Improving Decision Making in an ISP through Business Intelligence

Christopher A. Moturi[1] and Kendi Mutungi[2]

[1] School of Computing and Informatics
University of Nairobi
Nairobi, Kenya

[2] School of Computing and Informatics
University of Nairobi
Nairobi, Kenya

ABSTRACT— ***In order to attract subscribers and increase revenue in a very competitive Internet Service Provider (ISP) industry, the players make great effort to improve their service management. The ability to make effective decisions is crucial to survival in this dynamic business environment. This paper proposes a Business Intelligence Model for ISPs in Kenya to assist management in developing effective service management strategies.***

The needs and critical information requirements of the senior management of a leading ISP in Kenya were identified by conducting interviews. Using SAP Business Objects and SPSS, the Business Intelligence model was developed for verification. We explored customer usage characteristics and preference knowledge by examining monthly volume usage and the cost of bandwidth using data form the ISP covering a period of four months. Embedded OLAP tool was used to identify patterns to determine the usage value of customers. Customers were divided into clusters identifying customer value which enabled the senior management in the organization to develop direct and effective marketing strategies. Based on the model, senior management was able to learn from the past and forecast the future. The model improved information flow, increased the speed and quality of key marketing and sales decisions in the organization.

Keywords— Business Intelligence, ISP, Internet Service Provider, ISP Service Management, Predictive Analytics, Predictive Model

1. INTRODUCTION

In order to stay competitive and survive in today's dynamic environment, organizations must be able to quickly respond and adapt to changes in their business settings. Businesses need to understand how to successfully create customer loyalty resulting in profits over time (Oracle Corporation, 2006). To make decisions organizations must access information from various domains of activity, in the right format for the specific purpose, but the operational systems are not the adequate environment for obtaining all this information. There is need for Business Intelligence, and its supporting technology of data warehousing. Business Intelligence (BI) refers to systems and processes that help to simplify the use information in an organization to enable faster and easier decision making by providing key information to the decision makers in a timely and efficient manner. BI involves business information and analysis that are used within a context of key business processes, support decisions and actions, and lead to improved business performance. BI combines products, technology and methods to organize key information that management needs to improve profit and performance.

In the absence of proper BI tools, business analysts use spreadsheets such as Excel to analyze the data in a bid to make decisions that will lead to increased profit margins. Spreadsheets provides a simple interface for commonly needed functions like calculating, presenting and displaying numerical data but do not provide quality and consistency of information. Sharing of spreadsheets will lead to modifications and over time rogue spreadsheets with data from multiple dubious spreadsheets are propagated throughout the organization, and executives find themselves making decisions based on untraceable, questionable data. Business Intelligence tool that will supply the decision makers with suitable, accurate and timely information to help them accelerate decision -making and hence improve corporate performance.

This research analyzed the process a Kenyan based Internet Service Provider (ISP) follows during business intelligence, from data collection to the transformation of the information to decisions, identified the challenges faced by the organization with the lack of a BI system, and analyzed the main BI tools used by ISP's in Kenya. The ISP industry in Kenya is characterized by heavy pressure to raise revenue after hefty capital investments, and the lack of knowledge to develop competitive strategies. To attract subscribers, all ISP dealers are making an all-out effort to improve their service

management. This paper proposes a BI Model for ISPs to assist management in developing effective service management strategies.

We used the case of a Kenyan based ISP that offers internet services to corporates in 28 countries across Sub-Saharan Africa through its network of 35 distributor partners and subsidiaries. The ISP was founded in 1992 with 300 subscribers and by 2011 the subscriber base had grown to over 15,000.

2. RELATED WORK

2.1 Business Intelligence and Data Warehousing

Business Intelligence (BI) is a management strategy used to create a more structured and effective approach to decision making by using technologies and processes that allows users to acquire, cleanse, integrate, store, analyze and present information. BI applies the functionality, scalability, and reliability of modern database management systems to build ever-larger data warehouses, and to utilize data mining techniques to extract business advantage from the vast amount of available enterprise data. Blended with Knowledge Management technologies, BI can be used to solve business problems that require analysis of both text and data based on OLAP (Cody et al, 2002).

The key components of BI include

OLAP (On-Line Analytical Processing) - allows business users to slice and dice their way through data by providing multidimensional, summarized views of business data and is used for reporting, analysis modeling, and planning for optimizing the business.

Advanced Analytics - refers to data mining, forecasting or predictive analytics which takes advantage of statistical analysis techniques to predict or provide certainty measures or facts.

Corporate Performance Management (Portals, Scorecards, Dashboards) - provides a container for several pieces to plug into so that the aggregate tells a story.

Data Warehouse - This significant component supports the physical propagation of data by handling the numerous enterprise data integration, cleansing, aggregation, and query tasks. Data sources can be historical data, operational databases, external data or information already existing from the data warehouse environment. The data resides in many platforms for example spreadsheets, tables or unstructured information such as plain text. The data warehouse must contain data that will assist management of any level in the decision process, fast access to information the access, data consistency, and data confidentiality.

Data Mining - Data mining automates the process of finding predictive information in large databases. Typical examples of predictive problems include targeted marketing, and segmentation to identify population likely to respond similarly to given events.

2.2 Business Intelligence in the ISP Industry

In their paper Li et al (2008) proposes a Business Intelligence process for ISP dealers in Taiwan to assist management in developing effective service management strategies. By exploring customer usage characteristics and preference knowledge through the application of attribute-oriented induction method on IP traffic data of users, and using the self-organizing map method, they were able to divide customers into clusters with different usage behavior pattern. With the results obtained, they developed a system which enabled management to develop direct and effective marketing strategies in order to address competition in the deregulated telecommunication industry in Taiwan, which is characterized by the heavy pressure for raising revenue after hefty capital investments. This research draws a lot from this paper.

Altmann and Goel (2006) described an approach which provides ISPs with the information about the most economical interconnections to other ISPs. This approach helps small and medium-size ISPs to reduce their interconnection costs for upstream connectivity and to improve network performance for their customers. This approach is intended to reduce the overall cost of interconnection in small and medium-size ISPs which are competing for customers while, at the same time, they are under price pressure from upstream providers.

Sittha and Siriluck (2010) addressed the problem of bandwidth network quality management among ISPs in Thailand by developing a framework to improve the quality of service and increase bandwidth utilization, minimize complaint rate concerns to slow speed, and provide network planning guidelines.

Jui-Yu Wu (2010) examined various BI tools and presents an intelligent BI system framework based on many computational intelligence paradigms, including a predictor tool based on neuro-computing, a classifier tool based on neuro-computing, and an optimizer tools based on evolutionary computing and artificial life. Their framework offers an efficient data analysis capability of BI tool for supporting business decisions.

In Canada, BI has been used by ISPs to block specific Internet sites which they do not want Canadian users to visit.

Normile (2008) notes that although the telecommunication industry is hesitating in adopting BI solutions due to anticipated high cost and long implementation cycles, some telecommunications service providers have gone for non-scalable temporary solutions which often fail to leverage the ever-increasing volumes of data. There is need for an effective business intelligence environment based on the right architecture. The real challenge is to make the BI environment an integral part of the decision making process.

In order to address the challenge for today's enterprise applications that require reaching out across the organization and the Internet to integrate and transform the volumes of available data Roth el al (2002) have presented the components of an information integration technology platform.

2.3 Review of the Various Business Intelligence Tools

According Gartner (2012) a BI platform should delivers 14 capabilities organized into three categories of functionality: integration, information delivery and analysis.

1) Integration – BI infrastructure, metadata management, development tools, and collaboration
2) Information Delivery – reporting, dashboards, ad hoc query, Microsoft Office integration, search-based BI, and mobile BI
3) Analysis – OLAP, interactive visualization, predictive modeling and data mining, and scoreboards.

Information delivery is the core focus of most BI applications but there is increasing interest in deployments of analysis to discover new insights, and in integration to implement those insights.

There is a growing international consensus that BI tools must be more flexible, more affordable, and provide more support for day-to-day decision-making by line of business managers (Cooper, 2012). Companies desire smaller, better targeted end-user solutions. The current tools are seen as too costly, centralized, and slow for current market requirements.

The leading BI platforms include the following:

a) SAP – offers BI solutions that include Crystal reports, OLAP, data warehousing, web intelligence, predictive analysis, dashboards and analytical applications. http://www.sap.com/solutions/

b) IBM - IBM Cognos is a suite featuring a range of BI capabilities including reporting, analysis, dashboarding and scorecards on a single, service-oriented architecture. The suite includes Report Studio, Query Studio, Analysis Studio, Metric Studio, Metric Designer, Event Studio, Framework Manager and PowerPlay Studio.

   http://www-01.ibm.com/software/analytics/cognos/

c) Oracle – Oracle Business Intelligence is a suite of BI solutions that leverage Oracle BI Server as a common platform providing a level of integration among the tools. The integration provides a common service-oriented architecture, data access services, analytic and calculation infrastructure, metadata management services, semantic business model, security model and user preferences and administration tools.

   http://www.oracle.com/us/solutions/business-analytics/overview/index.html

d) Information Builders – the WebFOCUS BI provides dashboards and scoreboards that user a high-level view of critical indicators and metrics; query and analysis tool for information retrieval; mobile BI for users of smartphones and tablet PCs to interact with any data, at any time, and from any location; guide ad hoc reporting to enables business users to generate their own reports; integration with desktop products such as Microsoft Excel and Adobe PDF to enable users to work with data in their preferred formats; and dynamic report distribution with real-time alerts. http://www.informationbuilders.com/

e) SAS – SAS BI comprise of Enterprise BI that provides a portfolio of business intelligence capabilities and applies the power of SAS analytics and data integration to create a complete and easy-to-use business intelligence solution; Office Analytics that delivers analytics in a familiar Microsoft Office interface; Visual Analytics for exploration of big data using in-memory capabilities to better understand the data, discover new patterns and publish reports; and; Visual BI for dynamic and interactive business visualization.

   http://www.sas.com/technologies/bi/

f) Microsoft– Business Intelligence Development Studio is the IDE from Microsoft used for developing data analysis and BI solutions utilizing the Microsoft SQL Server Analysis Services, Reporting Services and Integration Services. It is based on the Microsoft Visual Studio development environment but customizes with the SQL Server services-specific extensions and project types, including tools, controls and projects for reports, ETL data flows, OLAP cubes and data mining structure. http://msdn.microsoft.com/en-us/

g) MicroStrategy – provides a high performance, scalable enterprise BI platform with interactive dashboards and analytics to large user populations through Web browsers, mobile devices and office applications. The platform includes scorecards and dashboards, enterprise reporting, advanced and predictive analytics. It outputs reports in HTML, PDF, Microsoft Excel and text. It can present data in tabular grid reports, graphs and charts, and combination grid-and-graph displays. It is available for Windows, UNIX, Linux, Solaris, HP-UX, AIX, and any data source (including SAP BW and Microsoft Analysis Services). MicroStrategy Software is often layered over massive data warehouses, and it boasts the ability to support large-scale, demanding BI environments. http://www.microstrategy.com/software/business-intelligence/

h) TIBCO – The Spotfire combines business process management, complex event processing predictive analytics and visual data mining software. It handles everything from real-time data capture and streaming to data analysis, forecasting and interactive reporting on a single platform. http://spotfire.tibco.com/

i) Tableau - Its offering is comprised Tableau Desktop a tool for graphically analyzing virtually any structured data to produce charts, graphs, dashboards and reports; and Tableau Server adds enterprise-class security and performance to support large deployments. http://www.tableausoftware.com/business-intelligence

The SAP Business Objects BI tool was select for the development of the proposed model based on the following reasons:

- It offers the broadest BI portfolio for optimizing business performance by bringing together all the information required for confident decision making, achieving alignment across people and teams on a single, heterogeneous platform.
- All business intelligence users and all data sources are on a single unified platform.
- Offers BI solutions for query, reporting, analysis, dashboard, and user-friendly information search and exploration, enabling quick access to information to make enlightened decisions.
- Information management solutions for delivering data, structured or unstructured, across the enterprise that is integrated, accurate, reconciled, and well understood.
- Enables one to rapidly search and dig deeper into billions of rows of data for a more comprehensive picture of any situation.

3. METHODOLOGY

3.1 Data Source

The research design was a qualitative and took the form of an analytical case study. The methods involved in the research ranged from the survey which described the status quo, the correlation-bases studies which investigated the relationship between quantitative and qualitative variables, to developmental studies which sought to determine changes over time. Data covering a period of four months was collected from different databases within a leading ISP in Kenya. The data included historical data as well as current organization records which comprised of general customer information. Senior members of the ISP who were involved in the decision making process were interviewed in order to understand the data and the conditions to apply to the queries pulling the data.

Data collection concentrated on customer account number, service level objective, volume usage/bandwidth allocation, and pricing as shown in Table 1 below. The data was stored as excel sheets prior to refining i.e. extraction, transformation and loading, so that it would be ready for analysis.

Table 1: Sample Data Collected

Distributor Partner	Service Plan	Allocated Usage(MB)	Actual Usage(MB)	Factored Used (MB)	Volume Used (MB) Jan 2011	Volume Used (MB) Feb 2011	Volume Used (MB) Mar 2011	Volume Used (MB) Apr 2011
Afsat Admin	HU	1229	0	0	0	0	0	0
Afsat Admin	HU	1229	1988	1559	1523	1488	1408	1559
Afsat Admin	LE+++	44237	22687	20882	20421	27803	22064	20882
Callkey	HU	1229	1823	1659	3465	1537	1419	1659
Callkey	SOHO	1843	3892	3388	904	2643	1979	3388
Callkey	HU	1229	1263	1162	655	813	536	1162
Virtual Sat	HU	1229	2205	1950	1594	170	1710	1950
Virtual Sat	SOHO	1843	529	525	264	1484	1224	525
Virtual Sat	SOHO	1843	5958	5806	2256	5684	7418	5806

3.2 Data Analysis

The data collected was analyzed to ensure validity for use. The data was analyzed using sequence of two steps. A requirement analysis was carried out, based on discussions with senior and middle management in the preparation and

analysis of information that supported decision-making in the ISP industry. Their positions together with a corresponding non-exhaustive list of the primary responsibilities of each position are given in Table 2.

Table 2: Principal Responsibilities by Position in an ISP

Senior Management Position	**Principal responsibilities, including but not limited to:**
Managing Director	Responsible for full profit and loss of the organization
Financial and Operations Director	Report and analyze financial result Design, develop and implement financial strategy Maintain inventory levels together with sales and marketing directors
Marketing Director	Evaluate market trends Review competitor information and business ranking data Develop strategies to better the organization's position in the marketplace
Sales director	Deliver sales results to meet budgeted targets Establish pricing guidelines on a product-by-product basis Use appropriate analysis techniques to identify business problems and issues, including gap analysis on sales performance, risk management and contingency planning
Business Development Director	Plan and execute new business development strategy Monitor success of new products in the marketplace Establish branded generic products in the marketplace

To fulfill the responsibilities listed in Table 2, which primarily focused on decision-making and assessment of performance, accurate management information was required. The reports required included: daily sales report by customer, product, and region; sales versus churn analysis; profitability analysis, for both customers and products; customer ranking by value and volume.

3.3 Data Mining

With the normalized records, a data mart with multi-dimensionality to facilitate the analysis of customer behavior was constructed. The data mining tool used was SPSS which allows one to use several statistical tools such as dynamic panel data, survival models with frailty, regressions and multilevel mixed models. The formula below was applied to transform data to achieve normalization. The formula took the ratio of customer's monthly volume consumption/recommended volume usage and compare it with a selected threshold rate.

IF (Customer Monthly Usage/Customer Recommended Usage)>=Threshold Rate

THEN Threshold Rate Record=1

ELSE Threshold Rate Record=0

Each distributor partner was analyzed individually, the results then interpreted cumulatively to extract patterns of similarities and disparities respectively. The modeling referred to the customer behavior model built with detailed dialogue records in the telecommunication industry (Berry & Linoff, 2004) and used network flow records as the input to establish customer behaviors of network usage. Table 3 represents the Total Number of Users per Distributor as well as the Volume Usage measured in megabits per second for a period of four months.

Table 3: Normalized Data

Usage Within & Excess Limit	**All**	**Within**	**Jan Excess**	**Feb Excess**	**Mar Excess**	**Apr Excess**	**Churned**	**All Excess**
Afsat Admin	31	24	1	1	2	4	25	7
Afsat Comm Ke	19	8		1	2	6	9	12
Callkey	366	101	40	41	62	112	36	260
Hughes N/K Sys Llc	1	1	0	0	0	0	0	0
Virtual Sat	72	16	9	9	14	23	7	55

From the data mining patterns of users who were within limit as well as exceeding the bandwidth, utilization was established for the period of four months in which the data was collected as shown in Tables 4, 5, 6 and 7 below.

Table 4: January 2011 Volume Usage

	Jan				
Partner	**Service Plan**	**Usage**	**Excess Usage MB**	**Status**	**Recommended SP**
Afsat Admin	HU	0	0	Within Limit	HU
Afsat Admin	HU	1523	294	Excess	SOHO
Afsat Admin	LE+++	20421	0	Within Limit	LE+++
Afsat Admin	ME	0	0	Within Limit	ME
Afsat Communications Kenya	SOHO+	3016	0	Within Limit	SOHO+
Afsat Communications Kenya	SOHO	2690	847	Excess	SE
Callkey	HU	3465	2236	Excess	SE
Callkey	SOHO	904	0	Within Limit	SOHO
Callkey	HU	655	0	Within Limit	HU
Callkey	SOHO	8954	7111	Excess	ME

Table 5: February 2011 Volume Usage

	Feb				
Partner	**Service Plan**	**Usage**	**Excess Usage MB**	**Status**	**Recommended SP**
Afsat Admin	HU	0	0	Within Limit	HU
Afsat Admin	HU	1488	259	Excess	SOHO
Afsat Admin	LE+++	27803	0	Within Limit	LE+++
Afsat Admin	ME	0	0	Within Limit	ME
Afsat Communications Kenya	SOHO+	7491	3805	Excess	SME
Afsat Communications Kenya	SOHO	3211	1368	Excess	SE
Callkey	HU	1537	308	Excess	SE
Callkey	SOHO	2643	800	Excess	SE
Callkey	HU	813	0	Within Limit	HU
Callkey	SOHO	14992	13149	Excess	LE

Table 6: March 2011 Volume Usage

	March				
Partner	**Service Plan**	**Usage**	**Excess Usage MB**	**Status**	**Recommended Sp**
Afsat Admin	HU	0	0	Within Limit	HU
Afsat Admin	HU	1408	179	Excess	SOHO
Afsat Admin	LE+++	22064	0	Within Limit	LE+++
Afsat Admin	ME	0	0	Within Limit	ME
Afsat Communications Kenya	SOHO+	6876	3190	Excess	SME
Afsat Communications Kenya	SOHO	2976	1133	Excess	SE
Callkey	HU	1419	190	Excess	SOHO
Callkey	SOHO	1979	136	Excess	SE
Callkey	HU	536	0	Within Limit	HU
Callkey	SOHO	10964	9121	Excess	ME

Table 7: April 2011 Volume Usage

	April				
Partner	**Service Plan**	**Usage**	**Excess Usage Mb**	**Status**	**Recommended SP**
Afsat Admin	HU	0	0	Within Limit	HU
Afsat Admin	HU	1559	330	Excess	SE
Afsat Admin	LE+++	20882	0	Within Limit	LE+++
Afsat Admin	ME	0	0	Within Limit	ME
Afsat Communications Kenya	SOHO+	3878	192	Excess	SE
Afsat Communications Kenya	SOHO	713	0	Within Limit	SOHO
Callkey	HU	1659	430	Excess	SE
Callkey	SOHO	3388	1545	Excess	SE
Callkey	HU	1162	0	Within Limit	HU
Callkey	SOHO	14934	13091	Excess	LE

3.4 Model Development

The BI model was developed using the methodology suggested by Olszak and Ziemba (2007) in two major stages i.e. the creation and the use ("consumption") of BI. The BI creation consisted of the following tasks: definition of the BI undertaking, identification and preparation of source data, selection of BI tools, designing and implementing of BI, and discovering and exploring other business applications and practices. The BI consumption stage consisted of access and analyses of facts.

SAP Business Objects that delivers data mining and predictive analytics, was used to design the model. Using powerful data mining technology, Business Objects Predictive Workbench enables poring over historical business information and creating a predictive model that can be utilized to solve both horizontal and industry-specific business problems. The predictive models help organizations achieve specific business goals, such as maximizing marketing efforts, designing optimal pricing plans, improving operational efficiencies and, most importantly, gaining agility and competitive differentiation.

We adopted the visual data mining techniques described in (Oliveira & Levkowitz, 2003) to visualize the data. The XCELCIUS SAP Business Objects tool was used to apply the findings of the analysis to a front end model. The tool has the ability to alter cell values in real time, in line with what the end user inputs or does on the dashboard and offers a point-and-click data visualization facility designed specifically to create interactive analytics and dashboards. If-then rules from data based on statistical significance were applied to give a function that is then applied to the model to give a live dashboard.

4. RESULTS AND DISCUSSION

The proposed Business Intelligence Model emphasized on knowledge identification through OLAP. With the help of the embedded OLAP tool, the model was able to identify patterns to determine the usage value of a customer. For example, it was possible to observe the distributor who had the highest number of customers hence identify the most profitable distributor. Various analytical charts were constructed. For Sales by Distributor (Figure 1), analysis of the sites from three dimensions that is customers within limit, customers exceeding volume usage, and the number of churned customers (Figure 2). This information is important to the senior management as they were able to identify potential revenue gaps.

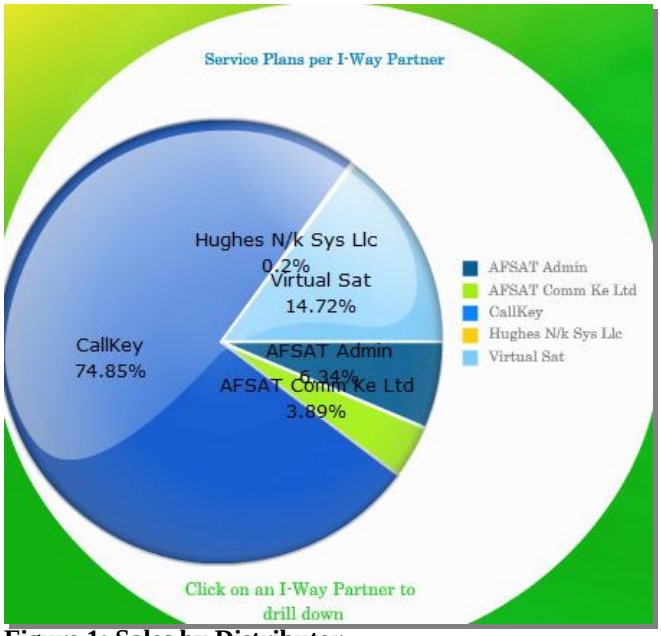

Figure 1: Sales by Distributor

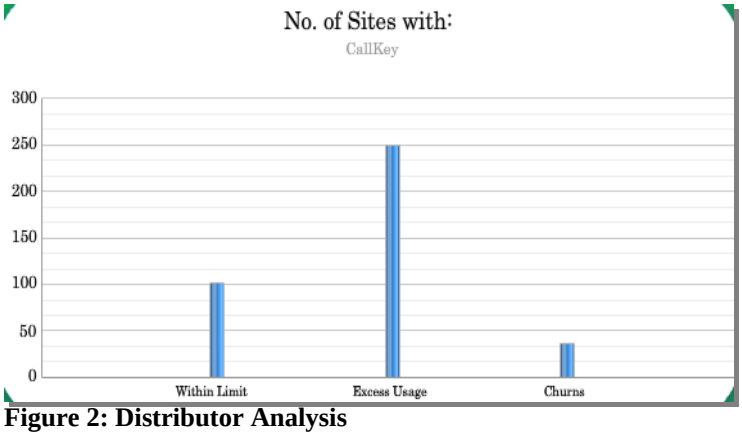

Figure 2: Distributor Analysis

The cross examination of usage behaviors of various groups could lead to the discovery of where the issues of personalized services lie and how to approach these issues. For example, the Overall Heavy Usage group (Figure 3) is of great immediate value to management as this group provides management a much focused target with heavy usage for nearly all time, and management could develop and market high value-added products that fit their needs. On the other hand, the Overall Light Usage group happens to be the smallest grouping with 30% of users, most of them probably individuals. This would present a challenge to management to conduct further analysis so that some of them may be converted to more regular users.

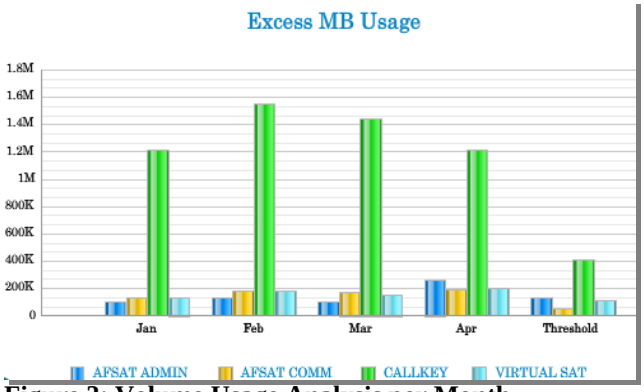

Figure 3: Volume Usage Analysis per Month

The advanced analytics module allowed for the system to provide certainty and predictive measures or facts. For example, Figure 4 shows the amount of revenue lost between the months of January to April for a particular distributor. This information is of utmost importance to the management as it provides information of factual nature.

Figure 4: Revenue Loss Analysis per Month

Lost Sales				
	Jan	Feb	Mar	Apr
AFSAT ADMIN	3000	3000	3000	1000
AFSAT COMM	26000	32000	34000	34000
CALLKEY	441000	555000	523000	522000
VIRTUAL SAT	88000	103000	97000	91000

Figure 5: Lost Sales by a Specific Distributor Due to Over Usage

In addition the advanced analytical module was able to predict future trends. The module incorporated a what-if analysis component which analyzed the usage patterns for a customer within a three month period and predicted the best service plan suitable for the customer needs. Furthermore, the module analyzed the net and gross profits sales the organization would achieve from such movements. Figures 6 and 7 depict an example of one such customer.

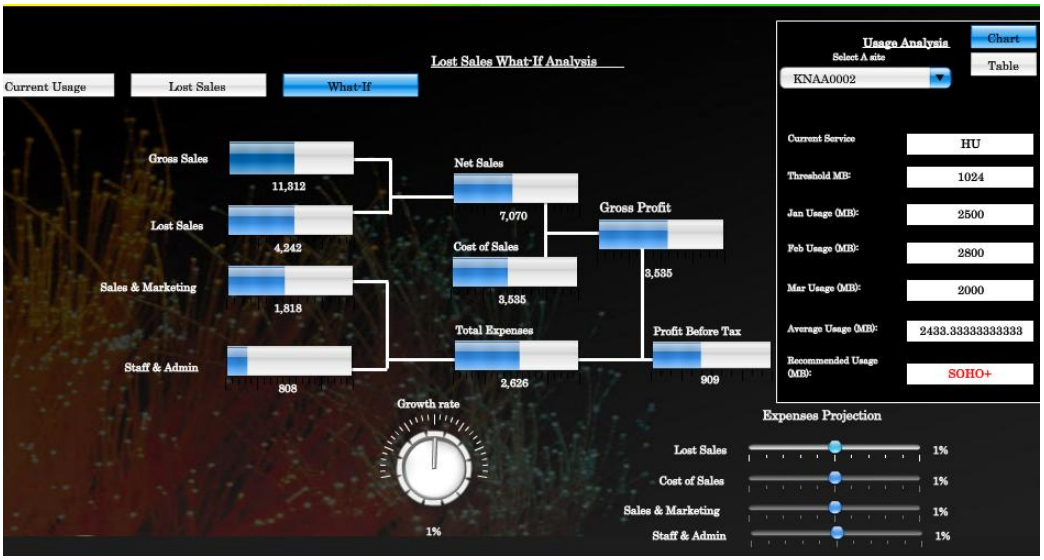

Figure 6: What-if Analysis

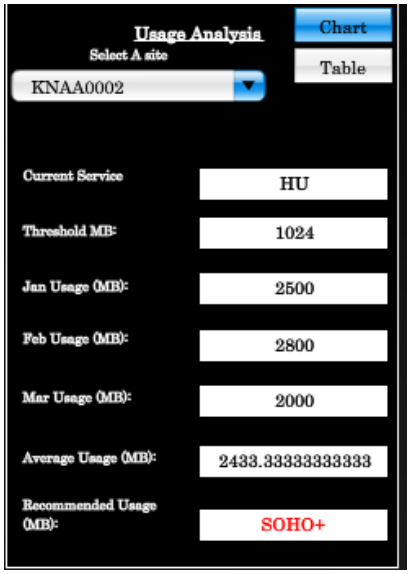

Figure 7: Customer Usage Recommendation

5. CONCLUSION

The developed Business Intelligence Model assisted in analyzing the monthly volume usage data and enabled the output of the information in the form of charts and reports which were easy to interpret. The model was tested with a Kenyan based ISP and all the users of the model agreed it was user-friendly. Most of the queries were predefined and ready for output without the user seeing the underlying database. The stand-alone application can run on any Operating System and no special software is required to run it. The data model used to design the database for the system was based on the relational model, and can therefore be used in relational databases. For example, anyone using Microsoft Access can use the same data model. The data model is generic and can be used by any organization in the service industry.

The assessment of the model after its application as a management delivery mechanism in the organization it was tested indicated that it led to significant improvements. Previously users had to request management information from a single person with access to a legacy system, which presented a significant bottleneck, as it was a time consuming process both in communicating requirements and producing the required reports. This was eliminated by managers preparing their own reports when required, allowing more flexibility. The model helped to improve information flow in the organization, increasing the speed and quality of key marketing and sales decisions. The managers spent significantly less time performing analysis and far more in the decision-making as the model was able to retrieve relevant sales and marketing information from the database at the user's request. As a result, the organization was able to increase its sales through improved targeted marketing and monitoring of the outcome.

However, for successful implementation of the BI model, the understanding of critical success factors is important. These factors have been identified by (Yeoh and Koronios, 2009) and they include organizational and process-related factors that are more influential than technological and data-related factors. The developed model focused only on certain information regarding sales and marketing. The BI tool used SAP Business Objects does not take in large data sets, hence limiting the amount of data which could be used. To build on this, future works should incorporate larger data sets and hence formulate more predictions that will eventually yield profits for an organization. The system may also be enhanced to automatically generate exceptional reports when an unusual situation is encountered to enable rapid managerial intervention.

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