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Impact of Big Data Analytics to Nigerian Mobile Phone Industry

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***Abstract*- In the last half decade or so, the buzz phrase in the business and research arena is Big Data and Big Data Analytics. One industry that can reap substantial benefits from big data and analytics is the mobile phone industry. Nigeria in the West Africa is one country where mobile phone market is considerably big. Over 90 per cent of individuals and corporate businesses completely rely on the mobile industry for their day-to-day transactions. Embracing advanced analytics of big data by the mobile operators in Nigeria will impact positively on revenue and reflect on GDP. In this paper, we discuss the business impact of big data analytics in the light of telecom industry. We point out the various ways the industry could leverage on big data and analytics to render customer-centric service and reap a good return on investment**.

Keywords: Big data, Validity, Veracity, Volatility, Profitability, Customer centricity.

I. INTRODUCTION

Big data is an aggregate of data sets that are large and complex, thus overwhelming the traditional data mining tools. Therefore, big data analytics is a term encompassing the new methods, tools and technologies for collecting, managing and analysing, in real-time, the vast increase in both structured and unstructured data for insightful and effective decision making. Big data today is a reality. Communications service providers that want to be innovative and maximize their revenue potential must have the right solution in place so that they can harness the volume, variety and velocity of data coming into their organization and leverage actionable insight from that data [1]. As people and devices are increasingly connected online, society is generating digital data traces at an extraordinary rate, unprecedented in human history. Social computing, networked appliances, e-business transaction, mobile computing, wearable "life logging" sensors and environmental scanners generate billions of events per second, many of which are stored for later analysis or can be analysed as a real-time data stream. [2].

Big data and analytics are intertwined, but analytics is not new. What is new is the coming together of advances in computer technology and software, new sources of data (e.g. social media), and business opportunity. This convergence has created the current interest and opportunities in big data analytics [3]. In fact, there is a dimension of practice and study called "data science" that encompasses the techniques, tools, technologies and processes for making sense out of big data. Governments and companies could integrate personal data from numerous sources and learn much of what you do, where you go, who your friends are, and what your preferences are. This leads to better services and profits for companies [4]. A telecom company, which has a huge amount of personal data, has a strong potential to improve revenue via improved user-centric services.

Big data analytics is a term encompassing the new methods, tools and technologies for collecting, managing and analysing in real-time the vast increase in both structured and unstructured data for insightful and effective decision making. It is a term that is used to describe data that is of high volume, high velocity, and/or high variety and requires new technologies and techniques to capture, store, and analyse it. The analysis is used to enhance decision making, provide insight and discovery in real-time, and support and optimize processes [5, 6]. The derivative parameters of this definition are shown in the Fig 1.

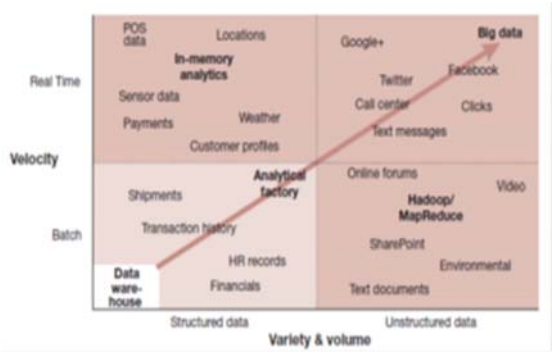

Fig.1. Big Data Derivatives (source [1])

These useful derivative characteristics of big data are high volume, high velocity and high variety – the three Vs [7]. In short, "big data" means there is more of it; it comes

more quickly, and comes in more forms [2]. According to [8] there are additional 3Vs of big data: Validity; Veracity; Volatility, these terms respectively try to answer the questions: Is the data correct and accurate for the intended usage? Are the results meaningful for the given problem space? And How long do you need to look/store this data? The enormous scale at which data is growing is typified by the analysis in Table 1, which shows a projection of growth of data from the year 2000 to 2020. This is a growth rate of about 40 to 50 percent per year. It is important to note that storing and managing 1PB of data may cost a company between $500K - $1M/year [9].

Table1 Big data growth rate

Year	Growth
2000	~800 Terabytes
2006	~160 Petabytes
2012	~2.7 Exattabytes
2020	~35 Zettabytes

Most operators conduct analytics programs that enable them to use their internal data to boost the efficiency of their networks, segment customers and drive profitability with some success [10]. Stored data does not generate business value and this is true of traditional data bases, data warehouses, and the new technologies for storing big data (e.g. Hadoop). Once the data is appropriately stored, however, it can be analysed and this can create tremendous value. A variety of analysis technologies, approaches, and products have emerged that are especially applicable to big data, such as in-memory analytics, in-database analytics and appliances [3]. Analytics could be defined as the use of "rocket science" algorithms (e.g. machine learning, neural networks) to analyse data [2]. A starting point for understanding analytics is to explore its roots, hence Decision Support Systems (DSS) in 1970s were the first systems to support decision making [11]. The progression from DSS to Business Intelligence (BI) and to Analytics is shown in Fig. 2.

Fig. 2: From DSS to BI to analytics [2]

There are three kinds of Analytics: Descriptive Analytics, Predictive Analytics, Exploratory or Discovery or Prescriptive Analytics. The Predictive Analytics tells what will happen; prescriptive Analytics suggests what to do. The Prescriptive Analytics can identify optimal solutions for telecommunication industries via revenue generation and churn reduction. Companies move from descriptive to predictive and then to prescriptive analytics. Another way of describing this progression is to ask what happened? – Why did it happen? – What will happen? – How can we make it happen? [12]. Analytics could be described as an art, science, or technique [13].

II. BIG DATA AND TELECOMMUNICATION INDUSTRY IN NIGERIA

The telecommunication industry land mass in Nigeria is characterised with major operators such as MTN Nigeria, Globacom Nigeria, Etisalat and Airtel Nigeria engulfed with stiff competition for survival. Customer capacity and profitability hinges on three key pillars; efficiency, insight, and performance. Profitability, customer churn reduction and increase in wallet share hinges upon obtaining a coherent, current and actionable view of a service provider's entire business [1]. In 2012, digital world of data was expanded to 2.72 zettabytes (10^{21} bytes) [14]. It is predicted to double every two years, reaching about 8 zettabytes of data by 2015 [15]. The proper harnessing of such magnitude of data is a source of revenue for Communication services providers. In a world where more and more customers interact online via Facebook, Twitter, blogs, etc., and talk about their experiences and issues online, communication service providers must have a proactive social strategy through collecting data and analysing the data to take action on customer retention and offer attractive services.

However, dealing with social media means dealing with unstructured data, which is complex as it does not always fit into neat tables of columns and rows. The advent of these new data types that can be both structured and unstructured means they must be pre-processed to yield insight into a business or condition. Data from Twitter feeds, blogs, call detail reports, network data, video cameras and equipment sensors is not stored directly in a data warehouse until it is pre-processed to correlate and normalize the data to detect basic trends and associations. It is a cost-effective mechanism to structure the unstructured data part, load that data into data warehouses for comparison and then use that data with other collected data to run advanced analytics processes on it.There is a need for solutions that can combine usage and subscription data with insight into the network, cost, customer mood and customer preference data to trigger specific actions, which helps enhance customer experience.

Communication service providers have no dearth of data at their disposal, but they are missing actionable insights from that data. The fact that data passes through the network does not mean that actionable, correlated information is available to the company. Communication service providers must find efficient ways to bring together normalize and correlate all data sources, which poses a serious challenge. The integration of data sources as a primary operational challenge is the top concern for the operators. A big data advanced analytics solution that

effectively utilizes structured and unstructured data to improve decision-making will be the "silver bullet" that communication service providers need to alleviate their business problems.

A. Building a Successful Business Case with Big Data Analytics in the Industry

The requirements for success with big data analytics for the industries are:

i. A Clear Business Need
ii. Strong, Committed Sponsorship
iii. Alignment between the Business and IT Strategy
iv. A Fact-Based Decision-Making Culture
v. A Strong Data Infrastructure

These are the same with most projects, including analytics and BI in general [3, 16]. The initial business case for big data analytics focuses on customer-centric objectives and uses existing and newly accessible internal sources of data [17]. Big data analytics can be especially helpful for companies that seek to understand customers better, develop meaningful relationships with customers and improve operations that enhance the customer experience [17]. Whatever the focus, successful big data initiatives should start with a specific or narrowly defined set of objectives rather than a "build it and they will come" approach [5]. This will yield a good return on investment (ROI).

The ROI benefits of big data analytics to Telecommunication Industry is illustrated through the comparison between legacy (traditional) analytics and big data analytics as shown in Table 2. Big data promises to promote growth, increase efficiency and profitability across the entire telecom value chain [10].These key benefits according to strategy and analysis are:

i. Optimizing routing and quality of service by analysing network traffic in real-time
ii. Analysing call data records in real-time to identify fraudulent behaviour immediately
iii. Allowing call centre reps to flexibly and profitably modify subscriber calling plans immediately
iv. Tailoring marketing campaigns to individual customers using location-based and social networking technologies
v. Using insights into customer behaviour and usage to develop new products and services

Big data can even open up new sources of revenue, such as selling insights about customers to third parties.

Table 2 Comparison of legacy analytics and big data analytics [1]

	LEGACY ANALYTICS	**BIG DATA ANALYTICS**
Storage cost	High	Low
Analytics	Offline	Real-time
Utilizing Hadoop	No	Yes
Data Loading Speed	Low	High
Data Loading Time	Long	Average 50%-60%
Data Discovery	Minimal	Critical
Data Variety	Structured	Unstructured
Volume	Gigabyte, terabyte	Petabyte, Exabyte, zettabyte
Velocity	Batch	Real-time
Administration Time	Long	Average 60% faste
Complex Query Response Time	Hours/days	Minutes
Data Compression Technique	Not matured	Average 40%-60% more data compression
Support Cost	High	Low

III. INFLUENCING CLIENTS PENETRATION AND RETENTION THROUGH BIG DATA ANALYTICS

The strategic use of big data and advanced analysis will help communication service providers sharpen their campaign management and pre-emptive churn avoidance mechanism effectively. Campaign effectiveness of Communication service providers have increased from 15-25 percent, and churn prevention has helped reduce churn from 8-12 percent by strategic utilization of big data and advanced initiatives [1]. This is a deep impact of big data to the industry. Leveraging customer data and their transaction data to precisely target and cross-sell or upsell offers to customers and persuade appropriate influences and their social circle is crucial for CSPs, which are all focused on minimizing churn. The ability to anticipate the wants and needs of consumers in a sales or customer service situation, known as "next best action" modelling can increase revenue, profits and customer satisfaction, as well as reduce churn [18].

A. Offer Optimization

Using advanced analytics for advanced offer management enables Communication service providers to confirm which service bundles and promotions are successful and to offer management capability based on data such as subscriber network usage, traffic-based promotion, loyalty points, event-based promotion and rule-based promotion. And identifying and offering innovative promotions, such as offers for early adapters, cross product promotions and loyalty points, will be critical in driving value-added services adoption, which will be provided

either by the service provider itself or by partnering with over the top (OTT) players [1].

B. Churn Identification, Prediction, Prevention and SNA

Social network analysis (SNA) and segmenting customers for more accurate marketing campaigns is part of the overall objective of increased customer satisfaction to prevent customers from churning [1]. The key to a big data driven advanced analytics solution in providing optimal churn prevention will be its ability to provide preventive churn actions in real-time. So, for example, a customer complaint or service quality problem would trigger a very targeted and customized offer that is more attractive to a subscriber, greatly decreasing the propensity of this subscriber churning. Strategic utilization of big data and advanced analytics enables communication service providers to shift their business intelligence focus from looking back at old records to looking forward with current data in a predictive and preventative fashion to determine things such as "What behaviours will trigger churn events?" and "What actions are most likely to prevent a churn event?"

Other use cases for real-time churn-preclude actions include:

1) *Multi-SIM prediction*: Preventing subscribers from buying SIM cards from other communication service providers by offering them more appealing rates or product bundles – proactive roaming offerings based on travel patterns.
2) *Rotational churn identification*: Identifying and preventing mobile subscribers that disconnect and reconnect their service in order to take advantage of promotions that only apply to new customers.
3) *Churn location*: Identifying and sending more appealing offers or even contacting subscribers located in areas that have higher churn rate.
4) *Leveraging SNA*: SNA dives into the billions of daily data transactions (by utilizing an algorithm using nodes and ties) and identifies and helps segment influences and patterns among social calling circles of friends and families. Combining this information with the data from the network, for example the CDR and CRM systems, communication service providers can process that data in both a defensive and offensive manner to help with overall customer experience enhancement, churn reduction and revenue growth.

IV. REDUCTION OF OPERATIONAL EXPENSES

Operational Expenses (OPEX) remains high for most communication service providers, and it typically consumes 30-40 percent of revenue. Network operations account for about 45 percent of this expenditure [1]. The expansion of network footprints due to organic and inorganic growth has resulted in poor capacity utilization. Strategic utilization of big data and advanced analytics can increase operational efficiency and significantly reduce OPEX to the order of 10-15 percent according to Heavy Reading. Next-generation customer care, planning, etc., strategies must be transformative, and communication service providers need solution infrastructure that can anticipate, contextualize, pre-empt customer complaint and help plan initiatives by being able to effectively address big data challenges. Harnessing big data effectively and utilizing it to provide actionable insight will be a critical attribute for service provider success. To achieve this, the following steps are necessary:

A.Pre-emptive Customer Care

In order to deliver on pre-emptive customer care in the communications industry, operators must create a robust repository of error fixes, enable proactive resolution of issues by guiding contact centre agents continuously to reduce average handling time (AHT). They should also have a continuous contextual intelligence update that effectively maintains an up-to-date context map of each customer experience. This is by continuously monitoring subscriber activities to identify and rectify issues and improve issue prediction based on industry best practices.

B. Cell-Site Optimization

The fourth generation (4G) networks are intended to be increasingly self-optimizing, with cells automatically managing how they interact with one another (adjusting their power to minimize interference, while maximizing bandwidth and coverage), managing their power consumption and how they load call traffic and handover traffic between cells. They will be able to do this much more effectively if they can augment the network performance with contextual information, which includes subscriber information such as user experience in specific areas, how that user experience varies according to the different types of services they might use, and typical patterns of user behaviour throughout the day.

C. Implementing Real-Time Analysis & Decision-Making

Software vendors must provide communication service providers integrated big data and advanced analytics driven solutions that will not only meet their real-time transaction needs, but also provide real-time intelligence, enabling the communication service providers to maximize revenue potential from a short window of opportunity. Research has shown that operators have been able to reduce fraud and revenue leakage by 15-20 percent, as well as increase revenue potential by 5-10 percent, by strategic utilization of advanced analytics-driven solution [1].

The big data and advanced analytics-driven infrastructure will need to process complex events in real time and provide the users of the system the best actions to take based on those events. This directly enables communication service providers to lower risks and provide excellent experience to their customers. Operators process and correlate event stream processing, as well as use advanced analytics modelling techniques to gain the best insight into their customer behaviour. The achievement of this translates to profitability, thus impacting on the bottom line of the investors as the OPEX is lowered.

D. Congestion Control

Data traffic on mobile network is growing exponentially through the introduction of powerful smart phones and data heavy multimedia services leading to network congestion in the radio access network (RAN). RAN congestion has emerged as a major problem for mobile operators. Solutions that incorporate subscriber information with their services and location information can provide visibility at individual sub-cell level and provide priority to certain subscribers based on their tires, etc., when they are moving across certain cells that are suffering from congestion issues. Since congestion events are often fleeting, making use of historical information about congestion from OSS systems to pre-empt similar problems and deploying RAN congestion only in those areas where congestion is anticipated. It is the key area where operators are planning to utilize big data and analytics solution [1].

E. Cyber Cop

Strengthening network security and reducing profitless resource consumption is at the top of most communication service providers' requirements. Operators can utilize a big data-driven advanced analytics infrastructure to identify in real-time malicious calls, applications, etc., and prevent them from wreaking havoc on their operations. Big data-driven analytics solutions must help detect abnormal subscriber consumption, fraud cases and help save operators from bad debt concerns. Detecting abnormal subscriber consumption, cyber security threats and changes in subscriber behaviour or traffic flows are critical areas in which pattern matching can be customer events and note major variances in patterns to raise fraud alerts and drive processes to block transactions or implement some revenue assurance fix processes.

V. INVESTMENT PRIORITIES FOR BIG DATA AND ANALYTICS

Widespread adoption of big data and analytics in the telecom industry as pointed out by Heavy Reading in the research conducted with major global operators suggests a fast growing multi-billion market potential that will provide opportunities for both hardware and software vendors. Some of the key findings are: The big data technology and services market is growing from $1.95 billion in 2013 to $9.83 billion in 2020 [1], as shown in Fig 5. This represents a total compound annual growth rate (CAGR) of 26 percent. Breakdown of CAGR growth between software, hardware and services are: software will grow at 29.3 percent CAGR; hardware will grow at 22.8 percent CAGR; and services will grow at 26.8 percent CAGR. Obvious correlation to this is that the Nigerian operators stand to make huge revenue and boost the national GDP by investing in big data &analytics thereby boosting the national economy.

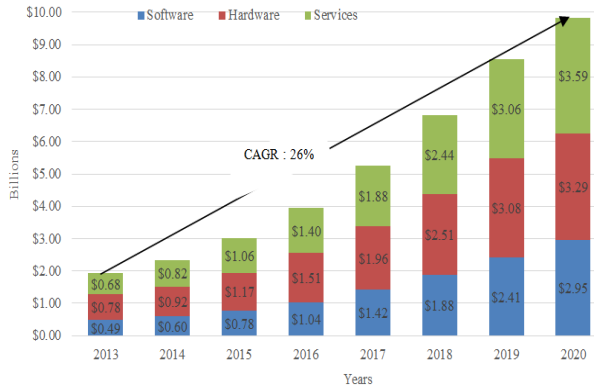

Fig. 5. Big Data and Analytics Market in Telecom [1]

VI. CONCLUSION

This paper presented the impact big data analytics can make on customer service and revenue generation of mobile phone industry. We defined big data and big data analytics and presented a number of ways that big data analytics holds many opportunities to influence how the telecommunication industry grow and develop for the better by adding huge data insight. Insightful decision via real-time analytics help and guide the communication service providers to have business platform that satisfy individual customer needs, reduces operational expenses and considerably improves revenue. The innovations and strategies derived from investing in big data and analytics generate high Return on Investment (ROI) for the operators. The proper correlations of data help to reveal more complete and deeper insight of customer needs, thus enriching the operators with more revenue. This process translates to advanced ways of capturing and retaining customers with identifiable churn reduction.

REFERENCES

[1]. A. Banerjee ''Big Data Advanced Analytics in Telecom: A multi- Billion Revenue Opportunity", Heavy Reading, pp. 4 – 19, 2013.

[2]. H. J Watson ''Big Data: Concepts, Technologies and Application'', Proc. America's conference On Information System, Seattle, WA, August 2012.

[3]. H. J Watson '' All about Analytics '', International Journal of Business Intelligence Research, Vol.4. No.2, 2013, pp. 13 – 28.

[4]. E. Clemons, J. Wilson, S. Barnett, F. Jin, & C. Matt "Investigations into consumers Preferences Concerning privacy: An Initial Steps towards the Development of Modern and consistent Privacy Protections around the Globe", proc. Hawaii International conference on Systems Science. 2014.

[5]. S. Miller, S. Lucas, L. Irakliotis, M. Ruppa, T.Carlson and B.Perlowitz. "Demystifying Big Data: A practical Guide to Transforming the Business of Government", Washington: Tech America Foundation. 2012.

[6]. S. Sicular"Gartner's Big Data Definition consist of Three parts not to be confused with three V's". 2013. http://www.forbes.com/sites/gartnergroup.

[7]. P. Russom"Big Data Analytics". TDWI Best practices Report. Seattle: The Data warehousing Institute, Fourth Quarter. 2011, http://tdwi.org/research/2011/09/best-practices-report-4-big-data-analytices.aspx.
[8]. A. H Tan "Big Data Analytics: Challenges and What Computational Intelligence Technique May Offer". pp. 9 – 10, 2013. http://www.ntu.edu.sg/home/asahtan.
[9]. D. A Heger"Large, Distributed Computing Infrastructures – opportunities & Challenges" DH Technologies, Data Nubes, 2012. www.dhtusa.com.
[10]. O. Acker, A. Blockus and F. Potscher"Benefitting from big data: A new Approach for the Telecom Industry" Booz & Company, pp. 3-9, 2013. http://www.strategyand.pwc.com.
[11]. D. J. Power "A Brief History of Decision Support, Systems",2007.http://DSSResources.Com/history/dsshistory.html.
[12]. W. Eckerson"Gauge Your Data Warehousing Maturity, DM Review," Vol.14. no.11, pp.34, 2004.
[13]. J. Ogunleye "Business Analytics & the Big Data" Data Nubes 2012.
[14]. M. K. Dagli, B.B. Mehta "Big Data and Hadoop: A Review." International Journal of Applied Research in Engineering and Science,Vol. 2.No.2, pp. 192. 2014.
[15]. Intel IT Center, "Planning Guide: Getting Started with Hadoop" Steps IT manager can take to move forward with Big Data Analytics, 2012. Available at http://www.intel.com/content/dam/www/public/us/en/documents/guide/getting -started - With-hadoop - planning-guide.pdf.
[16]. S.Williams"Assessing BI Readiness: A key to BI ROI" Business Intelligence Journal, Summer.2004
[17]. M. Schroeck, R. Schoskley, J. S smart, D. Romero – morales and P. Tufano, "Analytics: The real World use of big data" IBM Institute for Business Value. 2012. http://www-935.ibm.com/Services/us/gbs//thoughtleadership/ibv-big-data-at-work.html.
[18]. B. Fox, R. V. Dam and R. Schockley "Analytics: Real – world use of big data Telecommunication" IBM Institute for Business Value. 2013.

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