Original Research Article

Implementation of Data Warehousing in Telecommunication Companies in Rwanda: A Survey of MTN in Gasabo District and Tigo in Nyarugenge District

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Abstract: The study was to investigate the implementation of data warehouse at selected telecommunication companies in Rwanda (MTN and Tigo) and the objectives were to identify the key factors that lead to successful implementation of data warehousing in MTN and Tigo ,to find out the techniques used to implement data warehousing in MTN and Tigo and to assess the extent to which data warehousing contribute to MTN and Tigo in improving business processes using data collected from their head offices at Kigali. The data warehousing was assessed to find out how it contributes to Telecommunication Company to overcome issues raised with operation systems. The research was carried out using survey, descriptive and explanatory design where both qualitative and quantitative approaches were used. The primary data was collected using questionnaires and secondary data of the documentation review method was used. The targeted population was sampled using purposive method. The finding from the survey indicated the sixteen factors for successful implementation and the buttom up design as implementation technique of data warehousing in MTN and Tigo. Upon this, the finding showed the very high level of contribution of data warehousing to MTN and high level of contribution of data warehousing to Tigo. This high significance contribution implies the extent for which data warehousing are contributing in selected telecommunication companies. The recommendations derived from the findings addressed data warehousing managers of MTN and Tigo Rwanda, and government institutions. The selected telecommunication companies should continue to use data warehousing in their operations. The success of data warehousing is a process which also requires the performance improvement through well management and maintenance.
Keywords: Decision support system, Data Warehouse, Mobile Telecommunication network, National Information Communications and Infrastructure, Telecommunication Company.

INTRODUCTION

Management there is need for data warehousing to have access to more and better information. All organizations whether large or small are using information technology as the backbones for the operations which produce a large amount of data about their business [1]. The story of the data warehouse begins with the evolution of information and decision support systems .The profession and practice of information systems and processing is certainly immature, because it has existed only since the early 1960s. In this period, the world of computation consisted of creating individual applications that were run using master files which were housed on magnetic tape. The 1970s saw the advent of disk storage, or direct access storage device (DASD). With DASD came a new type of system software known as a database management system (DBMS) [2].

By the mid-1970s, online transaction processing (OLTP) made even faster access to data possible, opening whole new vistas for business and processing. By the 1980s, more new technologies, such as PCs and fourth-generation languages (4GLs), began to surface. Shortly after the advent of massive OLTP systems, an innocuous program for "extract" processing began to appear with the role of performance and control in making decision [2]. Data warehousing dates back to the late 1980 when International Business Machines Corporation (IBM) researchers Barry Devlin and Paul Murphy developed the business data warehouse. At that time, a popular system that utilized the concept of data warehousing was the relational database, which was run on minicomputers and used for OLTP functions. As technology continued to advance, several key factors including changing business trends,

the evolution of the global economy, enterprise resource planning, business process reengineering, increased focus on customer needs, and the rise of e-business led to the development of data warehouses in the 1990s [3]. The very essence of success in the data warehouse environment is the ability to manage large amounts of data, where data is compacted, and can be stored in a minimal amount of space where the accessibility of the data is very efficient [2].

In this time, the traditional information system technology was simply too slow and complex to provide relevant data efficiently and quickly. The completion of reporting request could take days or weeks using traditional reporting tools which were design more or less to execute business rather than to run business. To gain a competitive edge, organizations need to accelerate decision making timelines in their processes in order to respond rapidly to change .With traditional information system, the data that helps in making decisions, remains in operation system and can't be used by the organization, and this phenomenon is referred to as ''data in jail '', where the small portion of this data is entered, stored and processed to decision makers and management of enterprises, other part is unavailable. The unavailability of this data can cause significant reduction in sales and profit of organization.The cure of this problem was the construction of data warehouse [4].

The implementation of data warehousing around the world started in retail giants such as Wal-Mart, credit card companies such Visa and Amerca Express, major banks and transportation companies which include banks of America, Rayal bank of Canada, Allied Irish Bank, United Airlines, Continental Airlines [5]. As with all industries, the telecommunication companies (TC) need data warehouse to support a unique set of special types of reports. No industry has quite the high level of ongoing chaos, confusion and quickly changing requirements than telecommunications. Telecommunications companies capture and process thousands of times more data than any other industry [6]. In some part of Africa there are also a large number of telecommunication companies such as Safaricom, telcom Kenya, Orascom Telecom Egypt, MTN South Africa,Vodacom Group (South Africa),Telkom (South Africa),MTN Nigeria (Nigeria),Maroc Telecom (Morocco), [7].

However, the last decades of the 20th century, Rwandan society has also undergone the manifestation of the shift from an industrial to an information society characterized by technological innovation and diffusion such as economic value and information flows. Since this time, this society was characterized by a high level of information intensity in the everyday life of most citizens, in most organizations and workplaces [8].With this growing avalanche of data available in different institutions of Rwanda, some companies such as telecommunication companies implemented the new technology of data warehousing. It is on this basis that the researcher conducted a survey in the selected telecommunication companies in Rwanda to find out the factors for successful implementation of data warehousing.

Statement of the problem
In the 21st of century, most organizations in Rwanda including telecommunication companies are managing vast amounts of data which are still being stored in operational systems. The data consumers often cannot access the data they need because of poor infrastructure, which include frequent power outages; poor storage and filing systems that make it difficult to retrieve information, poor data security, loss of their data and officials also reported delays in receiving data from service providers. In addition to that, the cost of these systems is so high, they manage a small volume of data, and they cannot produce a big number of reports at the same time and cannot keep the historical data. The solution of these gaps is to adopt the new technology of data warehousing, as appropriate way of accessing, storing and using data to make an appropriate decision. The country has inadequate number of archives of historical data. In view this problem, the researcher decided to do a research on factors which contributed to data warehousing implementation. This study was to find out factors that not contribute to the implementation of data warehouse but also assess if data warehouse contributing to TC to overcome issues rose with operation systems.

Objectives of study
1. To identify the key factors that lead to successful implementation of data warehousing in MTN and Tigo.
2. To find out the techniques used to implement data warehousing in MTN and Tigo.
3. To assess the extent to which data warehousing contribute to MTN and Tigo in improving business processes.

Research questions
The study was guided by the following questions:
1. What are the factors determined successful implementation of data warehousing?
2. What are the techniques used in data warehousing implementation?
3. To what extent are data warehousing contributing to MTN and Tigo in improving business processes?

Significance of the study

The major significance of this study is mainly for academic, policy making and Government. This research was beneficial to people in the academic field in improving and acquiring knowledge related to data warehousing. The finding of this was to act as an eye-opened on the factors leading to data warehousing success. The study may be helpful to the future researchers who are interested in this topic. This research will be useful for academic purposes. This research will enrich the library of Mount Kenya University. This research find out the various factors lead to data warehousing success and problem encountered during the implementation of this project. The result is beneficial to the policy makers in using effectively data warehousing because the policy makers will respect the factors and the best technique used in implementing data. The study will be beneficial to government in planning and implementation of data warehousing projects.As result the public services will be managed and controlled effectively and efficiently.

METHODOLOGY
Research design

In this study questionnaires were used as a tool for collecting data. The survey method was used where non-probability or purposive sampling the. The population in this study consisted the total employees of IS departments, consultant and financial departments in MTN and Tigo head offices in Kigali. The total population was 39 where 18 in Tigo and 21 in MTN Rwanda.

Sample design

Due to the time constraints and the resources at the disposal, it was not possible to make a study on the whole population under consideration. The selection of respondents was done using purposive sampling to pick respondents who best meet the purposes of the study. Therefore, people who had knowledge in information system, administrators, specialists, managers and consultant of data warehouse in these telecommunication companies, who could retrieve, access and analyse information, were given with the questionnaires and they were considered as suitable respondents.

Table 1: Calculation of sample size

Name of telecommunication company	Population size	Sample size
MTN Rwanda	21	20
Tigo Rwanda	18	17
Total	39	37

Source: primary data

In this research the final sample size was approximately equal to whole population, for this reason the research used 39 as a sample size form the whole population.

Data collection

In this research primary data was collected by using questionnaires. The researcher collected a large amount of information from a large number of people in a short period of time and in a relatively cost effective way. The questions were composed by five main sections. The section (I) related to identification of responds, the section (II) related to objective one, the section (III) related to objective two, the section (IV) related to objective three and the section (V) related to challenges for which employees are facing when they are performing the functions in the selected telecommunication companies and suggestion on how to overcome them. The questioners was in English after realizing that the concerned information provider understood English and questionnaires included Likert scale and both open and closed questions were asked. In collecting secondary data, the documentation review

method was used. The researcher used documentation retrieved from company's website, from internet including articles and research paper.

Validity and Reliability

The concept of validity refers to quality of study, with respect to measurement procedures it relates to whether a research instrument is measuring what it is used to measure. In this research the use of its two approaches was used, the presence of establishment of a logical link between objectives of a study and the question were used in instrument, and the use of statistical analysis to demonstrate link. The validity of instrument was measured by computing the valid coefficient (CVI) that equals to total number of valid items divided by the total number of items. In this research the instrument is valid because CVIequals32/39=0.82 According to Amin [9]; the instrument will be certified valid when its maximum content index is at least 0.7. The reliability of research refers to its ability to produce consistent measurement each time. In this research, the coefficient Cronbach's alpha (α) was used to determine the reliability of

instrument. $\alpha = \dfrac{k}{k-1}\left[1 - \dfrac{\sum_{j=1}^{k} \text{var}(x_j)}{\text{var}(x_0)}\right]$. Where k is

number of questions and Var(x_j) is variance. The value of k=21, Var(x_0) =15.734 and sum of var(x_j) = 4.36. Using Excel Cronbach's alpha is 0.76. According to Hamdan [10] the instrument will be accepted when Cronbach's alphais great than 0.6. In this research, also the researcher got validity and reliability by consulting with the document as well as with the telecommunication companies' professionals working with data warehouse. The researcher compared the result found in the documents to those what professionals found while working with data warehouse.

Data analysis
After collecting opinions from questionnaires, a quantitative analysis was used to organize and analyse the answers gathered from the respondents using the tables and statistics that show the real situation which was compared and interpreted for further recommendation.

Editing
The purpose of editing is to better understand the survey processes and the survey data in order to ensure that the final survey data are complete, consistent and valid.All this was done to ensure completeness, accuracy, consistence, uniformity, legibility and complexity of the data.

Coding
The research adopted this technique to involve all responses and views from selected respondents in the communication companies. Here, the responses and view of every respondent was entered in a unique way, there after the researcher   matched and compared the views of all respondents to every question. This was so helpful to the researcher to classify the information into a meaningful form so as to drive essential patterns in the responses and deduce data to summary form that is easy to deal with.

Tabulation
Data tabulation is done after editing and coding. Tabulation is either done by hand or by computer. Tabulation by hand is essentially establishing frequency distribution of the codes and then calculating the number and the percentage of these codes. Each table was followed by explanations about the nature of the relationship between variables indicated in the tables. The research has done all this to present clear and understandable data.

After editing, coding, tabulating the researcher analyzed data by utilizing software for data analysis well known as statistical package for social sciences (SPSS). The objectives one and two was analyzed using descriptive statistics where frequencies, percentages and mean are drawn and calculated using excel. To identify the key factors which contributed to data warehousing requires to ordering their frequencies from the highest to lowest frequency. For the objective three the grand mean was calculated so that the researcher find its mean range of contribution based on Likert scale and chi square test .The high contribution of scale one has the mean range (1.00-1.8), normal contribution with scale of two (mean range 1.81-2.6), undecided with scale of three mean range (2.61-3.4), fair contribution of four (mean range 3.41-4.2) and no contribution with scale (mean range 4.21-5).

DATA ANALYSIS, PRESENTATION AND INTERPRETATION
Introduction
This chapter presents and discusses the findings on factors for successful implementation of data warehousing in selected telecommunication companies in Rwanda, based on set of survey objectives. The research findings were analyzed mainly from primary data and the responses were collected from the sample size of 32 respondents form MTN Rwanda and Tigo Rwanda.

Presentation of findings
The social demographic of respondents
In all 39 questionnaires given out to employees of MTN Rwanda and Tigo working in information system (IS) department, finance department and consulting department. A total of 32 questionnaires were returned representing eighty two (82%) percent rate of return. The social demographic of respondents were analyzed based on gender, age group, company, position held in TC, department, highest qualification attained, work experience and training on data warehousing. The social demographic of respondents are represented in the table 4.0.

Table 2: Distribution of respondents by Telecommunication Company

company	frequency	percentage
MTN Rwanda	17	53
Tigo Rwanda	15	47
Total	32	100

Source: primary data computed from survey data

The respondents from MTN Rwanda and Tigo Rwanda represent respectively fifty three (53%) percent and forty seven (47%) percent. It can therefore be noted that respondents from the two telecommunication companies were fairly represented.

Table 3:Distribution of respondents by agein MTN

Age group	Female	Male	Female %	Male %	Total %
20-30	0	2	0	12	12
31-40	4	8	23	47	70
41-50	0	1	0	6	6
51-60	0	2	0	12	12
Total	4	13	23	77	100

Source: primary data computed from survey data

Table above shows respondents' gender in which seventy seven (77%) percent are male while twenty three (23%) percent are female .This implies that the telecommunication company of MTN is dominated by male employees. In terms of age the majority of respondents fell between the ages of 31-40 who are male at the rate of forty seven (47%) percent followed by twenty tree (23%) percent respondents who were female and fell in the same range 31-40 years. At the time of survey, the majority of respondent dominated in range 31-40 years at rate of seventy (70%) percent.

Table 4: Distribution of respondents from Tigo by age

Age group	Female	Male	Female %	Male %	Total %
20-30	2	3	13	13	27
31-40	2	6	13	40	53
41-50	0	3	0	20	20
51-60	0	0	0	0	0
Total	4	11	27	73	100

Source: primary data computed from survey data

Table above shows respondents' gender in which seventy three (73%) percent are male while twenty seven (27%) percent are female .This implies that the telecommunication company of Tigo is also dominated by male employees. In terms of age the majority of respondents fell between the ages of 31-40 at rate of fifty tree (53%) percent. Result of the tables above shows that the majority of employees in the two telecommunication company are male. This gap was to inferiority of women in technical domain. This is because Rwanda has got few educated female than male and it is also evidence in the labor market. In terms of age the majority of respondents fell between the ages of 31-40. This is because they were young people, very courageous and ambitious in technologies.

Table 5:Distribution of respondents by status in MTN

status	Female	Male	Female %	Male %	Total %
Single	0	5	0	29	29
Married	4	8	23	47	71
Widow	0	0	0	0	0
Divorced	0	0	0	0	0
Total	4	13	23	77	100

Source: primary data computed from survey data

The majority of respondents at time of survey in MTN were married at rate of seventy one (71%) percent; followed by single people at rate of twenty nine (29%) percent. This is because MTN has last a long time.

Table 6: Distribution of respondents by status in Tigo

status	Female	Male	Female %	Male %	Total %
Single	3	5	20	33	53
Married	1	6	7	40	47
Widow	0	0	0	0	0
Divorced	0	0	0	0	0
Total	4	11	27	73	100

Source: primary data computed from survey data

The majority of respondents at time of survey in Tigo were single at rate of fifty three (53%) percent; followed by married people at rate of forty seven (47%) percent. This is because Tigo is a new company than MTN.

The result of the table above gives the belief to the researcher because both statuses taken in consideration participate in responding the questionnaires, which should reduce the bias.

Table 7: Position held by respondent at time of study in MTN

position	frequency	percentage
IS / IT Manager	1	6
DW manager	2	12
ICT officer	1	6
Webmaster	1	6
Network administrator	1	6
System administrator	2	12
Database developer	1	6
Senior manager of network	2	12
Director Finance	1	6
Accountant	1	6
Budget officer	1	6
Procurement officer	1	6
Storekeeper	1	6
Consultant	1	6
Total	17	100

Source: Primary data computed from survey data

Table above shows that system administrator, DW manager and senior manager of network constituted the majority of respondent in MTN twelve (12%) percent by each and the rest of respondents at rate of six (6 %) percent.

Table 8: Position held by respondent at time of study in Tigo

position	frequency	percentage
IS / IT Manager	1	7
DW manager	1	7
ICT officer	1	7
Webmaster	1	7
Network administrator	1	7
System administrator	2	13
Database developer	1	7
Senior manager of network	2	13
Director Finance	1	7
Accountant	1	7
Budget officer	1	7
Procurement officer	1	7
Storekeeper	1	7
Consultant	0	0
Total	32	100

Source: primary data computed from survey data

Table above shows that system administrator and senior manager of network constituted the majority of respondent thirteen (13%) percent by each in Tigo and the rest of respondents at rate of seven (7%) percent. There was no respondent from consultant position.

The results from the above tables show that the respondents are well placed in all position needed in this research .The respondents have enough knowledge about the factors for successful implementation to DW and how the companies benefit from it. Their responses are real drawn the best conclusion of this study.

Table 9: Distribution of respondents by department in MTN

Department	frequency	percentage
IS / IT Manager	11	65
finance	5	29
Consultant	1	6
Total	17	100

Source: Primary data computed from survey data

Table above indicates that sixty five (65%) percent of respondents comes from IS department, twenty nine (29%) percent from finance department and six (6 %) percent from consultant department.

Table 10: Distribution of respondents by department in Tigo

Department	frequency	percentage
IS / IT Manager	10	67
finance	5	33
Consultant	0	0
Total	15	100

Source: Primary data computed from survey data

Above table indicates that sixty seven (67%) percent of respondents comes from IS department and thirty three (33%) percent from finance department.

The result of the above tables shows that the information provided by the respondent was relevant for this survey because there are one who were participating in project of DW, using and benefit from DW. For this reason these departments contribute more on success of data warehousing. The measurement of success factors and implementation factors are both in hand of these departments.

Table 12: Distribution of respondents by highest qualification attained in MTN

Qualification	frequency	percentage
Secondary	1	6
Undergraduate	15	88
Postgraduate	1	6
Total	17	100

Source: Primary data computed from survey data

Table above indicates that six (6%) percent of respondents have attained respectively secondary and postgraduate, and eighty eight (88%) percent have attained undergraduate.

Table 13: Distribution of respondents by highest qualification attained in Tigo

Qualification	frequency	percentage
Secondary	2	13
Undergraduate	12	80
Postgraduate	1	7
Total	15	100

Source: Primary data computed from survey data

Above table indicates that thirteen (13%) percent of respondents have attained secondary, eighty (80%) percent have attained undergraduate and seven (7%) percent have attained postgraduate. As far as

education level is concerned, all respondents supplied information on their level of education in which the majorities eighty eight (88%) percent have attained undergraduate level in MTN and eighty (80%) percent in Tigo.

From above tables it shows it is strongly agree that the two telecommunication companies have intellectual capacity based on high education levels demonstrated. Based on that, the information get from the respondent are considered by researcher as accurate and relevant.

Table 14: Distribution of respondents from MTN by work experience

Qualification	frequency	percentage
Less than one year	0	0
Between one to three years	2	2
Between four to six years	3	18
More than six years	12	70
Total	17	100

Source: Primary data computed from survey data

The work experience shows that the majority of respondents seventy (70%) percent had worked in MTN more than six years, eighteen (18%) percent have worked between four to six years and twelve (12%) percent have worked between one to three years. No respondent has worked less than one year.

Table 16: Distribution of respondents from Tigo by work experience

Qualification	frequency	percentage
Less than one year	0	0
Between one to three years	2	13
Between four to six years	13	87
More than six years	0	0
Total	15	100

Source: Primary data computed from survey data

Table above shows that the majority of respondents eighty seven (87%) percent had worked in Tigo between four to six years and thirteen (13%) percent have worked between one to three years. No respondent has worked less than one year or more than six years because Tigo was licensed in 2009. With regard to experience, most of respondents eighty eight (88%) percent have worked more than four years in MTN and eighty seven (87%) percent in Tigo. The experience of four years is the period the researcher considered as long enough to provide information related to objectives of survey. Based on that, the information provided by the respondents is very crucial because it come from experienced people.

Table 17: Distribution of respondents by training on data warehousing in MTN

Training	frequency	percentage
Less than one year	14	82
Between one to three years	0	0
Between four to six years	1	6
More than six years	2	12
Total	17	100

Source: Primary data computed from survey data

Table above shows that the majority of respondents at rate of eighty two (82 %) percent fill in the range of less than one year, six (6%) percent between four to six years and twelve (12 %) percent more than six years.

Table 18: Distribution of respondents by training on data warehousing in Tigo

Training	frequency	percentage
Less than one year	14	93
Between one to three years	1	7
Between four to six years	0	0
More than six years	0	0
Total	15	100

Source: Primary data computed from survey data

Table above shows that the majority of respondents ninety three (93 %) percent fill in the range of less than one year and seven (7%) percent between one to three years. The result from the tables above show that the majorities of respondents fill in the range of less than one. This is because the majority of respondents have information on data warehousing but they do not work on data warehousing. The respondents who have been trained on data warehousing are people are technicians who recruited to manage data warehousing. The information from this group is very important because it is only them who support objective two of researcher.

Factors for successful implementation of data warehousing in selected telecommunication

In identifying the key factors that lead to successful implementation of data warehousing in selected telecommunication companies, MTN and Tigo, the respondents are asked to list out the factors that lead to their telecommunication company to implement successful their data warehousing. Multiple responses were allowed and the researcher attempted to group the responses into sixteen groups in MTN Rwanda and fifteen in Tigo Rwanda.

Table 19:List of factors contribute to data warehousing from MTN

Implementation factors	frequency	percentage
1.The preparation for theproject of D W	16	94
2.Top management support	9	53
3. User participation	10	59
4.Champion or motivation	11	65
5.Development technology	13	76
6. Source of data quality	8	47
7. Adequate staff	12	71
8. Support from outside and expertise	11	65
9. Adequate funding and budget	14	82
10. The business benefit	10	59
11. Project authorization	13	76
12. Practical implementation schedule	16	94
13. Selection of venders	10	59
14. Compatibility with regulation	4	24
15. Training courses	8	47
16. Availability of best practices adaptors	12	71
Total		65

Source: primary data computed from survey data

In investigating the various factors for successful implementation of DW in MTN, from the result of table above the researcher attempted to order these factors from that have highest frequency to lowest frequency. At the top of the factors there was the preparation for the project of data warehouse by a company at rate of ninety four (94%) percent, practical implementation schedule ninety four (94%) percent, followed by adequate funding at rate of eighty two (82%) percent, development technology at rate of seventy six (76%) percent, project authorization at rate of seventy six (76%) percent, adequate IS staff at rate of seventy one (71%) percent, best practices adaptors at rate of seventy one (71%) percent, motivation sixty five (65%) percent, support from outside consultants and expertise sixty five (65%) percent, user participation fifty nine (59%) percent, measurement business benefits fifty nine (59%) percent, selection of vendors fifty nine (59%) percent, top management support fifty three (53%) percent, source of data quality at rate of forty seven (47%) percent, training courses rate of forty seven percent (47%), and compatibility with industry standard twenty four (24%) percent.

Table 20:List of factors contribute to data warehousing from Tigo

Implementation factors	frequency	percentage
1.The preparation for theproject of D W	10	67
2.Top management support	8	53
.3. User participation	12	80
4.Champion or motivation	8	53
5.Development technology	12	80
6. Source of data quality	12	80
7. Adequate staff	11	80
8. Support from outside and expertise	9	73
9. Adequate funding and budget	12	60
10. The business benefit	10	67
11. Project authorization	5	33
12. Practical implementation schedule	8	53
13. Selection of venders	4	27
14. Compatibility with regulation	9	60
15. Training courses	9	60
Total		58

Source: primary data computed from survey data

Table above shows the various factors for successful implementation of DW in Tigo from that have highest frequency to the lowest frequency. At the top of factors there was user participation eighty (80%) percent, development technology eighty (80%) percent, the source of data quality eighty (80%) percent, the adequate funding eighty (80%) percent, followed by adequate IS staff seventy three (73%) percent,the preparation for the project of data warehouse by a company sixty seven (67%) percent, the business benefits sixty seven (67%) percent, the support from outside consultants and expertise sixty (60%) percent, compatibility with industry standard sixty (60%) percent, the training courses sixty (60%) percent, the

top management support fifty three (53%) percent, the champion sixty five (65%) percent, the best practices adaptors fifty three (53%) percent, the project authorization fifty three (53%) percent and the measurement selection of vendors twenty seven (27%) percent.

Techniques used in implementation for data warehousing in selected TC

In investigating various techniques that were used in DW implementation, respondents were asked to tick technique used in implementing DW in their telecommunication company.

Table 21:Frequency of respondents on techniques used to implement DW in MTN

Implementation factors	frequency	percentage
1.The preparation for theproject of D W	10	67
2.Top management support	8	53
.3. User participation	12	80
4.Champion or motivation	8	53
5.Development technology	12	80
6. Source of data quality	12	80
7. Adequate staff	11	80
8. Support from outside and expertise	9	73
9. Adequate funding and budget	12	60
10. The business benefit	10	67
11. Project authorization	5	33
12. Practical implementation schedule	8	53
13. Selection of venders	4	27
14. Compatibility with regulation	9	60
15. Training courses	9	60
Total		58

Source: Primary data computed from survey data

Table above shows that the respondents in MTN confirmed the utilization of bottom up design where they build the department data mart one by one at rate of eighty eight (88%) percent.The others twelve (12%) percent responded top-down design. This is because all respondents did not have equal skills on techniques used in implementing DW; some of them are working in finance.

Table 22: Frequency of respondents on techniques used to implement DW in Tigo

Techniques	frequency	percentage
Bottom-updesign	14	93
Top-down design	1	7
Total	15	100

Source: Primary data computed from survey data

The table above shows that the respondents in MTN confirmed the utilization of bottom up design ninety three (93%) percent.The other seven (7%) percent responded top-down design.

Tables above show that the majority of respondent confirmed the utilization of bottom up design in implementation of DW. This is because bottom up design was the only one known and used in their telecommunication company. Like author Punniah [11], the bottom up design has become the choice of many organizations because their data mart has less complex design and less expensive. This can be emphasised by Chuck *et al*. [12], the bottom –up approach ismore widely accepted today than the top down approach because immediate results from the data marts can be realized and used.

Table 23:Contribution of data warehousing techniques to telecommunication companies

Item	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Total
1. Availability of needed information	10	6	0	1	0	17
2 .Usability of information	6	8	2	1	0	17
3 .Understandability of information	6	5	6	0	0	17
4 .Relevance information	12	3	1	1	0	17
5. Format of information	9	6	1	1	0	17
6. Acquired knowledge	2	14	1	0	0	17
7. Decision effectiveness	9	6	2	0	0	17
8. Individual awareness	7	7	2	1	0	17
9. Individual improved productivity	6	10	1	0	0	17
10. Increase revenue of TC	14	3	0	0	0	17
11. Cost reduction in TC	4	9	4	0	0	17
12. Improved outcomes of TC	12	4	1	0	0	17
13 .Increase capacity of TC	10	6	1	0	0	17
14. Increase staff requirement	3	2	9	3	0	17
15. Overall productivity of TC	12	4	0	1	0	17
16. Business process change in TC	13	3	1	0	0	17
17. E-government within TC	10	5	2	0	0	17

Source: primary data computed from survey data

Table 24: Distribution of respondents by their attitude on level of contribution of DW to Tigo

Item	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Total
1. Availability of needed information	7	7	0	1	0	15
2 .Usability of information	8	2	4	1	0	15
3 .Understandability of information	7	3	3	1	1	15
4 .Relevance information	8	2	4	1	0	15
5. Format of information	7	7	1	0	0	15
6. Acquired knowledge	6	5	0	2	2	15
7. Decision effectiveness	6	6	3	0	0	15
8. Individual awareness	3	10	1	1	0	15
9. Individual improved productivity	3	6	6	0	0	15
10. Increase revenue of TC	11	3	1	0	0	15
11. Cost reduction in TC	5	5	3	1	1	15
12. Improved outcomes of TC	7	8	0	0	0	15
13 .Increase capacity of TC	7	4	3	1	0	15
14. Increase staff requirement	4	7	1	2	1	15
15. Overall productivity of TC	7	2	3	1	2	15
16. Business process change in TC	8	7	0	0	0	15
17. E-government within TC	4	5	5	1	0	15

Source: primary data computed from survey data

The extent to which DW employed to telecommunication companies can be assessed by considering the contribution of DW to telecommunication companies. The researcher assessed the functions for which DW is intended to do and for this reason, the researcher grouped the contribution into three categories, the contribution to information quality, to individual capacity and to TC at organizational level.

Table 25:Level of contribution of data warehousing to information quality in MTN

Level of contribution	High	Normal contribution	Undecided	Fair	No	Total information
Availability of needed information	59	35	0	6	0	100
Usability of information	35	47	12	6	0	100
Understandability of information	35	29	35	0	0	100
Relevance information	71	18	6	6	0	100
Format information	53	35	6	6	0	100
General average	51	33	12	5	0	100

Source: Primary data computed from survey data

Table 26: Level of contribution of data warehousing to information quality in Tigo

Level of contribution quality	High	Normal contribution	Undecided	Fair	No	Total information
Availability of needed information	47	47	0	7	0	100
Usability of information	53	13	27	7	0	100
Understandability of information	47	20	20	7	7	100
Relevance information	53	13	27	7	0	100
Format information	47	47	7	0	0	100
General average	49	28	16	5	1	100

Source: Primary data computed from survey data

In analysing the result of the tables above the majorities of respondents ninety four (94%) percent in MTN and respondents ninety four (94%) percent in Tigo agreed that DW has highly and normal contributed to availability of information while others six (6%) percent in MTN and seven (7%) percent in Tigo responded fair contribution. Therefore; it is accepted fact that DW contains a big volume of information such as customer records, services, product, etc.

On the context of usability of information, the respondents eighty two (82%) percent in MTN and sixty six (66%) percent of respondents in Tigo confirmed high and normal contribution of DW to the use of information while undecided, fair and no totalized eighteen (18%) percent in MTN and thirty four (34%) percent in Tigo. This is because the DW facilitates the quick transaction between users .The stored information must be used in comparative and competitive analysis. According to Shin [13] to be knowledge-based, a firm must be ready to detect, collect, process, and use available information effectively.

Sixty four (64%) percent of respondents in MTN Rwanda and sixty seven (67%) percent in Tigo agreed high and normal contribution of DW to telecommunication companies on storing understandable information while respectively thirty five (35%) percent of respondents in MTN and thirty four (34%) percent in Tigo were undecided. This is because DW enhances the quality of data. Understandable information is one characteristic of a good quality of data. A bout the relevance of information, eighty nine (89%) percent of respondents

in MTN and sixty six (66%) percent of respondents in Tigo confirmed the high and normal contribution of DW to store relevant information while undecided, fair and no contribution totalized twelve (12%) percent in MTN and thirty four (34%) percent in Tigo. A good way of ensuring relevance is to closely define the objectives of any information reports.

On the format of information, eighty eight (88%) percent of respondents in MTN and ninety four (94%) percent of respondents in Tigo confirmed the high and normal contribution of DW to format of information while undecided, fair and no contribution totalized twelve (12%) percent in MTN and seven (7%) percent in Tigo.This is because the data which come from diverse sources are converted into common format. The format is one of characteristics of good information.

The results represent the general average of eighty four (84%) of respondents in MTN and seventy seven (77%) percent of respondents in Tigo who agreed the high and normal contribution of data warehousing to enhance data quality in telecommunication companies. This is because data warehousing allows the business users to access and use data more efficiently. A data warehouse is built to provide an easy to access source of high quality data [12]. According to Inmon [14] the variables "more information" and "better quality information" are the benefits reflected in the output of a system-information. The data warehouse is expected to enable production of information of higher quality as well as new information that may be put to innovative use. Addition to that data warehousing solved issues raised with operation system before its implementation.

Table 27: Level of contribution of data warehousing to individual capacity in MTN

Level of contribution	High	Normal	Undecided	Fair	No	Total individual contribution
Acquired knowledge	12	82	6	0	0	100
Decision effectiveness	47	35	12	0	6	100
Individual awareness	41	41	12	6	0	100
Individual improved productivity	35	59	6	0	0	100
General average	34	54	9	1	1	100

Source: Primary data computed from survey data

Table 28: Level of contribution of data warehousing to individual capacity in Tigo

Level of contribution	High	Normal	Undecided	Fair	No	Total individual contribution
Acquired knowledge	40	33	0	13	13	100
Decision effectiveness	40		20	0	0	100
Individual awareness	20	67	7	7	0	100
Individual improved productivity	20	40	40	0	0	100
General average	30	45	17	5	3	100

Source: Primary data computed from survey data

In analyzing the tables above the most respondents ninety three (94%) percent in MTN and seventy seven (73 %) percent of respondents in Tigo agreed that DW is contributing highly and normally to individual knowledge. Six percent (6%) percent were not sure in MTN and twenty seven (27%) percent in Tigo said that there is fair and no contribution. This is because the concerned employees get the training on use and maintaining this new technology of DW in selected telecommunication companies. In addition the DW helps users to respondent market opportunities quickly. All represent the knowledge which individual can benefit from DW. This is in line with Haley, B. & Watson, H[15], who confirmed that the data warehouse has surfaced as a key source of information for knowledge workers and managers.

About the decision effectiveness, eighty two (82%) percent of respondents in MTN and eighty (80%) percent of respondents in Tigo agreed the high and normal contribution of DW to individual decision. Eighteen (18%) percent of respondents in MTN said no contribution and not sure. Twenty (20%) percent of respondent in Tigo were not sure. This high percentage due to the role of DW in TC where it supports further data analysis in order to find the underlying trends, relationship and etc. This helps to improve the existing management and enable the management to make better decision [14].

In the context of individual awareness, eigty two (82 %) percent of respondents in MTN and eighty seven (87%) percent of respondents in Tigo confirmed the high and normal contribution of DW to individual awareness. Eighteen (18 %) percent of respondents in MTN and fourteen (14%) percent in Tigo combine undecided and fair contribution. This is because employees themselves arewell-informed about what is going on in the world or about the latest developments in a sphere of activity in TC.

Ninety four (94%) percent of respondents in MTN and sixty (60%) percent of respondents in Tigo confirmed the high and normal contribution of DW to individual productivity. Six (6%) percent in MTN and forty (40%) percent in Tigo were undecided. This is because data warehousing reduces the stress on management of information, which facilitate employees of telecommunication companies to improve the productivity in their own department.

Tables above represent the general average of eighty eight (88%) percent of respondents in MTN and seventy five (75%) percent of respondents in Tigo who agreed the high and normal contribution of DW to individual. This is because the variables "improved productivity" and "better decision" are benefits resulted from the use of information by individual decision makers who accessing data warehousing [1]. Business organizations are facing stiff competition and increased uncertainties. To respond to such a turbulent business environment, an organization should be knowledge based and an effective learning unit [13]. Data warehousing has solved issue of delays raised with data warehousing.

Table 29:Level of contribution of data warehousing to MTN Company itself

Level of contribution	High	Normal	Undecided	Fair	No	TC
Increase revenue of TC	82	18	0	0	0	100
Cost reduction in TC	24	53	24	0	0	100
Improved outcomes of TC	71	24	6	0	0	100
Increase capacity of TC	59	35	6	0	0	100
Increase staff requirement	18	12	53	18	0	100
Overall productivity of TC	71	24	0	6	0	100
Business process change in TC	76	18	6	0	0	100
E-government within TC	59	29	12	0	0	100
General average	57	26	13	3	0	100

Source: Primary data computed from survey data

Table 30:Level of contribution of data warehousing to Tigo itself

Level of contribution	High	Normal	Undecided	Fair	No	TC
Increase revenue of TC	73	20	7	0	0	100
Cost reduction in TC	33	33	20	7	7	100
Improved outcomes of TC	47	53	0	0	0	100
Increase capacity of TC	47	27	20	7	0	100
Increase staff requirement	27	47	7	13	7	100
Overall productivity of TC	47	13	20	0	13	100
Business process change in TC	53	47	0	0	0	100
E-government within TC	27	33	33	7	0	100
General average	44	34	13	5	3	100

Source: Primary data computed from survey data

In analyzing the tables above the most respondents in MTN hundred (100%) percent and ninety three (93%) percent in Tigo confirmed the high and normal contribution of DW to TC by increasing revenue. Seven (7%) percent of respondents in Tigo were undecided. This is because the DW generates a ROI. The one reason of integrating DW in telecommunication companies is to gain competitive advantages, which lead the company to gain more than others.

In context of cost reduction, seventy seven (77%) percent of respondents in MTN and sixty six percent (66%) of respondents in Tigo agreed the high and normal contribution. Twenty four   percent of respondents in MTN were not sure while thirty four (34%) percent of respondents in Tigo said fair contribution and no contribution. This is because DW overcomes issue of high cost of legacy system in TC, the data warehouse can provide savings in billing processes, reduce fraud losses, and reduce the cost of reporting. The data warehouses can provide analysts with pre-calculated reports and graphs. This increases the productivity of business analysts.

About the level of contribution of DW to improve outcome of telecommunication companies,

ninety five (95%) percent of respondents in MTN and hundred (100%) percent of respondents in Tigo confirmed the high and normal contribution while six (6%) percent of respondents in MTN were undecided. The table 4.25 and table 4.26 show that ninety four (94%) percent of respondents in MTN and seventy four (74%) percent in Tigo confirmed the high and normal contribution of data warehousing to telecommunication capacity. Six (6%) percent were not sure in MTN while twenty seven (27%) percent of respondents in Tigo were undecided and said no contribution. Thirty (30%) percent of respondents in MTN and seventy four (74%) percent in Tigo confirmed the high and normal contribution of data warehousing to telecommunication companies staff requirements while undecided and fair contribution totalized seventy one (71%) percent in MTN and undecided, fair and no contribution totalized twenty seven (27%) percent in Tigo. Ninety five (95%) percent of respondents in MTN and sixty (60%) percent of respondents in Tigo confirmed the high and normal contribution of data warehousing to company productivity. Forty (40%) percent in Tigo combined who were not sure and those said fair and no contribution. Ninety four (94%) percent of respondents in MTN and hundred (100%) percent in Tigo confirmed the high and normal contribution of data warehousing to company business change. Six (6%) percent were not

sure in MTN. Eighty eight (88%) of respondents in MTN and sixty (60%) percent in Tigo supported the high and normal contribution of data warehousing to company companies by enhancing e-government within TC. Twelve (12%) percent were not sure in MTN and forty (40%) percent in Tigo said fair contribution and undecided. The results of economic terms in tables 4.25 and 4.26 refer to a complex chain of events that reinforces itself through a feedback loop and can be easily explained by a vicious circle of high productivity.The table 4.25 and table 4.26 show the general average of eighty three (83%) percent of respondents in MTN and seventy eight (78%) percent in Tigo who confirmed the high and normal contribution of data warehousing to Telecommunication Company at organizational level. This is because the variables "improved business processes" and "increased

competitive position" are benefits accrued at the organizational level. This findings is in line with Hwang and Xu [1] which showed that a well run data warehouse is purported to offer the greatest payoff at the organizational level by lowering costs, increasing revenues, improving business processes, and supporting initiatives such as customer relationship management and knowledge management. According to Moore and the organizations use the data warehouse for a variety of tasks such as planning, target marketing, decision making, data analysis, and customer services, and practitioners agree that it is changing the way business is done. The data warehouse can improve business performance in various ways, including better-targeted products, improved customer relationship management, and greater operational efficiency. It can also result in reengineering of business processes [13].

Table 31: Description statistics showing the grand mean on the extent to which the DW   techniques contributes to MTN

Items	Mean	Std	Interpretation
Availability of needed information	1.53	0.78	Very high
Usability of information	1.88	0.83	high
Understandability of information	2	0.84	high
Relevance information	1.47	0.85	Very high
Format of information	1.65	0.84	Very high
Acquired knowledge	1.94	0.42	high
Decision effectiveness	1.82	1.04	Very high
Individual awareness	1.82	0.86	high
Individual improved productivity	1.71	0.57	Very high
Increase revenueof TC	1.18	0.38	Very high
Cost reduction in TC	2	0.69	high
Improved outcomes of TC	1.35	0.59	Very high
Increase capacity of TC	1.47	0.61	Very high
Increase staff requirement	2.71	0.96	high
Overall productivity of TC	1.41	0.77	Very high
Business process change in TC	1.29	0.57	Very high
E-government within TC	1.53	0.70	Very high
Grand Mean	1.69		Very high

Source: Primary data computed from survey data

From the result presented in table above showed the extent to which data warehousing has contributed to MTN which is very high at grand mean of 1.69. This is because average of mean (grand mean) calculated filled between range of 1.00-1.80 and was considered very high, with the reference of Likert scale presented in chapter three.

Table 32:Description statistics showing the grand mean on the extent to which the DW   techniques contributes to Tigo

Items	Mean	Std	Interpretation
Availability of needed information	1.67	0.79	Very high
Usability of information	1.87	1.02	high
Understandability of information	2.07	1.24	high
Relevance information	1.87	1.02	high
Format of information	1.60	0.61	Very high
Acquired knowledge	2.27	0.44	high
Decision effectiveness	1.80	0.75	Very high
Individual awareness	2.00	0.73	high
Individual improved productivity	2.20	0.75	Very high
Increase revenueof TC	1.33	0.60	Very high
Cost reduction in TC	2.20	1.17	high
Improved outcomes of TC	1.53	0.50	Very high
Increase capacity of TC	1.87	0.96	high
Increase staff requirement	2.27	1.18	high
Overall productivity of TC	2.27	1.44	high
Business process change in TC	1.47	0.50	Very high
E-government within TC	2.20	0.91	high
Grand Mean	1.91		high

Source: Primary data computed from survey data

The result presented in table above showed the extent to which data warehousing has contributed to tigo which is high at grand mean of 1.91. This is because average of mean (grand mean) calculated filled between range of 1.80-2.60 and was considered high, with the reference of Likert scale presented in chapter three.

Table 33:Chi –square Test of data warehousing to functioning of MTN

Items	χ^2	DF	p-value
Availability of needed information	20	2	0.000
Usability of information	12	3	0.008
Understandability of information	11	2	0.004
Relevance information	24	3	0.000
Format of information	15	3	0.002
Acquired knowledge	30	2	0.000
Decision effectiveness	12	3	0.007
Individual awareness	11	3	0.012
Individual improved productivity	18	2	0.000
Increase revenue of TC	33	1	0.000
Cost reduction in TC	14	2	0.001
Improved outcomes / outputs of TC	23	2	0.000
Increase capacity of TC	18	2	0.000
Increase staff requirement	12	3	0.007
Overall productivity of TC	23	2	0.000
Business process change in TC	26	2	0.000
E-government within TC	17	2	0.000

Source: Primary data computed from survey data

Table 34: Chi –square Test of data warehousing to functioning of Tigo

Items	χ^2	DF	p-value
Availability of needed information	15	2	0.001
Usability of information	11	3	0.012
Understandability of information	8	4	0.410
Relevance information	11	3	0.012
Format of information	15	2	0.001
Acquired knowledge	7	3	0.072
Decision effectiveness	11	2	0.004
Individual awareness	18	3	0.000
Individual improved productivity	11	2	0.004
Increase revenue of TC	21	2	0.000
Cost reduction in TC	5	4	0.290
Improved outcomes / outputs of TC	23	1	0.000
Increase capacity of TC	9	3	0.029
Increase staff requirement	9	3	0.029
Overall productivity of TC	7	4	0.136
Business process change in TC	23	1	0.000
E-government within TC	7	3	0.072

Source: Primary data computed from survey data

The results of tables above is that it is not strong enough to say that telecommunication companies have benefit from data warehousing .The researcher used chi-square test to respond if data warehousing has a significant contribution to selected telecommunication companies or not. In the tables above the researcher attempted to compute the chi-square values and p-value. According to Kothari (1990) the **chi** square is a non-parametric test, it "can be used to determine if categorical data shows dependency or the two classifications are independent. This test is used when the researchers are testing the goodness of fit. If the calculated p-value is less than five (5%) percent, the researcher accepts the significance contribution. According to result from the tables above, the most p-value computed (significance column) is less than 0.05, it means the significance contribution .Otherwise (p-value greater than 0.05) the researcher rejected the significance contribution. Thus the majority accepted the high contribution which emphasizes the powerfulness of data warehousing than operation system. Data warehousing is best than operation system and overcome issues raised with operation system.

Identification of challenges faced by users of data warehousing when performing the functions

In identifying the challenges faced by the users of data warehousing when performing the functions, the respondents in MTN and Tigo were asked to give all the challenge they faced, multiple responses were allowed and exceed the number of questionnaires returned. The researcher grouped the challenge into different categories such as the maintenance of data warehousing at rate of thirty five (35%) percent in MTN and twenty nine (29%) percent in Tigo, training at rate of twenty nine (29%) percent in MTN and thirty six (36%) percent in Tigo, security policies issue eighteen (18%) percent in MTN and seven (7%) percent in Tigo, the size of data warehousing twenty four (24%) percent in MTN and twenty one (21%) percent in Tigo, deleting a useless data to gain storage cost at rate of one (1%)MTN and twelve (12%) in Tigo, capacity planning twelve (12%) in MTN and twenty eight (28%) percent in Tigo, loading performance thirty five (35%) percent and twenty one (21%) in Tigo, no developed help desk four (4%) percent in Tigo, the management process of DW three (3%) percent in MTN and four (4%) percent in Tigo, network management three (3%) percent in MTN.

In identifying the suggestion to overcome the challenges faced by the users of DW when performing the function, multiple responses also allowed. Out of 17 questionnaires received from MTN and 15 questionnaires received from Tigo, the training on data warehousing was the first suggestion with sixty one (61%) percent in MTN and sixty three (63%) percent in Tigo, followed by the participation in project implementation at rate of twenty (20%) percent in MTN and increase a number of data warehouse manager three (3%) percent in MTN and two (2%) percent in Tigo.

Summary of data analysis

This research used survey, descriptive and explanation method and data collected through questionnaires was analyzed statistically used descriptive and chi square inferential statistics via SPSS. A sample of 39 questionnaires employees of MTN Rwanda and Tigo working in IS department, finance department and consulting department involved in study with 32 questionnaires returned representing eighty two (82%) percent rate of return. The data was analyzed based on given objectives. The social demographic of respondents who informed on data warehousing and identification of challenges faced by users of data warehousing when performing the function and suggestion to overcome them were analyzed in this chapter. The research questions were answered. The list of factors contribute to DW success was established to answer the research question one. The respondents confirmed the utilization of bottom up design as technique of data warehousing implementation in selected telecommunication companies and confirmed the high contribution of data warehousing to MTN and to Tigo in supporting a quality of information, improving individual capacity and the ROI of TC. With data warehousing the issues raised with operation system were overcome at high level.

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS
Summary of findings

The research was to find factors for successful implementation of data warehousing in telecommunication companies in Rwanda, a survey of MTN and Tigo Rwanda. The most organizations of Rwanda still managing data in systems which are separated from each other simply "information islands". The product data were scattered in these systems, and were not accessible by product analysts from different departments because of lack of data warehousing. This research used survey, descriptive and explanation method and data collected through questionnaires was analyzed statistically used descriptive and chi square inferential statistics via excel and SPSS. A sample of 39 questionnaires employees of MTN Rwanda and Tigo working in IS department, finance department and consulting department involved in study with 32 questionnaires returned representing eighty two (82%) percent rate of return. The social responses were analyzed based on gender, age group, position held in Telecommunication Company, department, highest qualification attained, work experience and training on data warehousing. The respondents supplied information and distributions showed that seventy seven percent in MTN and seventy three (73%) percent in

Tigo were male. In terms of age, the majority of respondents fell between the ages of 31-40 was male. The majority of respondents at time of survey were married in MTN at rate of seventy one (71%) percent and single in tigo fifty three (53%) percent. In department, the majority of respondents sixty five (65%) percent in MTN and sixty seven (67%) percent of respondents came from IS department. Eighty eight (88%) percent of respondents in MTN and eighty seven (87%) percent in Tigo have attained undergraduate level. With regard to experience, most of respondents eighty eight (88%) percent in MTN and eighty seven (87%) percent in Tigo have worked more than four years.

Objective one: Factors for successful implementation of data warehousing in MTN and Tigo Rwanda

Objective one was to identify the key factors for successful implementation of data warehousing in MTN and Tigo, the result showed successively the list of sixteen and fifteen factors ordered from which has the highest frequency to the lowest frequency. List one for MTN, at the top of the factors there was the preparation for the project of data warehouse by a company at rate of ninety four (94%) percent, practical implementation schedule ninety four (94%) percent, followed by adequate funding eighty two (82%) percent,development technology at rate of seventy six (76%) percent, project authorization seventy six (76%) percent, adequate IS staff seventy one (71%) percent, best practices adaptors seventy one (71%) percent, motivation sixty five (65%) percent, support from outside consultants and expertise sixty five(65%) percent, user participation fifty nine (59%) percent, measurement business benefits fifty nine (59%) percent, selection of vendors fifty nine (59%) percent, top management support fifty three (53%) percent,source of data quality forty seven (47%) percent,training courses forty seven (47%), and compatibility with industry standard twenty four (24%) percent. List two from respondents of Tigo, At the top of factors there was user participation eighty (80%) percent, development technology eighty (80%) percent, the source of data quality at rate of eighty (80%) percent, the adequate funding at rate of eighty (80%) percent, followed by adequate IS staff seventy three (73%) percent,the preparation for the project of data warehouse by a company sixty seven (67%) percent, the business benefits sixty seven (67%) percent, the support from outside consultants and expertise sixty (60%) percent, compatibility with industry standard sixty (60%) percent, the training courses sixty (60%) percent, the top management support fifty three (53%) percent, the champion sixty five (65%) percent, the best practices adaptors fifty three (53%) percent, the project

authorization fifty three (53%) percent and the measurement selection of vendors twenty seven (27%) percent. The result showed also that there are complementarities between these factors.

Objective two: Techniques used for data warehousing implementation in telecommunication companies, MTN and Tigo

Objective two was to find out the techniques used for data warehousing in implementation in selected telecommunication companies. The result showed among the two techniques given, that the respondents in MTN eighty eight (88%) percent and ninety three (93%) percent in Tigo confirmed the utilization of bottom up design where they build the department data mart one by one.

Objective three: Extent to which are data warehousing contributing to MTN and to Tigo

The objective three was to assess the extent to which are data warehousing contributing in selected telecommunication companies. The technology of data warehousing improves the quality of information, individual capacity and generates high revenue of TC. The result showed that the general average of eighty four (84%) percent of respondents in MTN and seventy seven percent of respondents in Tigo agreed the high and normal contribution of data warehousing to enhance information quality in Telecommunication Company. The general average of eighty eight (88%) percent of respondents in MTN and seventy five (75%) percent of respondents in Tigo accepted the high and normal contribution of DW to individual capacity. The general average of eighty three (83%) percent of respondents in MTN and seventy eight (78%) percent of respondents in Tigo confirmed the high and normal contribution of data warehousing to Telecommunication Company at organizational level by increasing return on investment. Thus the result showed that the extent to which data warehousing contributing to MTN was very high with grand mean of 1.69 and high in tigo with grand mean of 1.91. This is because average of mean (grand mean) calculated filled between mean range of 1.00-1.80 and 1.81-2.60, respectively. The mean ranges 1.00-1.80 and 1.81-2.60 are the very high contribution of scale one and high contribution of scale two. The result showed that with data warehousing, the problem raised with operation system were overcame.

CONCLUSION AND ANSWER THE RESEARCH QUESTIONS

The conclusion is based on responses of research questions.

The question one: What are the key factors for successful implementation of data warehousing in selected company? In this survey, the results showed and ordered the sixteen factors in MTN, and fifteen factors in Tigo, for successful implementation of data warehousing.

The question two: what are the techniques used in data warehousing implementation in selected telecommunication companies? The result showed the utilization of bottom up design as technique used in DW implementation. This response agree with the author Punniah [11] who confirmed that the bottom up design has become the choice of many organizations because their data mart has less complex design and less expensive.

The question three: To what extent are data warehousing contributing to MTN and to Tigo, respectively? The result showed that the extent to which data warehousing MTN is very high and high contribution to Tigo. This result also has been strengthen by the chi square result which showed the significance contribution to selected telecommunication companies, where p-value calculated was less than one tabulated in regard to majorities of variables .This result also agree with Calvanese *et al*. [16] who confirmed the high contribution of data warehousing to Telecom Italian .

RECOMMENDATIONS

The recommendations derived from the findings and addressed to MTN and Tigo Rwanda, and government institutions.

MTN Rwanda and Tigo Rwanda

The selected telecommunication companies should continue to use data warehousing in its operations because it has contributed more in its functions and it has found to be effective. The success of data warehousing is a process which also requires the performance improvement through management or maintenance.

Government institution

The most institutions of government of Rwanda should think how they will integrate data warehousing in their functions because they are managing a big volume of data which are stored in scattered systems. The researcher addressed to these institutions to take care the role historical data in making decisions.

Suggestion for further study

Data warehousing is   very important not only in Rwanda but also over the world especially in this century because it allows the private and government institution to make effective decision and gain

competitive advantages .It is hereby advised that similar survey should be conducted like" Management of data warehousing after its deployment"

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