

## AN EMPIRICAL ANALYSIS OF CUSTOMER SATISFACTION WITH MOBILE NETWORK SERVICE FOR COMPETITIVE BUSINESS ADVANTAGE

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### ABSTRACT

Positioning for effective competitive advantage requires taking actions informed by the result of business data analysis. Business Intelligence provides the platform with which Information and knowledge is used to improve business operation. This exploratory study examines customer satisfaction as the basis of competitive advantage enjoyed by information network service providers and those responsible for decision making in related organizations. The aim is to statistically analyse data and complement this with Text mining, in order to have an holistic way of drawing inferences from both structured and unstructured data for the purpose of decision making. Two method of analysis were used to find the level of customer satisfaction. They include, descriptive method, which involves the use of SPSS15.0 and K-means clustering algorithm used to mine the unstructured part of the data gathering instrument (questionnaire). Questionnaire is used as the primary means of data gathering. The finding of this study reveal that competitive intelligence related inferences bring about a better customer service relationship between the network service providers and their customers and therefore improve the profits of the organizations involved.

**KEYWORDS:** Mobile Phone Network Providers, Business Intelligence, Data Mining, Text Mining, Competitive Advantage

### INTRODUCTION

No business is an island. For a business to succeed, it will need to deal with customers, suppliers, employees, and others (Fatudimu et. al, 2008). Not so long ago, the mobile phone was an amazing invention which revolutionized the communication among human beings. Here in Nigeria, the deregulation of the telecommunication industry in 1999 was revolution that created the need for new and improved mobile services. This is because the monopoly hitherto enjoyed by the Nigerian Telecommunication (NITEL) did not pay off as consumers could not enjoy quality services (Worlu, 2011). In less than twenty years, the mobile phones have gone from being rare and expensive pieces of equipment used by business to a pervasive low-cost personal item. In Nigeria today according to Ayo(2007), mobile phones outnumber landlines telephones, with most adults and children now owning mobile phones.

In 2001, according to Olatokun & Nwonne(2012), the number of connected phone lines in Nigeria was 450,000 for an estimated population of 120 million and the level of investment in the telecommunication sector was just US\$50 million. Six year after, foreign direct investment (FDI) in the telecommunication sector have reached \$9.5 billion, the largest after oil and gas industry and is still growing.

Therefore, in today's mobile technology market, there is a competition among network providers. Network providers are continually aiming at attracting versatile users by offering some attractive promotions and service aimed at

nurturing customer relationships (Rahman et al., 2010). On the other hand, users have become more sensitive to the attributes of network providers (Archibald, 1983).

According to Roger (2010), there are five GSM network and 13 CDMA-based network operators in Nigeria. The GSM operators include Airtel, MTN, Globacom and Etisalat while the CDMA network operators include Multi links, Starcoms, Visafone amongst others. User satisfaction is very important in today's business world and it makes phone users loyal to one telecommunication service provider (Hanif et al., 2010). There is therefore need to make informed decision to improve user satisfaction. This decision have to the based of accurate inference which result from business intelligence.

Business Intelligence (BI) systems combine data gathering, data storage and knowledge management with analytical tools to present complex and competitive information to planners and decision makers. This paper therefore aims to provide competitive advantage information to network service providers and those responsible for decision making in these type of organisations.

## LITERATURE REVIEW

The state of affairs in the mobile phone industry indicates a shift from second –generation mobile phones to third- generation. According to Worlu (2011), this means that a mobile phone is not only a device used for speaking but also a handset that allows consumers a variety of new services such as internet access and multimedia message services (mms). The best feature of the new mobile phones therefore, is the ability to connect free from time and place constraints, thereby permitting consumers to have easy and relatively cheap access to the internet via computers (Worlu, 2011). There is currently a shift from modern connections to wireless internet connections by the use of W-LAN and GPRS network. Strictly speaking the real benefits of 3G mobile devices to consumers border on faster, cheaper and easier access to the internet and more importantly, not bounded by space (karjaluoeto et al., 2003).

The study conducted by Worlu (2011) described the trends in the information and telecommunication (ICT) sector, thereby illuminating the issues underlying consumer satisfaction in the sector. The study was predicated on theoretical framework that articulated previous studies concerning factors that affect the choice of a mobile phone and service provider by consumers, as well as intention to adopt new mobile phone features and services like multimedia messages services (mms) and sending e-mails. Finally, the main result of the study indicates the following:

First, the age of purchasing a mobile among young Nigerians has lowered in just a few years from 18-19 to 14-15.

Secondly, the factors underlying the purchase of a mobile phone, were found to be the manufacturers, market conditions and influential persons. For the choice of service provider, the factors were found to be features and brand components of the pricing, quality and influential persons.

Thirdly, only about 15% of the respondents felt that their use of mobile services would increase in the next 12 months. One critical challenge is discernable here, the problem of making services more efficient and widely available must not be ignored in favour of other elements of the marketing mix (e.g product, price, promotion) that are easier to deal with. For example, many service providers have been criticized for an overdependence on advertising.

In addition to the above, in data mining, research has also been carried out as regards customer satisfaction, the following are some of the approaches which used k-means for competitive business intelligence. (Satish et al., 2012), used k-means clustering for B2B Segmentation using Customers' Perceptions.

They compared three clustering K-means, Normal Mixtures and Probabilistic-D, and their result shows that there can be a better understanding of markets by using soft clustering techniques. The analysis of customer service choices and promotion preferences using k-means algorithm was carried out in (Charles, 2009). The study was able to demonstrate that complex menu selections in franchise restaurant can be better managed and promoted. In (Wang and Zhang, 2004), K-means was used for business intelligence purposes. In their work, they were able to propose a KBSVM (K Means-based Support Vector Machine) method and show the effectiveness of this method.

And finally, K-means clustering method is used to discover knowledge that come from CRM system. In this stud, customer's preference as regards Insurance products were identified, and this also helped to improve the product selling strategies (Balaji and Srivatsa, 2012).

This paper therefore gives a different approach to the afore mentioned, in that it aims at providing decision based inferences from the holistic view into the combination of statistical analysis for structured data and the combination of k-means clustering for unstructured data.

## METHODOLOGY

The primary means of gathering data in our field of application, which is competitive intelligence, is through the use of questionnaires. A questionnaire was therefore designed and administered to over 200 respondents out of which 199 were returned valid. These questionnaires were designed with the goal of retrieving competitive intelligence information from Nigerian based network providers for effective business intelligence of network providers. This questionnaire was justified through a pilot study. The questionnaire contained both structured and unstructured part.

The structured part of the questionnaire consists of demographic profile of respondents such as gender, age, academic qualification, occupation, state and nationality. This is important to have background information about the respondents. Other items in the structured part of the questionnaire have to do were the mobile phone and network usage of the respondents.

Respondents were asked to respond to question on their mobile phone usage such as voice calls, data and SMS on a five point like scale ranging from strongly agree to strongly disagree. Participants were asked to state how long they have been patronizing their network provider and average amount spent on mobile phone on monthly basis.

Participants were asked to rate performance the customer service of their network whether good, satisfactory, unsatisfactory or poor.

The data input to the Text mining system is the unstructured part of the questionnaire which includes the respondents' answers to questions such as:

- What do you like most about your network service?
- What do you dislike most about your network service?
- What improvements would you like to see, if any with regard to your network service?
- What type of problem do you usually encounter with your network service?

The structured data were analyzed using the Statistical Package for Social Sciences (SPSS version 15.0) software.

Measures of central tendency and simple percentage are considered appropriate as quantitative tools for analysis in this part of the study.

According to (Satish et al., 2012), K-means algorithm is one of the most widely used hard clustering techniques. The algorithm works as follows:

- Specify the number of clusters (k in k-means)
- Randomly select k cluster centres in the data space
- Assign data points to clusters based on the shortest Euclidean distance to the cluster centres
- Re-compute new cluster centres by averaging the observations assigned to a cluster.
- Repeat above two steps until convergence criterion is satisfied.

The advantage of k-means clustering is that it can handle large data sets and can work with compact clusters (Satish et al., 2012). WEKA work bench used for the k-means clustering. The WEKA workbench is a comprehensive collection of machine learning algorithms and data pre-processing tools. It consists of algorithms for regression, classification, clustering, association rule mining, attribute selection and data visualization facilities.

## RESULT OF THE STUDY

The presentation of the result of this study is based on the two type of analysis carried out. For the structured part of the questionnaire, a descriptive analysis was reported for the unstructured part, the result of text mining is presented.

### Descriptive Analysis

#### Demographic Description of Survey Participants

The demographic analysis of the survey respondents showed that 48.0% were male and 52.0% were female. 96.0% of the respondent are within age 15 – 40years, Table 1 gives the detail of the age distribution of respondents. Sixty percent (60%) of the respondent have at least BSc. degree or its equivalent; Higher Diploma Degree. Only 8.4% are secondary school certificate holder and the remaining 11.5% have a form professional certification or the other. 79.3% of the respondents are employed while 20.7 percent are unemployed.

**Table 1**

	Frequency	Percent
<b>Age</b>		
15-20	74	37.0
21-30	86	43.0
31-40	32	16.0
41-50	8	4.0
<b>Total</b>	<b>261</b>	<b>100</b>
<b>Academic Qualification</b>		
High school	43	21.5
BSc./HND	120	60.0
Post Graduate Degree	35	17.5
Others	2	1.0
<b>Total</b>	<b>262</b>	<b>100</b>
<b>Occupation</b>		
Student	96	48.0

**Table 1: Contd.,**

Education	25	12.5
Finance	12	6.0
Civil Service	15	7.5
Legal	5	2.5
Manufacturing	8	4.0
IT & Telecoms	7	3.5
Business	5	2.5
Others	27	13.5
<b>Total</b>	<b>261</b>	<b>100</b>

### Mobile Phone Usage of Respondents

Above half (56%) of the respondents are MTN subscribers. This is not surprising as MTN rated as the most popular network since its entrance into Nigeria market. Result of the analysis also showed that respondents are relatively consistent with their network providers (Table 2). Only 4.5% are below one year subscription to their network provider, 15% are above 10year, 51.5% are within 4-9year and 29% are within 1-3year of patronage with their network provider.

**Table 2: Network Provider and Subscription Period**

Network Provider			Duration of Subscription		
Provider	Freq	%	Year	Freq	%
mtn	112	56	1 - 3	58	29
glo	23	11.5	4 - 6	56	28
airtel	37	18.5	7 - 9	47	23.5
etisalat	25	12.5	10&above	30	15
others	3	1.5	<1	9	4.5
<b>Total</b>	<b>200</b>	<b>100</b>	<b>Total</b>	<b>200</b>	<b>100</b>

The analysis of the mobile phone functional usage of respondents showed that voice calls (82%) and SMS (72%) are the most used though, the respondents did do badly in using their phone for functions such as browsing or other data access functionalities. Table 3 gives the detail of the phone usage of respondents.

**Table 3: Respondent's Phone Use**

	Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree	
	F	%	F	%	F	%	F	%	F	%
Voice calls	163	82	28	14.0	1	0.5	4.0	2.0	4.0	2.0
Data	89	45	47	23.5	27.0	13.5	25	12.5	10	5
SMS	143	72	46	23.0	6.0	3.0	5.0	2.5	0.0	0.0

According to Table 4, respondents spend considerably well on phone operation. 55% of the respondents spend over ₦1,000 and 27.5 spends between ₦5,000 - ₦10,000 monthly

**Table 4: Average Monthly Expenditure on Phone Usage**

Amount (₦)	Frequency	Percent
< 1000	18	9.0
1000-5000	110	55.0
5000-10000	55	27.5
10000-20000	11	5.5
20000-50000	6	3.0
<b>Total</b>	<b>200</b>	<b>100.0</b>

### Customer Service and Care Assessment of Network Providers

Items measuring customer relations of the mobile network providers as depicted in Figure 1 and 2 showed that majority of the respondents are satisfied with their network providers. According to Figure 1, 21% of respondents rated the customer service of their network as good, 51.5% indicated the customer service is satisfactory while 22% and 5.5% judged it as unsatisfactory and poor respectively.

Looking at Figure 2, only 3% that is, six respondents indicated that the general assessment of their network provide is excellent. 27% believed it is good, almost half (43.5%) of the respondent said it is satisfactory while the remaining 25.5% indicated that it is unsatisfactory and poor.

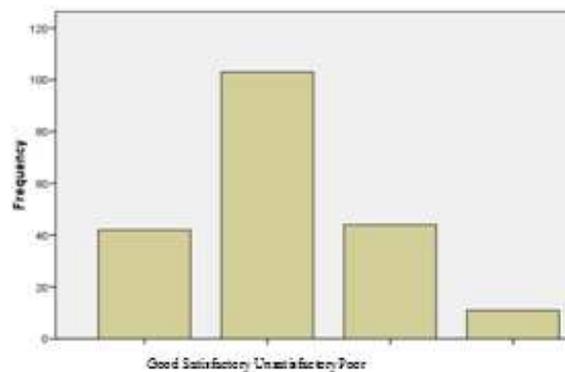


Figure 1: Rate of Customer Service of Network Providers

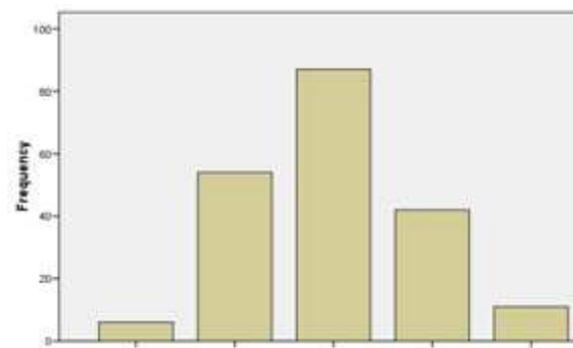


Figure 2: General Assessment of Provider's Customer Care

### Text Mining

#### Text Mining Consist of Two Major Step, Text Pre-Processing and Knowledge Discovery

**Text Pre-Processing:** The following text pre-processing was carried out on the unstructured data, filtration i.e removal of stop words and IDF Transform. The IDF Transform is used to determine the word frequencies in the document. it uses the formular;

$$f_{ij} * \log \left( \frac{\text{num of Docs}}{\text{num of Docs with word}} \right) \quad (1)$$

Where  $f_{ij}$  is the frequency of word  $i$  in document (instance)  $j$ .(Andrea and Sergio, 2010)

**Knowledge Discovery:** The following is the output gotten from the K-means algorithm on the unstructured part of the questionnaire data produces the following results.

Instances =199

Attributes =52

Number of iterations=11

**Table 5: Clustered Instances**

Cluster Label	Instances
0	67 (34%)
1	59 (30%)
2	40 (20%)
3	33 (17%)

Table 5 reveals the result of performing the K-means algorithm on 199 instances of data, the attributes were 52, i.e number of distinct words that was clustered. The algorithm ran for 11 iterations in order to get the 4 clustered shown in Table 1. Cluster 0 has the highest number of instance with 34%. Instance in this case refers to the number questionnaires. The cluster labelled c1 contains 30%, c2 contains 20% and cluster c3 which is the smallest cluster contain 17%. Four clusters were selected for running the k-means algorithm because of the size of the instance considered which is 199. Figure 3 shows a section of the output of the k means algorithm in WEKA.

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Number of iterations: 11
Within cluster sum of squared errors: 643.0593256751681
Missing values globally replaced with mean/mode

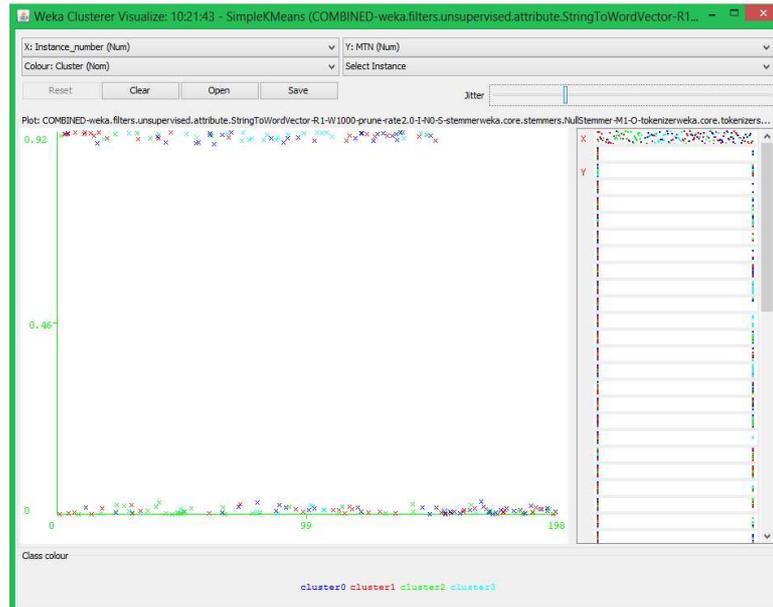
Cluster centroids:

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Attribute	Full Data (199)	Cluster#			
		0 (67)	1 (59)	2 (40)	3 (33)
adequate	0.0462	0.1373	0	0	0
affordable	0.2599	0.3021	0.1525	0.3373	0.2726
airtel	0.3463	0.3428	0.1797	0.751	0.1606
bad	0.1111	0	0.2498	0.1842	0
bonus	0.0632	0.1252	0.0711	0	0
bonuses	0.3083	0.4163	0.4727	0.093	0.0563
call	0.3564	0	0.2046	0.2264	1.5091
callrate	0.0632	0.1252	0	0.1049	0
calls	0.1867	0.0792	0	0.0664	0.8847
care	0.2309	0.1372	0.1558	0.5744	0.1392
charges	0.1346	0.0999	0.2837	0.0837	0
cheap	0.3328	0.0741	0.2245	0.1242	1.3045
cheaper	0.2243	0.1402	0.3981	0.0587	0.2847
coverage	0.3471	0.4536	0.2575	0.2072	0.4604
customer	0.3386	0.1312	0.1738	1.0985	0.1332
cxall	0.0462	0	0	0	0.2788
data	0.2494	0.1288	0.4754	0.2697	0.0654

**Figure 3: K-Means Algorithm Output in WEKA**

It displays the occurrence of the attributes in the four clusters. These clusters is visualized in Figure 4, it reveals four clusters such that cluster0 is blue colour, cluster1 is red, cluster2 is green and cluster 3 is a lighter shade of blue. The figure is a graph of the instance number verse a particular variable. In this case, the instance is *MTN* and its revealed to appear in all the in clusters with an instance number of about 0.92.



**Figure 4: Visualization of the Clusters**

Figure 5 reveals the 10 items having the highest weight values in the four clusters view in Microsoft excel after sorting the attributes according to their occurrence in the clusters.

c0	c1	c2	c3
network	messages	customer	call
poor	high	service	rates
coverage	etisalat	airtel	cheap
wide	data	glo	voice
bonuses	bonuses	care	calls
mtn	internet	services	quality
airtel	tariff	poor	high
affordable	cheaper	internet	tarriff
free	plan	faster	expensive
tarriff	fast	promos	coverage

**Figure 5: Selected Attributes**

**Cluster c0:** In this cluster, the first 3 most prominent words are network, poor and coverage, which signifies that customers of network service providers are experiencing poor network service, also MTN and Airtel also features in this the prominent list of this cluster what indicates that there is a close association of these two network service providers with poor network that customers are experiencing.

**Cluster c1:** In this cluster, we can infer some trends which include high data, *internet bonus*, and *cheaper tarrif* being associated to *Etisalat* network. It is safe to say that these are observations of customers as regards *Etisalat* network.

**Cluster c2:** This cluster is referring mainly to the customer service of the *Glo* and *Airtel* network. From the cluster, we might imply that its poor because the attribute *poor* is not too far down the cluster from the *customer* and *service*.

**Cluster c3:** cluster 3 is not particularly referring to any network but signifies customers wanting *cheaper call rates*.

## CONCLUSIONS

This exploratory study was conducted to analyze customer satisfaction and business intelligence activities of service providers in the mobile phone network service sector. The study proves that customer satisfaction is the major goal of the service providers in the mobile phone network service sector. It also shows that service providers cannot afford to ignore business intelligence activities if they must survive in the telecommunication industry. This is because customer satisfaction and business intelligence are major determinant of sustainable competitive advantage in the telecommunications market.

The result of the k-means clustering also revealed both positive and negative attributes strongly connect to specific mobile network service providers. For example the *Etisalat* network is strongly associated with *cheap tariff* while *theglo* and *airtel* network is strongly connected to poor customer service.

At present, mobile phone service market in Nigeria is one of the most aggressively competed market, and the competitions is driven by discounts, and promotion. Even at that, regular business intelligence and market surveillance constitute the key to sustainable competitive advantage.

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