Challenges in Building and Maturing of a Telecommunications Business Intelligence Solution in a Developing Country

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ABSTRACT

South Africa as a developing country has since 1994 gone through a process of privatisation of some of the state departments. The Department of Post and Telecommunications was one of those departments. During this transition period, data warehousing and business intelligence has played a critical role in measuring the performance of the new telecommunications company against targets set by government. This new telecommunications company had to meet the targets set while also preparing for competition. This paper will describe the challenges that were faced during the privatisation. It will also describe a new business intelligence literacy and cultural maturity model and a new data warehouse lifecycle model that evolved from the struggle to overcome the challenges that existed.

1. INTRODUCTION

In 1994, just after the privatisation of the Department of Post and Telecommunication, the new democratic government of South Africa was the sole shareholder of the only landline telecommunications company in South Africa. The Government had vibrant discussions with all the relevant parties on how telecommunications might be restructured to create an even distribution of access to telecommunications services to all the people in the country. This resulted in a White Paper on Telecommunications policy which was released in March 1996 (Anon, 1996).

The major proposal contained in the White Paper was that the owner and operator of the fixed telephony infrastructure would be granted a limited period, the so-called exclusivity period, of monopoly in the provision of basic telecommunication services. This exclusivity period was to last for five years, until May 2002, but could be extended to six years, if the telecommunication operator met network rollout and service targets. The rollout targets included doubling its subscriber access lines by 2.7million; installing 120,000 new public telephones; connecting 3,200 villages for the first time and providing service to more than 20,000 priority customers such as schools and clinics. The exclusivity period was intended to allow them to expand the network as rapidly as possible in order to facilitate universal access and to move towards universal service. The agreement left the telecommunications provider with the challenge to plan and manage the implementation targets set by government while at the same time preparing for competition once the exclusivity period expired.

This paper will firstly provide a background of the status of business intelligence in the telecommunications company. That will be followed by challenges faced in building and maturing a business intelligence solution in the company. The paper will then conclude with two models that resulted from the challenges.

2. BACKGROUND

The new company already had a Data Mart (DM) on infrastructure information. Although the DM was in place it was not used at all. The main reason was that people did not know how to use it, simply because of the lack of technical knowledge and a lack of training on the business intelligence tools available to the business. The legal requirement to manage the agreement with government has forced the company to start using available data. When people started asking for information concerning spare infrastructure it was realized that the required information was available in the DM. However, people did not know how to access and/or use the information. The lack of knowledge on how to use the DM has resulted in sales people selling telephone services in areas where there was no infrastructure.

Williams and Williams (2004) stated that, historically, many data warehousing (DW) and business intelligence (BI) initiatives have been IT-driven, and much of the focus within the industry has been on the technical aspects of delivering information to the BI user community. Having arrived at a point where many of the technical challenges and trade-offs were at least well understood, more attention was needed on how BI can be used to deliver business value. The BI user is not interested in the technical working of the DW and BI solution. They are more interested in the value that it adds to the business. Does it create the right business questions and does it facilitate the correct answers to the critical business questions to ensure the competitive advantage? In the case of South Africa and the sole provider of telecommunications in the country, it was at that stage important to start using the DW and BI tools that were already available in the company.

3. CHALLENGES

3.1 BI literacy and culture

To be able to use the information and data available in the DM brought the company to a point that management had to make a decision between the following alternatives:

1. Train all the business people on the existing BI tool (Business Objects)
2. Implement a new BI tool which also needed training
3. Create a new division that will fill the gap between the technical working of the data warehouse (ICT) and the business.

The first two options were seen as expansive, risky and very time-consuming, as there was no culture for the use of electronic information in the company. Business people would have access to electronic information, but would print it out before using it. When going to a meeting managers would print reports and take a hardcopy with them to the meeting. Dashboards were on paper against the wall. Secretaries printed out the new information every day and stuck it on the wall. So, training alone would not be sufficient for the company and therefore it made sense to take the third option.

The third option was selected because it was seen as the quickest solution and also a steppingstone to get the BI literacy and cultural maturity level of the company to a level to use electronic information. In BI it is hard to split literacy from culture. Bodly (1994) believes that culture involves at lease three components: what people think, what they do, and the material products they produce. Literacy is considered as the ability to locate, evaluate, use and communicate. It was difficult to split the two realities, because the one could be the result of the other and that leaded to business not using the DW and BI solution.

A new division was consequently created to fill the gap between the ICT and business. The company was divided into six regions to render a telecommunications service in South Africa. A decision was taken to use that same regional approach to implement this new division called Knowledge and Information Management (KIM). One manager per region was appointed with between three to five knowledge

workers depending on the size of the region. Knowledge workers were people with a combination of ICT and business skills.

3.2 Plan and Manage the Implementation Targets Set by Government

The fact that a DM and BI solution was already in place as well as the establishment of the KIM division have helped a great deal in implementing and managing the targets set by government. South Africa has a 41% rural population and these rural communities have access to schools and clinic's which were also in the rural areas where there was no infrastructure. To start off with the urban schools and clinics was easy, but that would not fulfill the additional requirement for services to the priority customers. The same applied to prepaid phones. To install a payphone (coin or card) was also a way of taking a telephone service to these rural communities.

Therefore, to be able to start working on the targets set by government, the first step was to determine the spare infrastructure in order to send the sales teams to sell where there was infrastructure available. Otherwise sales personnel would have sold in areas where there was no infrastructure and that would result in customers waiting for their services while the company has to plan and build that infrastructure. Building the infrastructure could take months or years depending on the size of the project.

A report on infrastructure was initiated by the KIM division. The infrastructure consisted of two network areas:

1. Core network (exchanges and transmission systems)
2. Access network (cables to the different houses, coin phones and businesses)

Figure 1 below is a high-level graphical representation of the network of a landline telecommunications company.

On the core network each connection needed a telephone number and a port on the exchange. On the access network, each connection needed the following positions on the network:

1. strip and line on the Main Distribution Frame (MDF)
2. an exchange and distribution point position on the Street Distribution Cabinet (SDC)
3. one position on the Distribution Point (DP)

A sales list with the spare infrastructure was provided to the sales division in the different regions. Sales lists were made available on weekly basis. From the dimensional model in figure 2 below, it is clear that there were no facts; the information consisted of a combination of dimensions. Therefore a factless fact (Kimball, 2002) was used.

After the sales team went out and sold telephone services to these addresses, it was important to track the orders through the order system. Not only has the number of orders in the order system increased rapidly, it was also important to get the orders through the system as soon as possible to ensure that the services were provided to the customer to achieve the targets set by government.

3.3 The Order Process

The order process consisted of the following steps:

1. Capturing paper order on the system
2. Credit vetting of new customer
3. Allocate access network

Figure 1. Landline telecommunications network

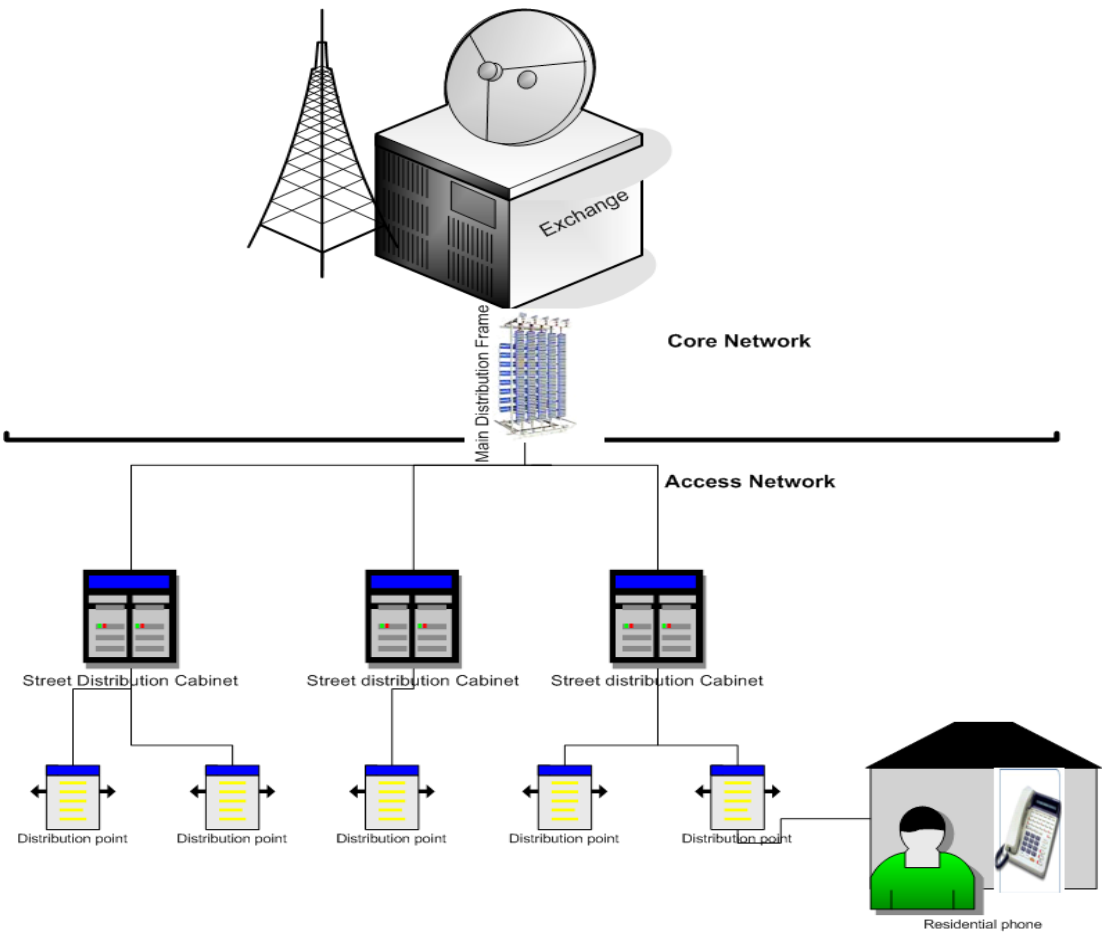
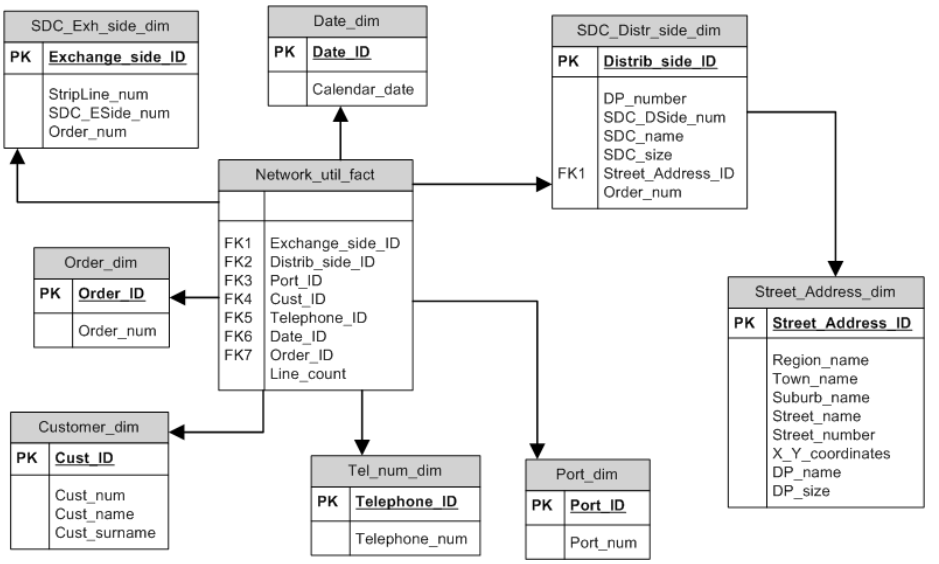


Figure 2. Infrastructure dimensional model

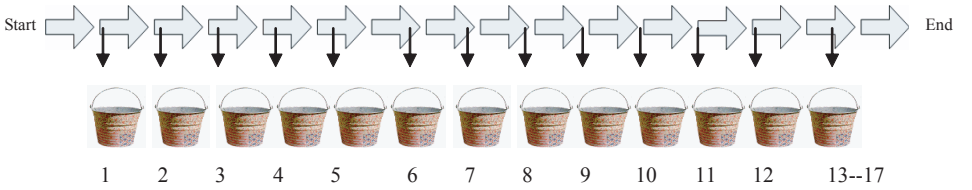


4. Allocate core network
5. Receive connection fee
6. Order sent to exchange to create a new port and telephone number
7. Order sent to main distribution frame for cross connection
8. Order sent to technical team for installation
9. Finished order sent to billing team to start the billing process

The nine step process would have been sufficient in the perfect world, but all orders could not go through the process without getting stuck somewhere in the process. These orders were dropping off the "order pipeline" and therefore the orders that got stuck in the system were grouped into, what was called buckets. Some examples of these drop-off conditions were as follow:

1. sometimes addresses were incorrect on the paper order and the capturing of the order could not be finished,

Figure 3. Bucket system



Bucket number	Bucket description
1	Street address or X and Y coordinates not completed
2	Postal or Billing address not completed
3	Wait for credit vetting results
4	Credit vetting score lower than required score, send letter to customer
5	Waiting for payment
6	Waiting to allocate access network
7	No distribution side access network available
8	Waiting to allocate exchange side network
9	No exchange side access network available
10	Waiting for cable repairs
11	Waiting for allocations of a port on the exchange
12	Waiting for telephone number to be allocated.
13	No core network available at the exchange
14	Waiting to run cross connection on the main distribution frame
15	Waiting for installation
16	Customer not at home
17	Installation completed, wait for billing

2. the information on the network was incorrect and no network existed for the address,
3. the customer was not available for the installation of the service, etc.

To make provision for all these conditions, the following process was modeled and all the different drop-out conditions were called buckets. Figure 3 represents the business requirement.

When the requirement occurred to track the orders through the OLTP system, the orders were already in the system. That meant that it was a business critical information requirement. There was no time to go through the data warehouse development lifecycle. A solution was needed immediately. The KIM section consequently designed the front-end solution for the order-tracking system and called it the bucket system.

The data warehouse Extract Transform and Load (ETL) team was asked to provide the information required in a flat file. The ETL process transformed the different conditions into buckets . That meant that depending on the order's condition, a bucket number was placed next to the order in the flat file. This bucket number was known as the current bucket and the snapshot date was known as the date that the order went into the particular bucket. This was only for the first run of the flat file. For the second run there were a current bucket and previous bucket and the number of days spent in the current bucket. The number of days in a bucket was calculated day by day from the first snapshot date that an order went into a specific bucket. This flat file was accessed by an excel pivot table. The advantage of this flat file was that it could be used while the bucket process was refined. Changes that occurred because of the refinement were easy to handle because it did not require a total redesign of the dimensional model. It required only small changes to the ETL and the flat file which could be done in minutes.

This bucket process was helping business to concentrate on orders that were longest in a particular bucket. The orders were also divided amongst the different sections. Core network sections were responsible for core network buckets, the access network sections were responsible for the access network buckets and finance was responsible for the financial buckets, etc. The responsible section would log into the order system and attend to the order. This bucket system was not only used to follow the orders through the order system, it was also used in the call centre for people phoning to find out where their orders were in the process.

After this bucket system was in place for a month and the KIM section was happy that all information needed was included and correct, the process was started to model this system into a proper dimensional model and business intelligence solution. The advantage of this quick Business Critical Information Solution (BCIS) was that the requirement was now understood very well and there was a proper interim solution in place that fulfilled the immediate need.

The flat file was modeled into a proper dimensional model and the ETL-process was now changed to load the tables of the dimensional model. Documentation was then done on the ETL and dimensional model. All of this was done without the user knowing that it happened. The only thing that could not be done without the user knowing or being interrupted was the user interface BI tool. Excel was used as the BI tool and it had to be changed with Business Objects (BO). The BO front-end was done in parallel and after it was completed the Excel front-end was switched off.

The question could be asked; why is a new solution built while the interim solution is working well. The answer is simple. With the interim solution the focus is on delivering the information and not to optimize the solution. It is for instance not possible to put indexes on a flat file.

4. BUSINESS INTELLIGENCE AND DATA WAREHOUSING MODELS

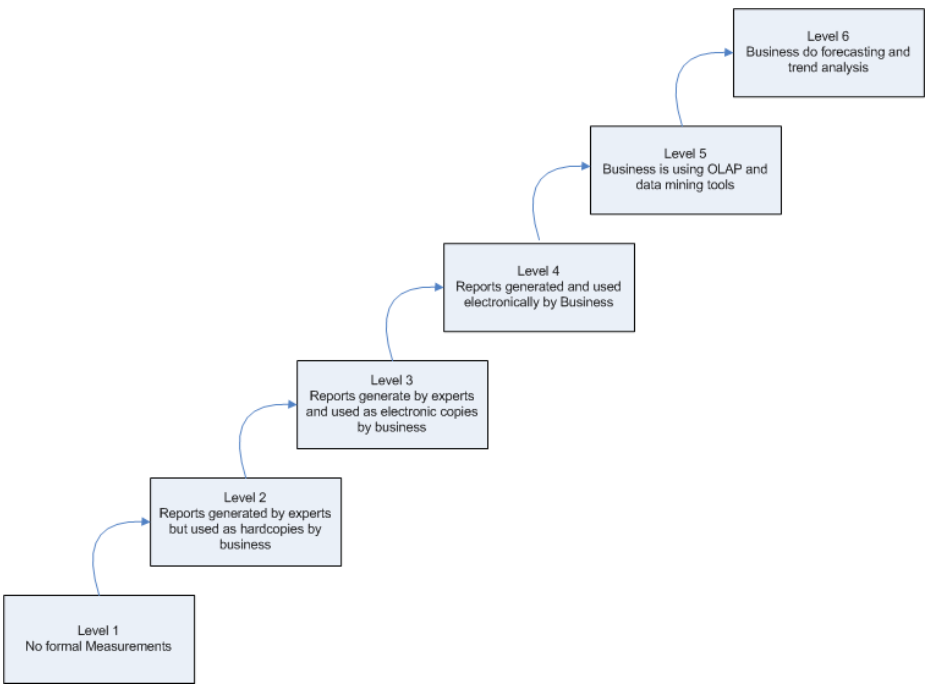
From this exercise the following two models resulted:

1. BI Literacy and Cultural Maturity Model
2. The data warehouse lifecycle model for Business Critical Information Solution called the Double Wave Data Warehouse Lifecycle Model.

4.1 BI Literacy and Cultural Maturity Model

Eckerman (2004) has developed the Data Warehousing Maturity Model. This model focuses on the maturity of the data warehouse. It consists of the following six stages: 1. Prenatal (System), 2. Infant (Individual), 3. Child (Department), 4. Teenager (Division), 5. Adult (Enterprise), 6 Sage (Internal enterprise). The Data Warehouse Maturity Model represents the incremental growth of the data warehouse. It enables an organization to know how mature the technical side of the data warehouse is. As we have mentioned earlier in this document, Williams and Williams (2004) stated that, historically, many data warehousing and business

Figure 4. BI literacy and culture maturity model



intelligence (BI) initiatives have been IT-driven, and much of the focus within the industry has been on the technical aspects of delivering information to the BI user community. The real success of the data warehouse and business intelligence of today lies in how well it is utilised by the business. How "BI literate" the business is, is important information for businesses. A BI Literacy and Cultural Maturity Model is needed to measure the literacy of the business users. This model also suggests ways to increase the maturity level of BI literacy in an organisation. An organisation can have the best DW with the best BI tools, if it is not used; it means nothing for the organisation.

From this study six maturity levels for BI literacy and culture materialized (*See Figure 4*).

Level 1: No formal Measurement
Level 1 does not appear in most new companies and is normally not a level that last very long in bigger companies because it is very hard to manage any organization without any form of measurement. The business management team therefore plays a major role in putting measures in place to manage the performance of the organization. Reports are in some instances built into OLTP systems and therefore results in a lack of integration in all business information.

Level 2: Reports Generated by Experts but Used as Hardcopies by Business
Business people in a company at this level are used to the fact that information is right in front of them on the wall. To run and use reports electronically forces people to change their comfort zone. This is a cultural change and this cultural change could be initiated and improved by creating a new section of people with both ICT and business skills (knowledge and information management section) as mentioned earlier in this document. The business people receive training to use the electronic reports and the Knowledge and Information Management (KIM) section is available to assist with any problems that might be experienced by the business people.

Level 3: Reports Generated by Experts and Used as an Electronic Copy by Business
This level is very prominent in organizations in developing countries where the ICT skills level amongst business people is low. The low ICT literacy could be as a result of the culture that exists in the organization. In companies at this level a culture exists that only ICT people are responsible to use ICT tools and can therefore not be addressed only by the provision of IT training to the business people. To get to the next level a new culture is needed where business people are responsible to use ICT tools and ICT people only maintain these ICT tools. This new culture need to be driven by the business management team which should lead by example. Business management should use electronic reports when doing management meetings. Using electronic reports would be difficult at first but the KIM team can play a huge role in educating business people in these meetings.

Level 4: Reports Generated and Used Electronically by Business Users
This level takes the longest to reach because it is not only dependent on the PC skills of the business people. Previously it was done by someone else, now they should do it for themselves. One way to get to this stage quicker is by only building BCIS that is needed urgently or by using this information for performance appraisals. The business people receive training to generate or run the reports with a proper BI tool and the KIM section is available to assist with any problems that might be experienced by the business people.

Level 5: Business is Using OLAP and Data Mining Tools
Moving from the use of reports to the use of online analytical processing (OLAP) could mean a lot to the business. This is the first step towards a complete business intelligent solution. This level of maturity within the business requires that The Data Warehousing Maturity Model (Ackerman 2004) is at level 5 (Adult). Data mining could result in new information that could be modeled back into the BI and DW solution. This level require creative KIM analysts who are very well equipped with both OLAP and business skills.

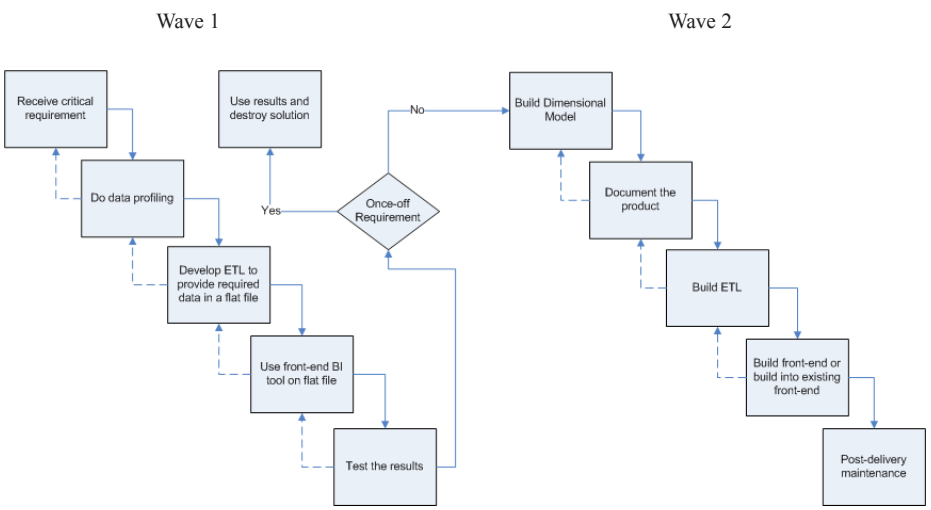
Level 6: Business Does Forecasting and Trend Analysis
Level 6 is to a certain degree not dependent on the literacy of the business people, it is a strategic decision made by top management and therefore dependent on the appointment of statisticians in the company. The approval of these statisticians is normally dependant on the value created by the BI solution up to level 5.

4.2 The Data Warehouse Lifecycle Model for Business Critical Information Solution

The Double Wave Data Warehouse (DWDW) lifecycle model consists of two iterations for the development of a BI and DW solution (*See figure 5*). Wave one concentrates on the rapid implementation of a BCIS. Wave 2 concentrates on modeling the ongoing requirement into a permanent dimensional model. The dimensional model leads to database optimization opportunities, because the dimensional model is a database design that supports extractions of large SQL queries and online analyses. Kimball (1998) has developed "The Business Dimensional Lifecycle diagram" that focuses on the development of a complete solution where there is enough time available for a complete solution.

The DWDW lifecycle model was created to build the BI and DW solution incrementally.

Figure 5. The double wave data warehouse lifecycle model



Information in business is often needed for a "window of opportunity" or legal requirement which cannot wait for a project to finish. When this need arise, there is often not enough time to go through a full software development lifecycle. The requirement can also sometimes be a once-off requirement and the information will not be used in future again. In this case it doesn't make sense to model it into the data warehouse. It is safer to wait for a BCIS to arise and build the BI solution the less expensive way. As soon as this interim solution satisfies the need of the customer, then a proper model can be built and integrated with the exiting BI and DW solution.

5. CONCLUSION

This paper discussed some of the challenges faced by developing countries in building and maturing a telecommunications business intelligence solution. The Double Wave Data Warehouse Lifecycle Model was created to construct a robust source (Data warehouse) for the electronic information in an organization while the BI Literacy and Culture Maturity Model was created to monitor and grow the BI maturity of the organization. The first wave of the Double Wave Data Warehouse Lifecycle Model enable the BI team to deliver business critical information to the business in the shortest possible time with the main focus on delivering the information, while wave two is focused on ensuring the robustness of the solution.

The BI Literacy and Culture Maturity Model ensures that the technical part of the BI solutions grows at the same pace as the human (soft) part of solution. A BI solution that is not used by the business cannot be described as a successful BI solution even though it is technically sound.

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