mbarika, 2002) examined the contribution of teledensity to economy and society. On the other hand, Hardy (1980) found casual relationship between the network coverage and the national economy in over sixty nations. These findings demonstrate the significance of higher levels of teledensity in rising economy of a given country. Teledensity of Tanzania is low, indicating that many Tanzanians do not have mobile phones or fixed telephone line as a device of communication. TCRA (2009) reports that the problem seems to be persisting because the growth rate of teledensity is also low. According to Commonwealth Telecommunications Organization – CTO (2008), higher Total Cost of Ownership (TCO) which reflects prices of mobile handsets, running cost of mobile phones, unavailability of network coverage and low income of individuals are among the causes for low teledensity level. Also, a low level of teledensity in rural areas of most developing countries is associated with limited electricity, difficult terrain, and lack of transport. Other barriers mostly mentioned are low literacy levels, diverse indigenous languages, strong oral traditions, nomadic lifestyles or

livelihoods and scarcity of communications infrastructure i.e. network coverage (Mbarika et al., 2007; Mbarika et al, 2001; Mbarika, 2003).

Despite of the several efforts made that include licensing several network operators to run mobile phone business in the country, mobile operators rolling-out their networks in various parts of the country and the companies engagement in various marketing campaigns and promotions, teledensity level of Tanzania is still low. With the teledensity level of 58%; while some customers are having multiple Subscriber Identification Module (SIM) card, means that actual figure of teledensity is lower than the one reported.

Available literature asserts that electronic communications (e.g. mobile phones) can support mobilization of different resources required for economic-growth in Africa (Gallaugher and Wang, 1999; Mbarika et al., 2002b). United Nations Conference on Trade and Development (UNCTAD) annual report of 2007/8 reveals that; Mobile connectivity (Network coverage) is very much responsible for the current surge in ICT utilization and has significant input into value-creation processes for different economic activities and in the academic sector. The level of a country's Network coverage (i.e. basic telecommunications infrastructure) tends to be associated with its teledensity level (Mbarika et al., 2002a). This study aimed at determining the relationship between network coverage and teledensity level. Findings from this research were expected to assist on how this relationship could be used to raise the level of teledensity in Tanzania. Thus, the study was actualized in order to fulfil the following two objectives, namely;

a)	To establish the relationship between the network coverage and the customer base growth of a mobile phone company, and;

b)	To identify factors leading to low teledensity figures in Tanzania.

## 2.0	Materials and Methods

The research adopted a cross-sectional explanatory survey. It was confined to four mobile network operators, namely: Tigo, Zantel, Vodacom and Zain (Airtel). The reason for choosing these operators is that they are the giant cellular mobile operators in Tanzania. Furthermore, the study covered five regional headquarters of Tanzania, namely; Dodoma, Arusha, Dar es Salaam, Mwanza and Mbeya. Reasons for selecting these regions was based on two factors; first being

geographical representation of Tanzania (Central zone, Northern zone, Coastal zone, Lake zone and Southern zone) and second being the big proportion of business operations in these regions compared to others.

According to TCRA (2009) total mobile subscribers as of June 2008 were 10,110,416; with Vodacom grabing 4,520,120; Zain (Airtel) holding 2,819,828, Tigo having 1,701,433 and Zantel registering 1,069,035. Given the population size of 10,110,416 mobile subscribers and working to a 95% level of accuracy with a 5% margin of error, the minimum representative sample size becomes 384 subscribers. This was approximated to 400 respondents who were then selected based on stratified sampling technique proportionate to size. According to National Bureau of Statistics of Tanzania, Dar es Salaam is the city with largest population compared to other four major cities covered in this study. It is also the biggest commercial centre compared to other cities selected for the study. Due to these reasons; Dar es Salaam contributed 40% of the sample size and the rest 60% of sample size was equally portioned into the remaining regional headquarters chosen. The table below depicts the distribution of the sample for the study.

Table 1: Distribution of the sample

	Operators:	Vodacom	Zain	Tigo	Zantel	Sub - Total from each region	% of sample size from each region
Regions	Dar es salaam	72	44	26	18	160	40%
	Mwanza	26	17	10	7	60	15%
	Arusha	26	17	10	7	60	15%
	Mbeya	26	17	10	7	60	15%
	Dodoma	26	17	10	7	60	15%
Subtotal for each operator:		176	112	66	46	400	100%
% of population sample proportions:		44%	28%	16.5%	11.5%	100%	

Data for this study was collected through a questionnaire survey. Before the questionnaire was administered, it was translated into Kiswahili (language spoken by almost all Tanzanians) and then pilot tested. In addition, secondary data were also utilized. Data collected was analysed using regression technique. To measure the association between variables; correlations analysis

was employed. Also, descriptive statistics were used to analyse survey data. Statistical Package for the Social Sciences (SPSS) for Windows assisted in performing the required analysis.

3.0   Results and Discussion

3.1   Relationship between Network coverage and Teledensity (Growth of Customer base)

In this study dependent variable i.e. teledensity was taken to be the growth in customer base and was further defined as the number of customers subscribed to a mobile phone company (operator) and it was measured by getting the actual number of subscribers for five subsequent years for each operator. On the other hand, independent variable i.e. network coverage was defined by number of Base Transceiver Stations (BTS) for every operator and was measured by getting actual number of BTS for five subsequent years from every operator involved in this study (Refer to Table 1 below). The model was estimated considering data from all the operators.

Table 1: Customers Base Growth and Network Coverage

Year	Vodacom		Zain		Tigo		Zantel	
Year	No BTS (Hundreds)	Subscribers (Milions)	No BTS (Hundreds)	Subscribers (Milions)	No BTS (Hundreds)	Subscribers (Milions)	No BTS (Hundreds)	Subscribers (Milions)
2002	2.85	0.30						
2003	3.25	0.70	1.64	0.32				
2004	3.69	1.05	2.74	0.50	1.96	0.30		
2005	3.91	1.56	3.99	0.88	2.87	0.42	0.31	0.10
2006	5.18	2.98	6.39	1.52	4.92	0.76	0.84	0.36
2007	6.91	3.87	10	2.51	5.37	1.19	0.93	0.68
2008	9.78	5.41	11.59	3.86	9.35	2.57	5.00	1.06
2009	10.35	5.92	11.71	4.44	10.73	3.26	6.17	0.99

Source: Individual mobile phone network operators in Tanzania, 2009

Linear regression analysis in this research shows that there is a strong positive relationship between network coverage and customers' base growth. The analysis gave correlation and regression coefficients (shown in Table 2 and Table 4 below respectively). The analysis further showed that, the relationship led to Pearson's Product Moment correlation coefficient (r) = 0.826

which implies a strong positive relationship between network coverage and customers' base growth for the four operators. This value gives the coefficient of determination R Square of 0.683 equivalent to 68.3% indicating that customers' base growth is being explained by mobile network coverage at that tune leaving the remaining 31.7% being the explanatory power of other factors put together. It is interesting to note that the value of Beta (standardized) = 0.826 is significant at level of significant = 0.000 while that of constant value is not significant (Table 4). The interpretation is that, there is significant positive relationship between Network coverage and Teledensity (customer base) to the extent that, if Network coverage is zero (not existing), one should not expect customers to subscribe for telecommunication services.

Table 2: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.826[a]	.683	.665	1.01440

a. Predictors: (Constant), Base Transceiver Stations

Table 3: ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	39.888	1	39.888	38.763	.000[a]
	Residual	18.522	18	1.029		
	Total	58.410	19			

a. Predictors: (Constant), Base Transceiver Stations

b. Dependent Variable: Number of Subscribers (Million)

Table 4: Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations

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	B	Std. Error	Beta			Zero-order	Partial	Part
1(Constant)	-.296	.463		-.640	.530			
Base Transceiver Stations	.398	.064	.826	6.226	.000	.826	.826	.826

a. Dependent Variable: Number of Subscribers (Million)

Views from mobile phone Network operators who participated in this study further showed that, apart from the size of the network i.e. Network coverage, stability and availability of the Network i.e. network that is free from congestion, are highly contributing factors to the customers' base growth. The findings in this study with regard to the influence of Network coverage to customers' base growth are in-line with the previous studies done in many areas including Singapore, India, China and Korea. The report from India showed that, network coverage is one of the factors that predominantly drive the growth of customer base, India's Telecommunications Regulatory Authority (TRAI, 2007; ITU, 2008). On the other hand, mobile phone usage report from Wikinvest (2007) shows how extensive network coverage in China has significantly rewarded the growth of customer base. International Telecommunication Union (ITU) report on Ubiquitous Network Societies- the case of the Republic of Singapore (ITU, 2005a) shows that; Singapore was the first in the world to have a nationwide fiber optic network covering 99 per cent of the entire country since 1998, Network coverage was also a key factor for the customer base growth in Singapore. ITU report (ITU, 2005b), case of the Republic of Korea reveals that, South Korea was the world's broadband (mobile phone network) leader by a large margin in 2004. Extensive Network coverage was one of the reasons for success in the growth of customers' base and hence Teledensity in South Korea.

The findings of this study and those from previous studies elsewhere appeal that; sufficient Network coverage which is stable and available at all times to the customers is one of the fundamental factors in the growth of customers' base. Basing on this rationale, it follows that, like in other countries, among other factors, Network coverage has sufficient influence in the growth of customer base in Tanzania. Legitimate efforts from different Telecommunications stakeholders through their Research and Development plans, will pave the viable approach on

how in the Tanzania environment, Network coverage can be well extended throughout inhabitable areas. This will eventually elevate level of Teledensity in the country.

3.2   Factors which lead to low teledensity

The second research objective was on identifying the factors contributing to the low level of Teledensity in Tanzania. These factors are listed in table 5 below. Among other reasons; financial problem is ranked highest by 66.5% of the respondents considering it as the most hindering factor for an individual to possess a mobile phone; this is followed by running cost (53.8%) as another hindering factor. Most of the respondents are satisfied by the distribution of mobile phone services with only 27.8% of the respondents unsatisfied. The results show that 51.5% of the respondents are considering unavailability of network coverage as one of the hindering factors for customer base growth.

Findings from the four telecom operators show different reasons that are restraining customers in joining their networks and hence leading to low level of Teledensity in Tanzania. Among the factors mentioned, is the perception of potential and incumbent customers in the society. Both low and high tariffs have been mentioned to have negative perceptions to some customers. Network that provides its services with low tariffs is regarded by some customers to be of low quality and inferior to other networks. On the other side, high tariffs have been mentioned to be unaffordable to majority of the customers, it is considered to be of high income earners in the society especially for voice calls. This phenomenon leads to some people deciding to stay without subscribing to any telecommunication network. Other factors mentioned by operators include; unavailability of Network coverage in remote areas, poor quality of Network, instability and congestions of Network. Others are insufficient budgets for proposed Network rollouts for a given financial year, unavailability of stock e.g. recharging vouchers (especially in rural areas) and bigger proportion of population in Tanzanian being located in rural areas where earnings of dwellers are low and only obtained during specific periods.

Table 5: Factors contributing to low Teledensity level in Tanzania

Measurement	Agree	Strongly agree	Total	%	Mean	Std Deviation

Unavailability of mobile Network coverage	82	124	206	51.5	3.35	1.49
Poor mobile Network coverage	106	66	172	43	3.18	1.35
Poor quality of network coverage (e.g. reliability, ease of making calls, dropped calls, etc) in areas of interest	106	76	182	44.3	3.26	1.40
Difficulties to own electricity services	104	72	176	44	3.25	1.39
Lack of alternative ways to charge mobile phone (handsets) e.g. use of solar power	102	68	170	42.5	3.24	1.33
High initial cost of mobile handset	100	105	205	51.3	3.48	1.40
Mobile phone has low priority compared to other needs	76	46	122	30.5	2.95	1.43
High running cost of mobile handset services	100	115	215	53.8	3.55	1.38
Poor distribution e.g. availability of SIM cards, vouchers, handsets, etc	73	38	111	27.8	2.69	1.44
Financial problems e.g. Low income, low levels of purchasing power	128	138	266	66.5	3.98	1.24
Lack of knowledge on how to use Telecommunications technology	67	48	115	28.8	2.86	1.40

Mobile networks operators further mentioned maintenance of networks in rural areas to be very costly due to poor infrastructure such as roads etc and lack of electricity. This situation has led to insufficient network coverage in most of the rural areas. According to interviews done with network operators, circumstances in rural areas leads to returns from investments in Telecommunications infrastructure not only very low but also taking longer to be realized compared to urban areas.

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Studies that have been done elsewhere came up with almost similar findings. Low levels of infrastructure (Network coverage) and regulatory barriers were mentioned as among the hindering factors for Teledensity growth in Least Developed Countries (LDCs) (Mbarika, 2001). Other factors found in previous studies for LDCs are lower GDP per capita and socio-economic problems. Findings for the studies done in India, Korea and Singapore for instance show high prices of services offered by network operators as hindering factors. Regulatory authorities and increased competitions in markets adjusted the situation and hence prices were lowered or subsidized. International Conference on System Sciences (ICSS) report by Mbarika, et al. (2007) shows that, study done in two continental regions i.e. Latin America and Sub-Sahara Africa found obstructive policies, lack of electricity in rural areas, financial difficulties for networks rollouts and geographical terrains being inaccessible for network deployments as factors causing low level of Teledensity.

4.0   Conclusion and Recommendations

4.1 Conclusion

This study has found that there is a strong positive influence of network coverage to the customer base growth of a mobile phone company and hence Teledensity level. The results revealed financial problems, unavailability of network coverage and regulatory barriers to telecommunications industry as the fundamental factors leading to the low Teledensity figures in Tanzania. According to respondents, policy amendments that will lead to tariffs and costs reduction are necessary measures required in raising Teledensity figures in Tanzania. The study is of the opinion that infrastructural development in rural areas in terms of rural electrification, network coverage extension, etc is an important aspect that has to be considered for improving Teledensity level in Tanzania.

4.2   Recommendations

This section elaborates about general recommendations, recommendation to mobile phone network operators, recommendation to TCRA and to the government.

4.2.1   General Recommendations

Strong and positive relationship has been realized between the network coverage and the customer base growth. With regard to this, the study recommends a feasible and economical network extension in rural areas where most Tanzanian population is staying. Financial difficulties faced by operators, incumbent and potential customers; is among the significant reasons for low Teledensity; it is therefore recommended to all telecommunications stakeholders in Tanzania to identify necessary measures and feasible approaches to implement as a strategy to strengthen financial status.

4.2.2   Recommendations to the Mobile Phone Networks Operators

Network coverage is scarce in rural areas; this is hindering rural population to benefit from telecom services compared to their colleagues in urban areas. The study proposes for mobile phone companies to adopt cost effective network infrastructures in rural areas so as to extend network coverage and hence increase rural connectivity. Prices of services and other costs are currently prohibitive to consumers of telecom services. It is hereby recommended that mobile phone network operators put forward reasonable and affordable prices of services to both incumbent and potential customers.

4.2.3   Recommendations to TCRA

Most of the respondents have mentioned reduction of both handset prices and running costs as the feasible way for subscribers to possess a mobile phone. With regard to this; there is a need for TCRA to come up with a policy that will govern and suggest flat rate tariffs for mobile phone services in Tanzania. It is also important to set low and mandatory prices for selected handsets. Experience from Republic of Korea, India and Asian region shows a positive result with this approach. According to Telecom Regulatory Authority of India (TRAI, 2007); this approach was used in India and had led to customers base growth and hence Teledensity. This study has found out that nearly 50% of respondents possess more than one SIM card, this denotes that actual Teledensity of Tanzania is almost half of that is reported by TCRA statistics. This study is of the opinion that TCRA adopts proper way of assessing Teledensity level (counting individuals having mobile phones) and not number of SIM cards that are operational.

4.2.4   Recommendations Relevant to the Government

In order to raise Teledensity level in Tanzania; the government is advised to put in-place indispensable measures required to raise GDP per capita. Lack of electricity has been mentioned in this study as a forbidding factor causing unsatisfactory network coverage in rural areas where the larger population of Tanzanian is situated. Thus, the government needs to give priority to infrastructural development in rural areas in terms of power extension, road construction as well as fiber optic introduction.

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