BUSINESS INTELLIGENCE MODEL FOR A STUDENT DATA WAREHOUSE IN UUM ENVIRONMENT

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BUSINESS INTELLIGENCE MODEL FOR A STUDENT DATA WAREHOUSE IN UUM ENVIRONMENT

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ABSTRACT

Organization was and still in a need for the data warehouse techniques to keep itself in the lead, the best in using these techniques and come up with the desired results are the applications that are using the OLAP techniques and the BI methods, in this study there was a need for a data warehouse, BI model and the OLAP techniques to analyze the data so I had addressed these three factors as my problem and solve it by building the BI model, building a system and use the OLAP techniques in the system to the decision makers in the UUM university make better decisions for the benefit of the university and its students.

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By the Name of Allah, the Most Gracious and the Most Merciful

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LIST OF ABBREVIATIONS

UUM	Universiti Utara Malaysia
SDW	Student Data Warehouse
BI	Business Intelligence
IT	Information Technology
ETL	Extract Transform Load
DSS	Decision Support System
VC	Vice chancellor
My SQL	Multithreaded, Multi-User SQL Database Management System
OLAP	Online Analytical Process
UML	Unified Modeling Language
HP	Hewlett Packed
DDM	Dimensional Data Model
SPSS	Statistical Package for Social Sciences
JSP	Java Server Pages

CHAPTER ONE

INTRODUCTION

1.1 Data warehouse

The data warehouse is a collection of data architected and formed into one environment and can serve the user through multiple tools, these tools analyze and predicate the data to come up with the results which will give the organizations better and cheaper solutions. There are six characteristics that should be in the data warehouse and these are:

1.1.1 Subject-Oriented

The information presented is about a specific subject or specific kind of interest means that the data is processed and the result will be the desired information, for example the end user can make a request after that the data will be processed, structured and then presented to the user about the required subject.

1.1.2 Integrated

The data warehouse is all about one kind of information in other words when the extraction is complete there is another step come after that and this step is the

integration of different kinds of data into one single formation and it can contain all the data about different things like students, classrooms, lecturers and the ages.

1.1.3 Non-Volatile

The information inside the data warehouse is not changeable at every time the data warehouse is accessed.

1.1.4 Time-Variant

The data is about the history of the subject as well as the current subject data. The historical data is considered as an important part of the whole system of data warehouse.

1.1.5 Accessible

The objective from the data ware house is the data in it can be accessible from the end user to do the analysis or retrieve it.

1.1.6 Process-Oriented

The process and maintenance of the data warehouse is viewed to the user because they go naturally for the data warehouse.

The data warehouse is requesting architecture during its building, this architecture must be detailed in its components but when we look the whole architecture appears as a number of blocks and simple information but when we invade the frames and go deep in the architecture the details appears to complete the big picture in our head.

The data warehouse by its own is not a big deal unless there are tools that are supposed to get the information out of it by analyzing the data and predicate solutions to

the specified matters that can be important to the end user (S. Fon, 2008), The user demands allows the system analysis to drill in the data in many ways as possible to find the results.

The final step of analysis and prediction is to find out whether the data collected is accurate and reliable; the main focus is when the data is generated and the questions that come to our minds is that the data is confidence or not to be used as a decision to the problem, when can say that when the data warehouse was invented it was a jump to the invention of the tools that can help the organization make their decisions, give the appropriate suggestions, analyze their data and store the history data.

1.2 Business Intelligence

It can be defined as a process organized and dedicated to the organization that require it, the right BI process is the process that gives an organization the decisions in a formation that it can be use to develop its work. (Hart M., Esat F., Rocha M. and Khatieb Z., 2007)

From the early 1990s most of the IT projects was focusing on the application that are connected with the organizations' performance and activities, like the trading between the partners via the internet these projects was focusing on the reducing the cost of the organization performance with their partners and enhance the current activities, some of the applications was focusing on getting its performance to the higher level to provide the full service to the customers, for example the program "cosmos" that is used by the international company FedEx which was designed to track down the goods along the path of it delivery to make sure that it is safe and to guarantee its delivery to the destination, this program is using the internet to provide the full report to the customer service.

The organization managers started to use the data warehouse in the same period of time to get best decisions for their companies, in this period of time the ETL (Extract, Transform and load) which is a technique used to convert the databases tables in to the data warehouse, so as the hardware problems and the information delivery and these problems were following the technical side of the data warehouse and can be seen followed by these points:

- Relevant products
- The big and huge amount of knowledge generated from the data warehouse.
- Developed data warehouse architectures were defined and introduced to be implemented in different kind of organizations.

1.3 Problem statements

In these days there are a lot of matters that we have to take in our considerations, the first is connection between the university and students that is not very effective and can be resulted from the high responsibility that the university have toward its' students in a really bad shape, this problem can be divided into two sides the first side is the manager side (Vice chancellor) as we can call it and the second is the customer side (student side), as for this study we are taking the manager side to be our problem.

The university management is not aware of the problems that the students face in their first entrance to the university and the old students problems, to avoid these series of problems the data warehouse of the university should support the analysis of the data and provide possible solution to the problems ahead of the students to give the management the ability to explore a group of possible solutions and the ways to do those solutions.

There are a lot of studies done to evaluate the students' performance, the activities of the students and how to build a data warehouse for students (D. Liezl, 2008); (B. Mirta, M. Mirjana, M. Igor, 2003) but none of these studies mentioned anything about the connection between the vice cancellers and students during their studies and the side effect problems that take away the student concentration on their study.

1.4 Research questions

The research questions for this study are:

1.4.1 What are the requirements to build a business intelligence model for the problem?

1.4.2 How can we build the proposed model?

1.4.3 What are the effects of the model?

1.4.4 How can we apply the proposed model?

1.4.5 Is it a good solution?

1.5 Research objectives

There are three main objectives of this research:

1.5.1 Determine the requirements needed to build the BI model.

1.5.2 To build the proposed BI model for the UUM data warehouse.

1.5.3 Build a system for the proposed BI model.

1.5.4 Evaluate the system.

1.6 Scope and limitation:

The scope of this study was focusing on the UUM environment; the model is for the Business Intelligence that is connected with the UUM data warehouse and it is from the manager side of view.

The implementation of this study is done by using a data warehouse system programmed and implemented using My SQL language for the database sets and the analysis of the data warehouse and by using the techniques of OLAP to derive the expected results.

1.7 Summary

This chapter is to define the introduction for this project, the project is taking the UUM as the place to be implemented, it is about gathering the requirements needed to design a BI model for the UUM, building a system prototype and evaluate the system.

CHAPTER TWO

LITERATURE REVIEW

2.1. Business Intelligence value

There is a common term can be seen in the business intelligence frequently this term is called business value in the economic science and that term means measuring the outcome of the product to the company that has released it minus the cost of the product after the tax is concluded, it is similar to the IT concept where the business value is measured to the company after measuring the cost of the products and its IT facilities used in it.

The organizations' investments using the BI can get business profits to the company but it can destroy the business value if it is not measured in the right way an example of that when an organization invest an amount of money in the BI tools the outcome of the products after subtracting the tax will cost the same amount of BI tools and the organization will come out with nothing but losing money and time, when we reach this point we must explain that many organizations use BI to enhance the relation between the customers and the organization these uses to the BI can remove the doubt in the customers' minds against the organization and in return it can make the customers want to be linked more strongly to the organization or even talk in proud when they say anything about the organization, in that way the organization will have a huge cash flow

in its return because the good customer is the best way of announcement to the organization and these customers can attract more and more customers to the organization.

The business value can be enhanced depending on the BI used by the organization, which will take concentration to the next points:

- Enhance the management of the organization like enhance the control and monitor plans or even changing the way of management.
- Enhance the way of organization order flow like speeding the paper work and shrink the long link between the management and the small staff.

These two points can lead to better business outcome and lower cost for the organization; there is also another plan the organization can take it which is the way of treating different kinds of customers (Williams S. and Williams N., 2003). Like organizing some sort of plans to give promotions to the loyal and good customers.

There are a lot of examples mentioned about the relation between the customer and the organization management and there is a question comes to the mind what is the difference between the organization and the university, to answer this question first there are simple things to explain first is the V.C. can be an organization manager because the V.C. is responsible for a big organization which is the university and the customers can be the students studying in this university, and because there are a lot of things related to the way the university treat its students and the problems facing the students inside the university and outside of it may be, the V.C. has to take all the problems in mind to solve it and make the student satisfied of the way that the university is treating him/her, the second point is that the university is just like the organization when it is dealing with the

customers it has to give them the products which is in this case the good and the right raise and the most important thing which is the knowledge for the students to be a working power to build the world.

There is also a relation that is clearer by now between the data warehouse and the Business Intelligence, the tools can be applied also to the data warehouse to get the best decisions for the enterprises, and this relation can be addressed in the following graph.

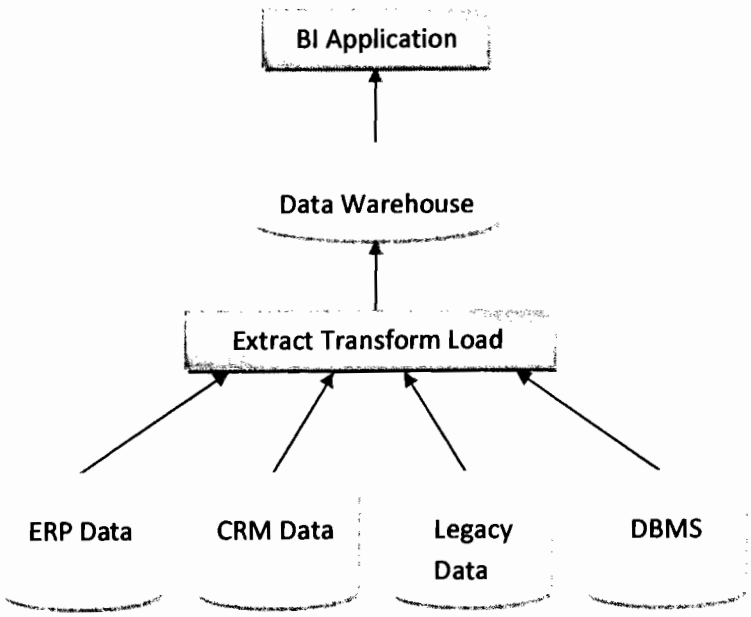


Figure2. 1: The relation between BI and Data warehouse (ERSI, 2006)

2.2. Success factors

In order for the model to present good results it is also important to consider two points in its contents these points will affect the success of the model and the system after that and these points are:

2.2.1. Implementation factors

The benefits of data warehouse has been discussed in a lot of literatures, (Hwang M. and Xu H., 2007) mentioned in their study eight implementation factors that can be applied on the data warehouse to get the maximum benefits of its' data, first we are taking these two factors and they are the easy to use the system and the information retrieval speed to know the degree of the system quality. These two factors are focusing on the decision support side of view; one of the most desirable thing in the data warehouse is the easy of using the system and the efficient of data introduced to the decision makers, the data warehouse is considered successful in its' work when it has these two features, beside that more features can be applied to the systems to attract the users like standardization, security and scalability. And from another side of view the data warehouse that does not have a nice user interface or does not support the data analysis in an efficient way can be a waste of time and money to the users and considered as a bad investment.

In the first and second factors there was a focus on data retrieval and how we deal with it through the interface the third and fourth factors are focusing on how to get more information and in the best quality possible these two can affect the system output because the data warehouse is expected to give the better quality of information beside the prediction of a new information, means that the expected result will be qualitative and quantitative information.

The fifth and the sixth factors is about the better developed productivity by the employee and a better decision making by the decision makers which will help and as long as the data warehouse results gets into the right hands to get the full and best treatment the more decisions making goes smoothly and enhanced.

The next two factors are the final two and they are focusing on more competitive organization level and more enhanced business process the result can be seen from the organizations performance and that means when the better decisions reaches to the organization, the organization will get the best customers in a best and low price, the relation between the customers and the organization will reach higher level of trust and support.

The role here wasn't about how strong the data warehouse or its' tool like online analytical process(OLAP) and data mining to get the results but on how we can apply the right implementation on the data warehouse to get the required results, in their study (Hwang M. and Xu H., 2007) mentioned the implementation factors and how it will derive the best results, the first half of the factors was depending on the data and how good it is to get the good results, while the other part of the factors was about the schedule and the planning to get the right information.

2.2.2. Data synchronization

The data warehouse should be synchronized in its' design also to get the implementation on the maximum rate of benefit scale, when the data is loading into the data warehouse there is a time interval between these loads and the data updates, because there is a statistic time period for the data updates but in the mean time the data mining and the OLAP processes requires a real time data and to do that when the data is updating we need to minimize the time intervals between the data updates, such a process that requires to get the real time data can set the system to the exhaustion point, to balance and save the system from this tragedy we need to provide algorithms to set the balance on

the right balance, this procedure is for the data warehouse to provide the real time data and take the system to the relief point and because the data is so important to the system we need to provide a real time data with less heavy work on the system and the tools that provide us with the information (Italiano I. and Ferreira J. , 2006); Some of the features in the transactional systems and in specific those which has periods of near points in time intervals and the one that have fixed loading times, Most of the systems in the world require either close interval update or the update in real time like the data warehouse which require a real time data, the data update in the data warehouse sometimes forced to be dynamic which require in its turn a dynamic maintenance for the data.

The real time data intervals can be updated by the users some times and this operation requires a lot of resources, when time intervals shrink the static time intervals, the analytical tools must shrink also to meet the required transactions in the required time, this operation also affect the optimization of the data warehouse factors.

(Pau K-C. , Si Y. and Dumas M., 2006), have introduced a data warehouse model for the workflow of an order, the work shows that it has a dimensional blocks to describe the process which is different from the usual models that describes the databases constructed using blocks to describe the workflow, the model is consisting of three queries each one of these queries was to fulfill a certain requirement, the first query was designed to apprise the training of the employees in their responds to the customers, the second query was to apprise and calculate the time of respond in each section and the third query was to measure the wasted time spent in each delivery over a year or month; this design give us the idea that we have more than one part in the model to achieve before building a model, each part is connected with the parts and the model flows in a series of nodes that

cannot be broken because if one of the nodes is broken the node after that will not work so as the model.

2.3. On-line Analytical Processing (OLAP)

The OLAP can be defined as a tool used on the data warehouse to come out with results defined by the users to push the organizations forward into their path to be between the first companies in its business, The term multidimensional cube is used a lot in this study because it is the three layers of data that is used by the OLAP to come up with the results, Dr. E.F. Codd is the first one who used the term OLAP in 1993 and he is also known as the creator of the relational database, in his study he defined eighteen points that organizations must have to get the full benefits of the OLAP.

According to (Williams S. and Williams N., 2003), OLAP considered as the best and strongest technique among the BI tools which can be very useful to its users because it offer them to do multiple kinds of requests such as:

- Do rapid, dynamic and multiple analyses to the data.
- Show the knowledge from different sides of view.
- Come up with a data in a series time intervals.
- Drill-down into multiple levels of data layers in the data warehouse to come up with different kinds of details.

Some of the OLAP applications supply incremental and significant updates to construct well performed processes that can get a huge amount of cost saving to the enterprises. HP (Hewlett Packed) has announced in December 2009 that there are ten trends of BI and they are interrelated to each other if any company adopted these trends

in 2010 it will reach high level of computing environment and enter the competition in a robust way, these ten trends are focusing on the data, technology, data warehouse and analysis tools revolution and how can it invested in the BI field.

2.4. Data warehouse schemas

2.4.1. Star schema

Two scientists (Kimball and Inmon) discovered the same set of rules that define the performance of the data warehouse, they used different kinds of designs, Ralph Kimball created the design that is known as the Dimensional Data Model (DDM) the shape of this model was similar to the star so it is known know as the star schema.

The star schema is consisting of a fact table and dimension tables connected to the center which is represented by the fact table, the fact table represent the a single transaction or some kind of event that occurs in a single period of time while the fact table represent the single branch in the hierarchy (shipment, date, stock, ... etc.).

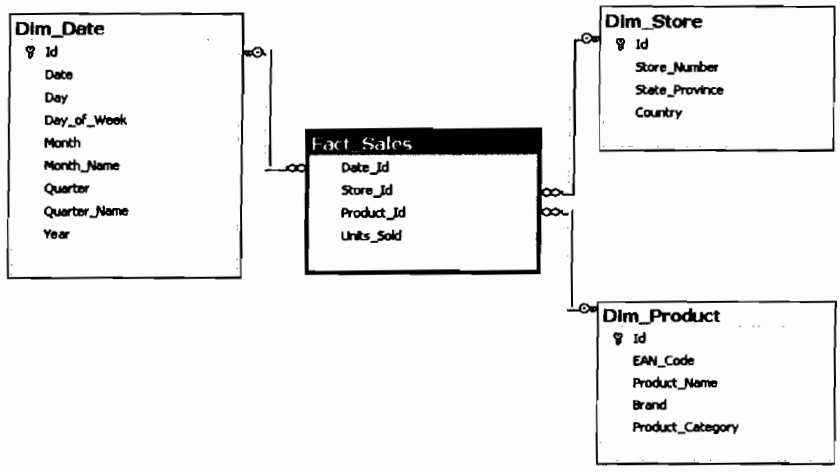


Figure2. 2: Simple example from the default tables in SQL server forming star schema

Bill Inmon used the Third Normal Form Data Model which can be figured as tables connected to each other, this form offers a data flexibility, and there was a comparison between the two models to determine which one of them is better than the other one, the answer to this question was that the two designs have their strengths and their weaknesses and it depends on the person to choose which one of them is better for his/her work by avoiding the weakness points (Silvers, 2008).

2.4.2. Snowflake Schema

It is another image of star schema with more complexity because sometimes the designers face problems with one of the dimensions that is too complex to be in a one dimension row, the solution will be by extending the dimension to be more than one table (two or more than two) connected together, by splitting the dimension table into two or more tables the final form will look like the snowflake that is why it is called snowflake schema (Silvers, 2008).

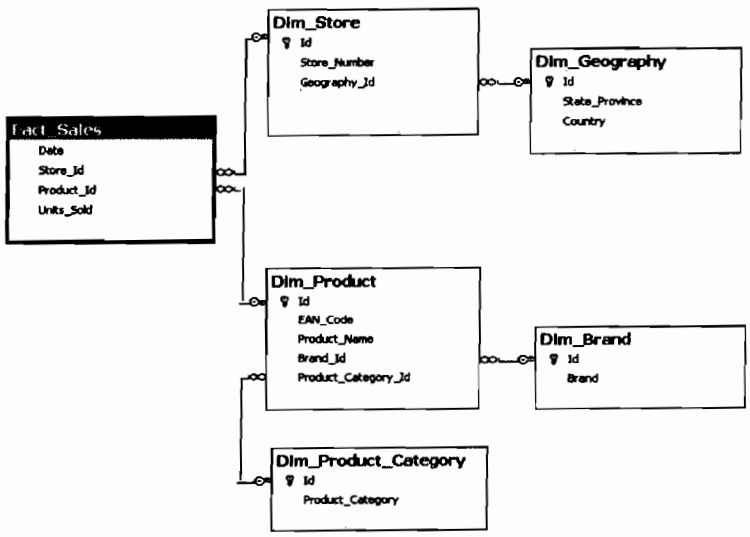


Figure2. 3: Simple example from the default tables in SQL server forming snowflake schema

2.5. Related work

According to (Javed, A., M. U. Shaikh, B. M. Bhatti, 2008) the articles in these days are focusing on the kind of learning instead of testing it, the authors didn't care about the quality of learning provided or if the ways were effective or not, the articles were not discussing about the if the courses were effective and helpful to the students or not, they tried to produce an effective BI model to help them realize why there is a draw back in the level of knowledge given to the students, the model will also help the instructors in realizing the gaps in the learning process and the university taking a step forward in knowledge.

(Van Dyk, L, 2008) has described in his study a framework for the purpose of enhancing the learning activity and monitors the online behavior of the data warehouse created for graduate and postgraduate students, the framework contains a decision support system and BI tools to serve this purpose, the purpose of this study was to gather the all the data in every educational organization and connect it in to one large data warehouse and then divide as the system needs into smaller data marts then use the BI and DSS techniques.

2.6. Summary

This chapter is including the literature reviews done in the field of analyzing knowledge from the data warehouse, the structure of data warehouse and the models addressing these kind of things, the goal was to define the foundation of this study to begin with the model, the system and the evaluation of the system.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The most suitable way to complete a research in any type of fields is to find the suitable methodology to go all the way with research designing, according to (Vashnavi V. and Cuechler W., 2008) the steps of designing a research in a field consists of five steps each step has a different kind of work, the first step of the methodology which is the awareness of problem, this step can be found from the critical reading to literatures specially the last updated literatures that presents to the reader the last inventions and discoveries in the specific section, the second step is the suggestion which is called by many researchers the concept design, this step contains data structures, models and can be the defining of the components, the third step which is the development stage resembled by the artifact that the researcher or the scholar can construct in his/her research and depending on the type of research the artifact is presented, the fourth step is the evaluation step which can be done by selecting one or more of the evaluation methods (interview, survey, questionnaire, ... etc.) or by using some kind of software, the selection of the evaluation depends on the research and way that beat fits with it, the fifth and the final step that is called the conclusion, it represents the documentation of the findings, the discussion on the research, future work and the description of the results.

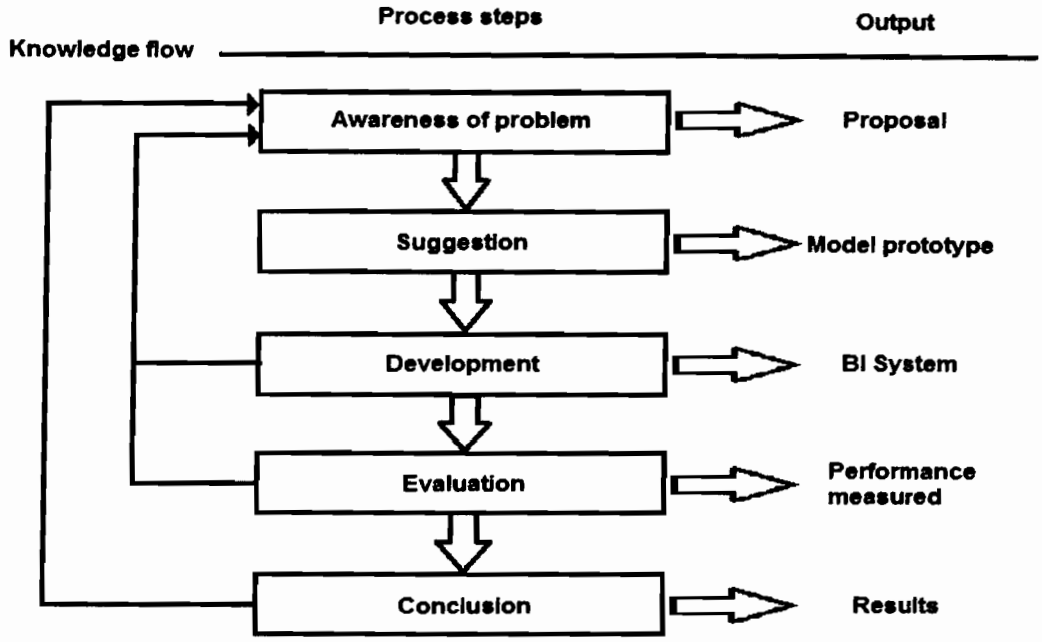


Figure 3. 1: Research methodology (Vashnavi V. and Cuechler W., 2008)

3.2 Methodology Steps

As that is seen in the (figure 3.1) the methodology is consisting of five parts the third and the fourth parts have a feedback to the first part, so as the last part which has a feedback to the first part to correct the wrong or modify it, the third and fourth parts have the same feedback because each of them is connected by the same kind of measures.

3.2.1 Awareness of problem

In the study the gathering of the right literature which represent the foundation of the problem basement, the outcome of this stage is the research proposal, the proposal can give to the reader the full view on the research and the problems in ahead of it beside the way to deal with these problems in the right manner.

3.2.2 Suggestion

This step is the begin of the whole research, in this step the prototype of the model is suggested with the ability to modify it before the stage is cleared the prototype, the outcome of this stage was the BI model prototype.

3.2.3 Development

This step will be the edge to determine the proper development to the model and apply it by using data warehouse programming language, the outcome of this stage was the system for the database records.

3.2.4 Evaluation

It is the most important step in the methodology which will guide us through the right steps in during the finalizing of the system to see if it work out like the expectations in mind or not, the robust system that is done didn't need to have a feedback to the first step and didn't require any system modifications.

3.2.5 Conclusion

It represents the findings of the research and the future work that has been cleared through the this study, all the results are described in this step with a discussion on it from the sides of business intelligence and data warehouse that are evolved in this study.

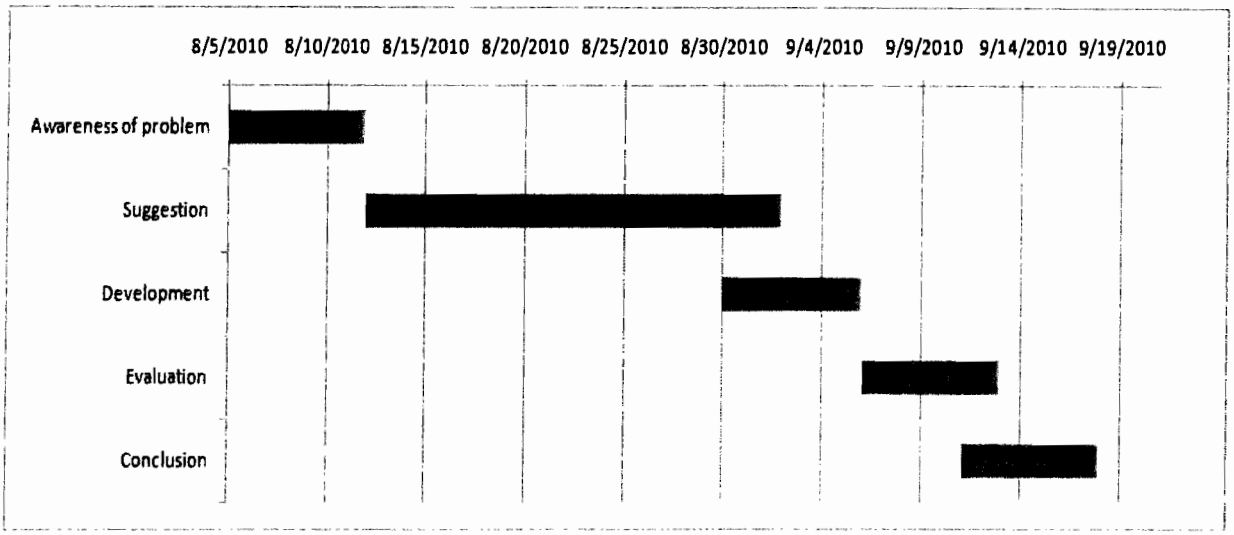


Figure 3. 2: Project Gantt chart

3.3 Summary

The methodology has addressed all the steps that has been followed in this study and the way to do all of them, the researcher has used them all in this study furthermore the analysis for the system will be presented in chapter four beside the snap shoot of all the interfaces of the system, the model is presented in chapter five with the explaining of the steps.

CHAPTER FOUR

REQUIREMENT GATHERING AND SYSTEM ANALYSIS

4.1 Introduction

This chapter introduces the system made for Business Intelligence model for a student data warehouse in UUM environment and list all the requirements needed to build the BI model and the system.

4.2 List of requirements

In the interview with the student affairs office principal, there was one important question to be asked and that is "what are the most frequently questions that comes into your mind as a principal in the student affairs office?", the answer was in five questions listed below:

- How many students that have done more than one problem in the year 2009 and at which UUM college they were studying in (CAS, COB and COLGIS)?
- What is the average of students' grades in the three colleges of UUM (CAS, COB and COLGIS) and which one of these colleges got more local students?

- How many students are there in the CAS that have less than one year left to finish their study?
- What is the problem rate comparison between local and international students?
- How many students are there in the university that have grade greater than "B+"?

These five questions is the basement to build the BI model which is shown in chapter five.

Listed below are the functional requirements and non-functional requirement of the system. In the priority column, the following short hands are used:

M: mandatory requirements (the system must do it)

D: desirable requirements (the system preferably do it)

O: optional requirements (the system may do it)

4.2.1 Functional requirements:

No.	Requirement ID	Requirement description	Priority
	SDW_01	View Main page	
1	SDW_01_01	The user / admin can access the main to view the GUI for the system, the main page is the gate to the system activities	M

	SDW_02	Login	
2	SDW_02_01	The user can login to the system when he/she key in the right user name and password and then press enter button	M
	SDW_03	Manage records	
3	SDW_03_01	The admin can add, update and delete student records	D
	SDW_04	View info.	
4	SDW_04_01	The user can click on the button about us to know the information about the system capabilities	D
	SDW_05	Generate reports	
5	SDW_05_01	The user can generate reports from the data warehouse by selecting one of the kinds of reports available, the available reports in the system is 1*1 tab, 1*2 tab and graphical report which can be represented by bars	M
	SDW_06	View reports	
6	SDW_06_01	The user can view the generated reports by clicking on the button view previous generated reports to see all the reports generated at all the times	M
	SDW_07	Log out	
7	SDW_07_01	The user / admin can choose to log out from the system at	M

any time he/she wants to do it

4.2.2 NON-FUNCTIONAL REQUIREMENTS

No.	Requirement ID	Requirement description	Priority
	SDW_08	**Reliability issues**	
8	SDW_08_01	If the system is crashing, it must be no more than once per 24 hours.	M
9	SDW_08_02	If the system has reached the point of crash, it should not be more than 10 Minutes.	M
10	SDW_08_03	If the system has reached the point of crash, it must behave perfectly normal when reloaded again.	M
	SDW_09	**Usability issues**	
11	SDW_09_01	The system must be available twenty four hours a day and seven days a week.	M
	SDW_10	**Security issues**	
12	SDW_10_01	Only the managers will be able to login to a system to do the available activities.	M
13	SDW_10_02	Only the administrator can log in to the database and	

		make the maintenance.	
14	SDW_10_03	Unauthorized person should not use the system, just view the main page.	M
15	SDW_10_04	The system cannot enter unauthorized pages of the program database.	M
16	SDW_10_05	No one can change the password without login to the system.	M
	SDW_11	**Understandability**	
17	SDW_11_01	The system is easy to understand.	M
	SDW_12	**Performance**	
18	SDW_12_01	The system must have a reasonable speed according to the technology used to access many of officers at the same time.	M
	SDW_13	**Availability**	
19	SDW_13_01	The system must be available to the managers only not all kinds of users.	M

4.3 USE CASE DIAGRAM

The use case diagram is the perfect way to describe the activities of the system by using figures to define the cases that the users of the system has to deal with to do the activities of the system also the users here are defined as actors, this use case diagram is one of the analysis steps defined by the UML.

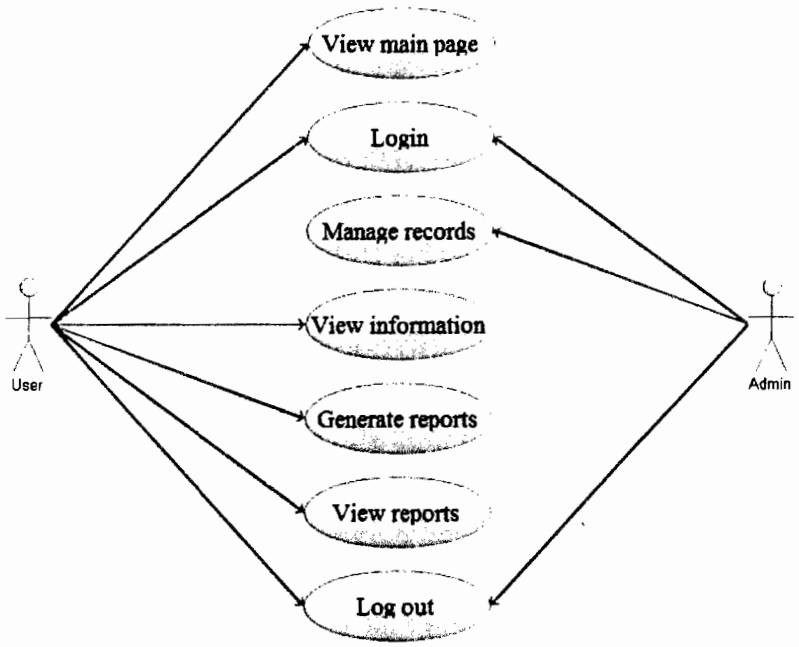
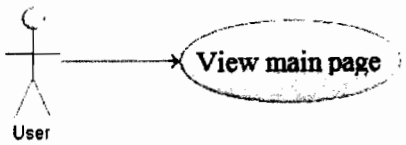


Figure 4. 1: (use case diagram)

4.4 Use case specification

4.4.1 Use case: View main page



- Brief description

This use case is initiated by the user that can be able to view the main page.

- Pre-conditions

Not applicable.

- Characteristic of activation

This execution depends on user demand

- FLOW OF EVENTS

A. Basic Flow

The user views main page.

B. Alternative Flow

Not applicable

C. Exceptional Flow

Not applicable.

- POST-CONDITIONS

Not applicable.

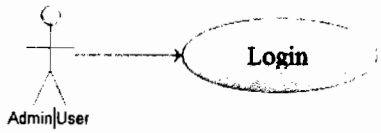
- RULE(S)

Not applicable.

- CONSTRAINT(S)

Not applicable.

4.4.2 Use case: Login



- Brief description

This use case is initiated by the admin/user that can be able to login to the system.

- Pre-conditions

Insert username and password.

Click on the enter button.

- Characteristic of activation

This execution depends on admin/user demand

- FLOW OF EVENTS

A. Basic Flow

The admin/user views main page.

B. Alternative Flow

Not applicable

C. Exceptional Flow

E1. Invalid username or password message will be displayed if the admin/user inserted the wrong username and/or password.

- POST-CONDITIONS

View the system main page to activate system capabilities.

- RULE(S)

Not applicable.

- CONSTRAINT(S)

Username and password.

4.4.3 Use case: Manage records

- Brief description

This use case is initiated by the administrator that will be able to add, update and delete the student records.

- Pre-conditions

Security check

- Characteristic of activation

This execution depends on admin demand

- FLOW OF EVENTS

A. Basic Flow

The can add, update and delete the students records by entering the student data warehouse.

B. Alternative Flow

Not applicable

C. Exceptional Flow

Not applicable.

- POST-CONDITIONS

View the system main page to activate system capabilities.

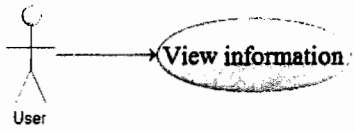
- RULE(S)

Not applicable.

- CONSTRAINT(S)

Not applicable

4.4.4 Use case: View information



- Brief description

This use case is initiated by the user; it is to view the information about the system capabilities.

- Pre-conditions

Not applicable

- Characteristic of activation

This execution depends on user demand

- FLOW OF EVENTS

A. Basic Flow

The user can click on the button about us to view the system capabilities.

B. Alternative Flow

Not applicable

C. Exceptional Flow

Not applicable.

- POST-CONDITIONS

View the page that contains the explaining on system capabilities.

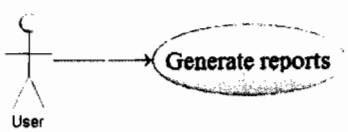
- RULE(S)

Not applicable.

- CONSTRAINT(S)

Not applicable.

4.4.5 Use case: Generate reports



- Brief description

This use case is initiated by the user to generate reports from the data warehouse.

- Pre-conditions

Not applicable

- Characteristic of activation

This execution depends on user demand.

- FLOW OF EVENTS

A. Basic Flow

The user can click on the button generate reports to give the user the option to generate two kinds of reports.

B. Alternative Flow

Not applicable

C. Exceptional Flow

Not applicable.

- POST-CONDITIONS

Give the information that is required to generate the report and the report name.

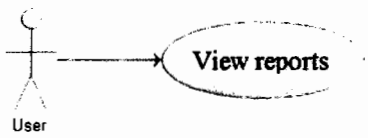
- RULE(S)

Not applicable.

- CONSTRAINT(S)

Not applicable.

4.4.6 Use case: View reports



- Brief description

This use case is initiated by the user to view all the generated reports from the data warehouse.

- Pre-conditions

Not applicable

- Characteristic of activation

This execution depends on user demand.

- FLOW OF EVENTS

A. Basic Flow

The user can click on the button view reports to give the user the option to view all the reports.

B. Alternative Flow

Not applicable

C. Exceptional Flow

Not applicable.

- POST-CONDITIONS

Click on the desired report to view.

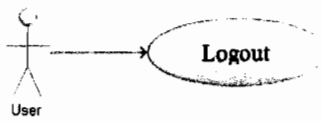
- RULE(S)

Not applicable.

- CONSTRAINT(S)

Not applicable.

4.4.7 Use case: Log out



- Brief description

This use case is initiated by the admin/user to log out from the system and return to the main page.

- Pre-conditions

Not applicable.

- Characteristic of activation

This execution depends on admin/user demand.

- FLOW OF EVENTS

A. Basic Flow

Click on the log out link to go to the main page.

B. Alternative Flow

Not applicable

C. Exceptional Flow

Not applicable.

- POST-CONDITIONS

Not applicable.

- RULE(S)

Not applicable.

- CONSTRAINT(S)

Not applicable.

4.5 Activity diagram

4.5.1 Activity diagram for view main page

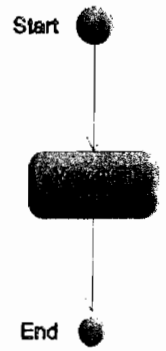


Figure 4. 2: Activity diagram for user (view main page)

4.5.2 Activity diagram for login

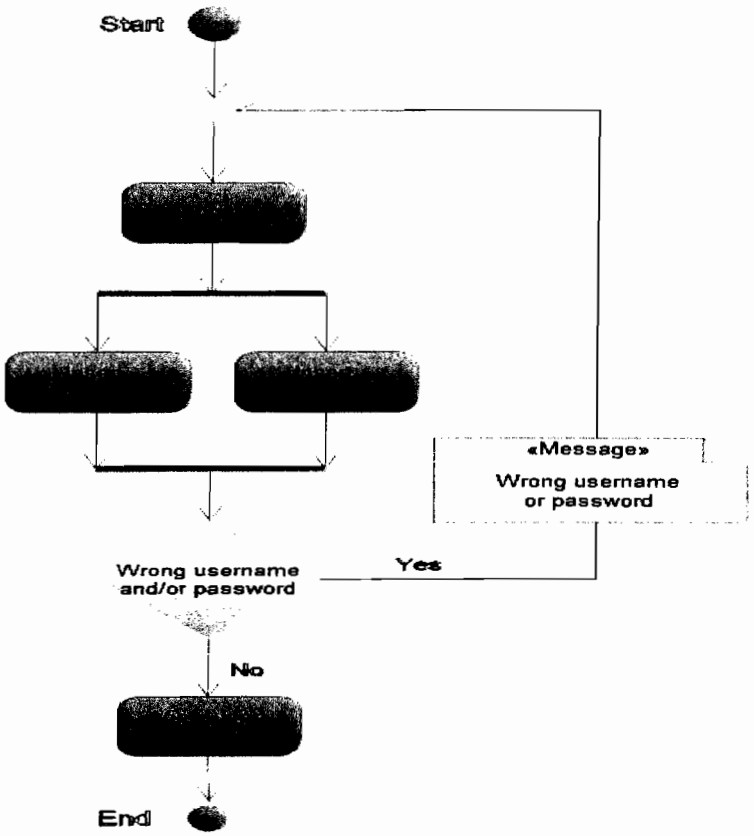


Figure 4. 3: activity diagram for admin/user (Login)

4.5.3 Activity diagram for manage records

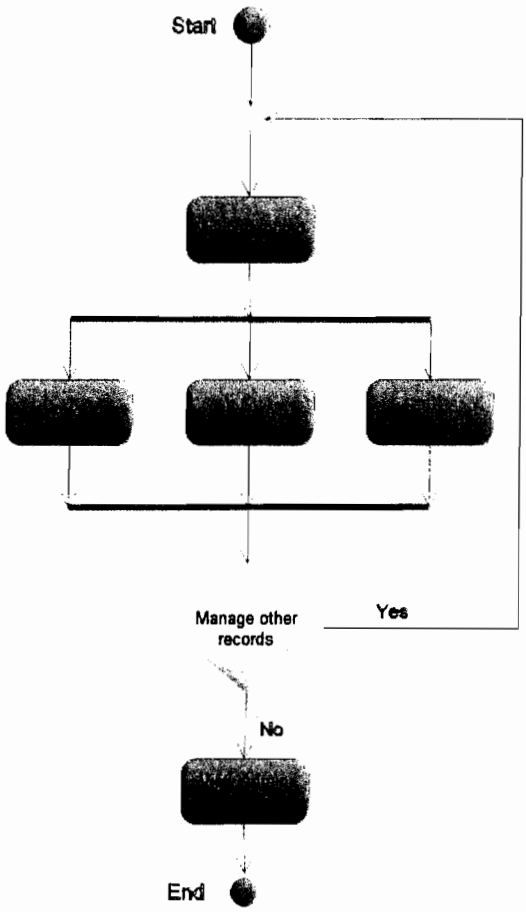


Figure 4. 4: Activity diagram for admin (manage records)

4.5.4 Activity diagram for view information

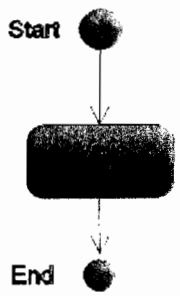


Figure 4. 5: Activity diagram for user (view information)

4.5.5 Activity diagram for generate reports

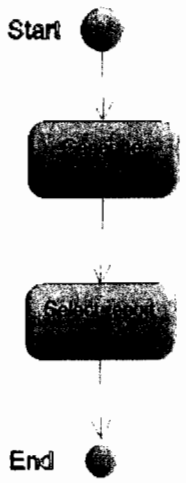


Figure 4. 6: Activity diagram for user (generate reports)

4.5.6 Activity diagram for view reports

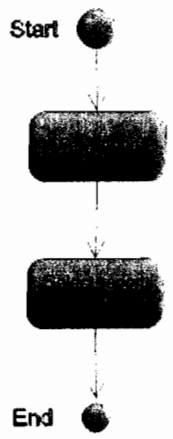


Figure 4. 7: Activity diagram for user (view reports)

4.5.7 Activity diagram for log out

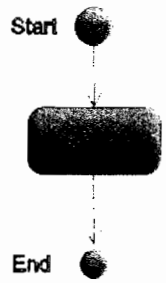


Figure 4. 8: Activity diagram for admin/user (log out)

4.6 Sequence diagram

4.6.1 View main page

In this sequence diagram the user has the ability to access the main page of the system.

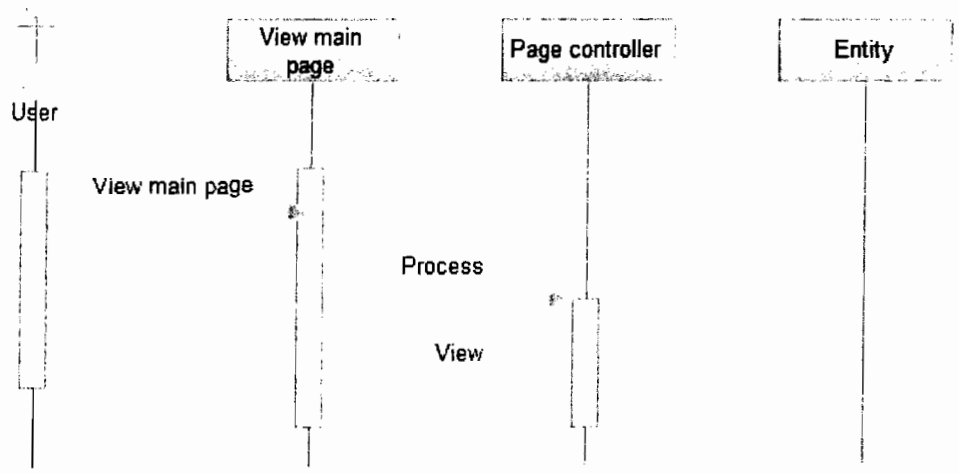


Figure 4. 9: sequence diagram view main page

4.6.2 **Login**

In this sequence diagram, both of the user and the administrator has the ability to login to the system by writing the username and password.

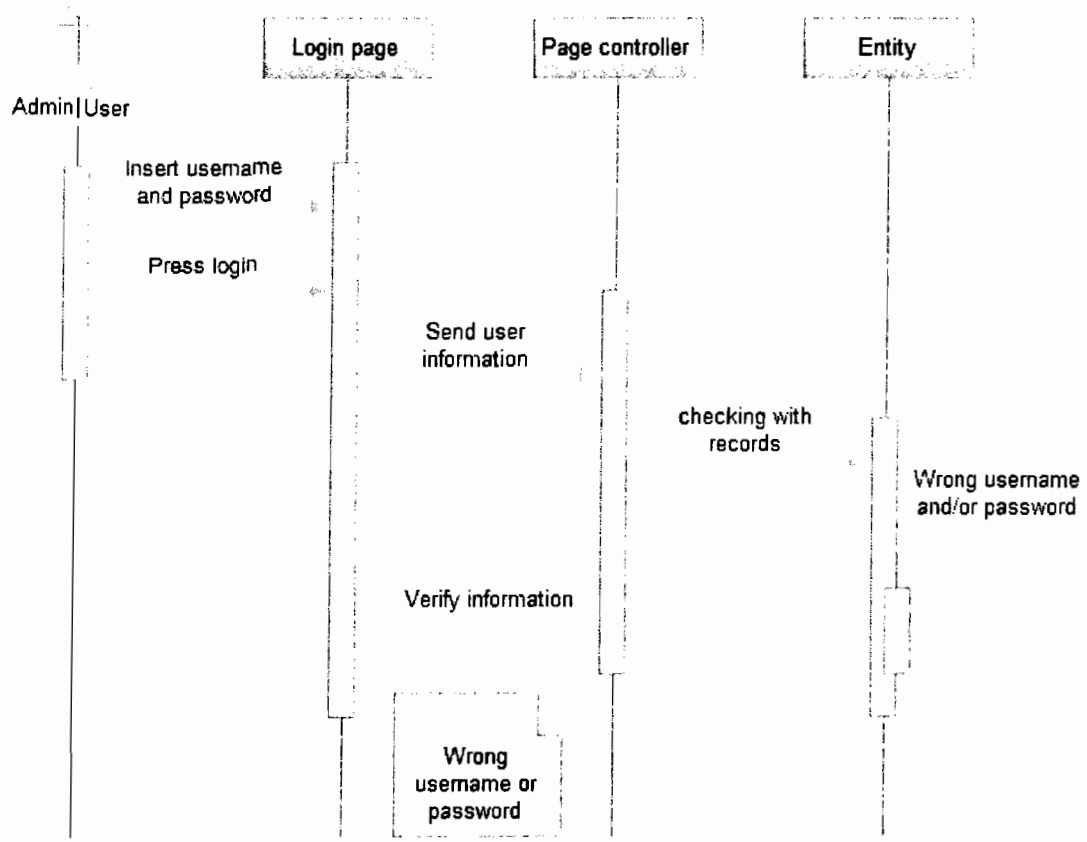


Figure 4. 10: Login sequence diagram

4.6.3 **Manage records**

In this sequence diagram the administrator had the ability to manage the students records by adding, updating and deleting these records.

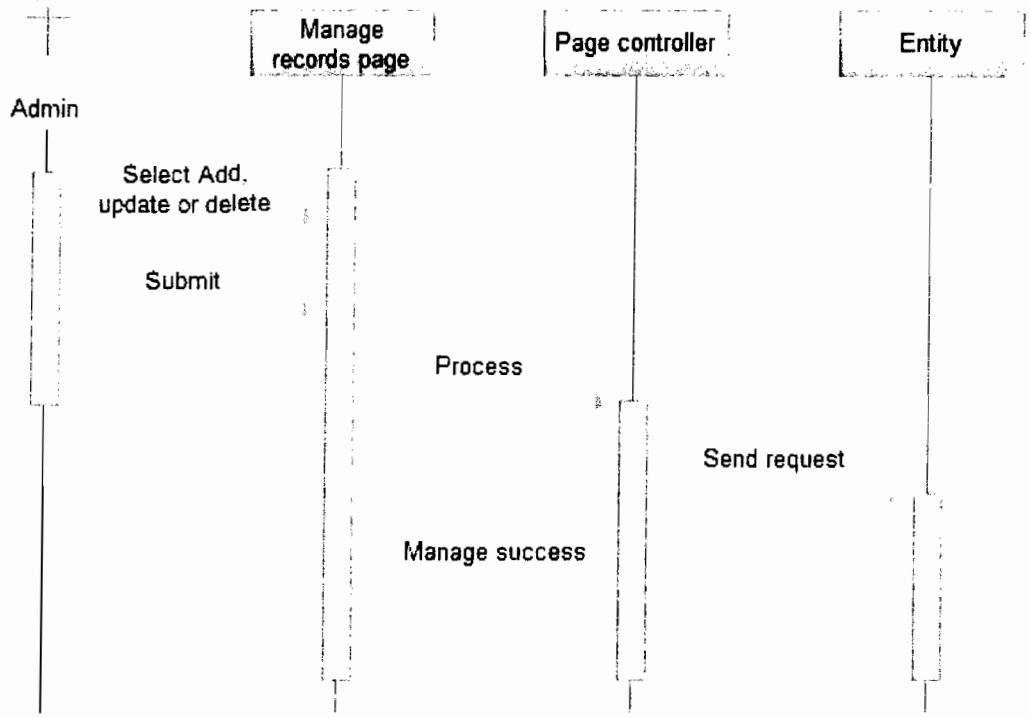


Figure 4. 11: Manage records sequence diagram

4.6.4 **View information**

In this sequence diagram the user has the ability to access the information about the system, this information is like a guide to the user to inform the user about the capabilities that the system can do, the system doesn't have to access the data base to show the information.

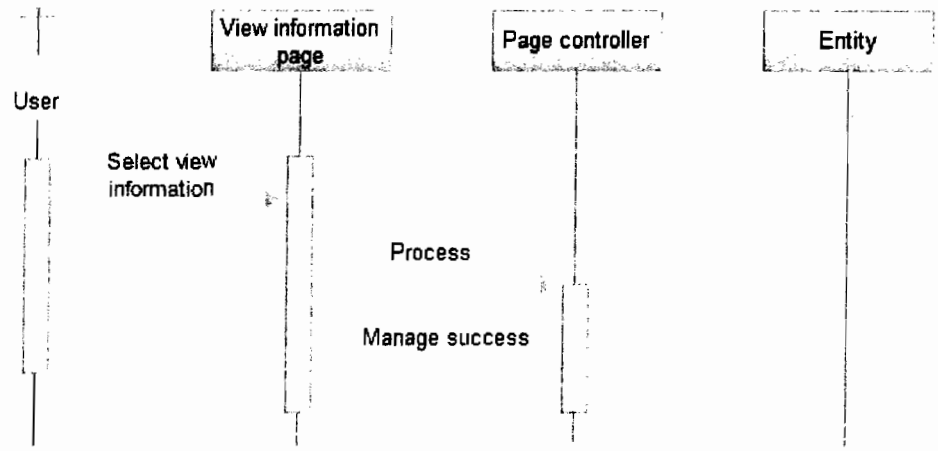


Figure 4. 12: View information sequence diagram

4.6.5 Generate reports

In this sequence diagram the user has the ability to generate reports from the system data warehouse, the reports generated contain three types of reports and one of these three is the graphical report.

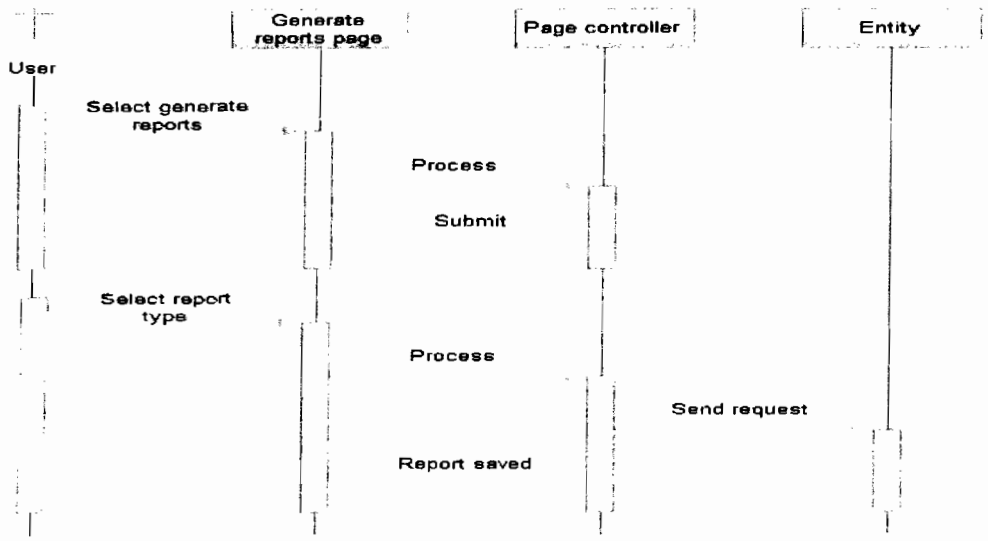


Figure 4. 13: Generate reports sequence diagram

4.6.6 View reports

In this sequence diagram the user has the ability to view the generated reports by clicking on the report name to view it.

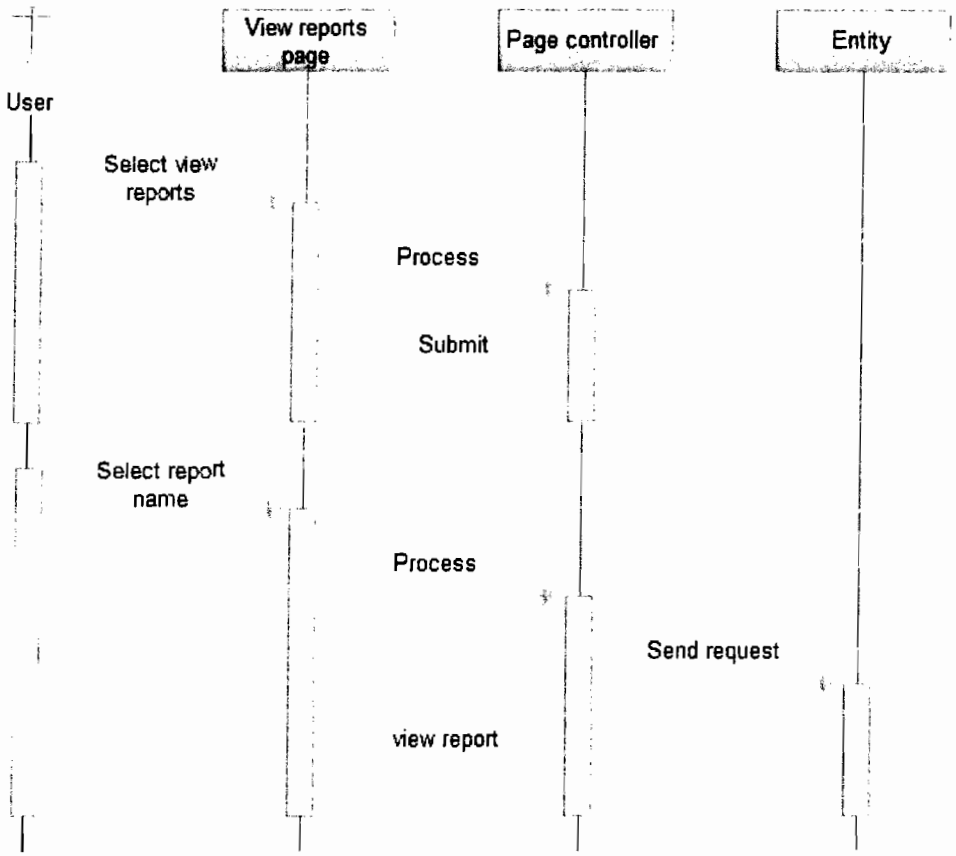


Figure 4. 14: View reports sequence diagram

4.6.7 **Logout**

In this sequence diagram both of users and administrator has the ability to logout from the system.

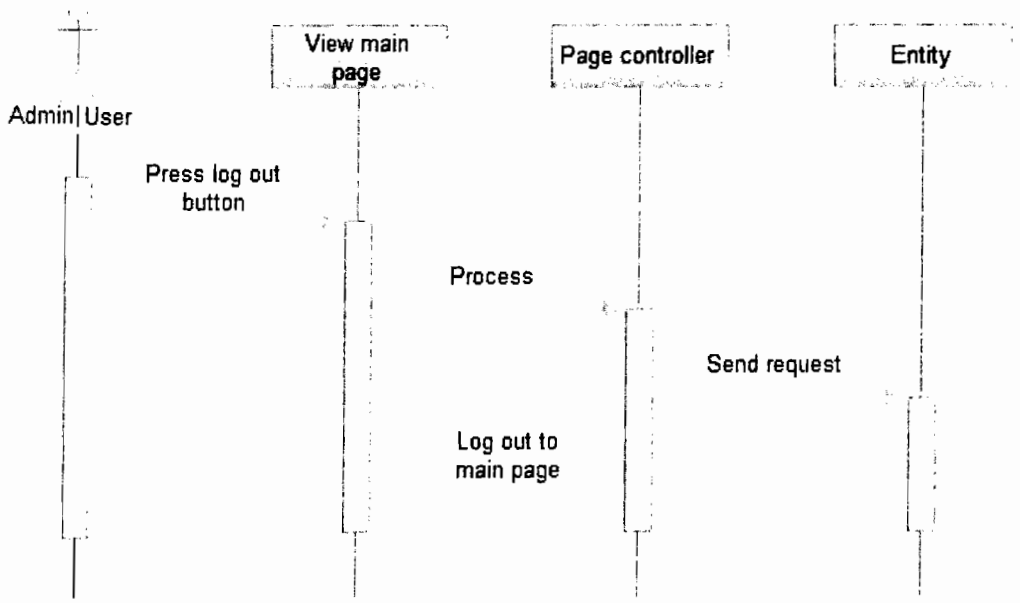


Figure 4. 15: Log out sequence diagram

4.7 Class diagram for SDW

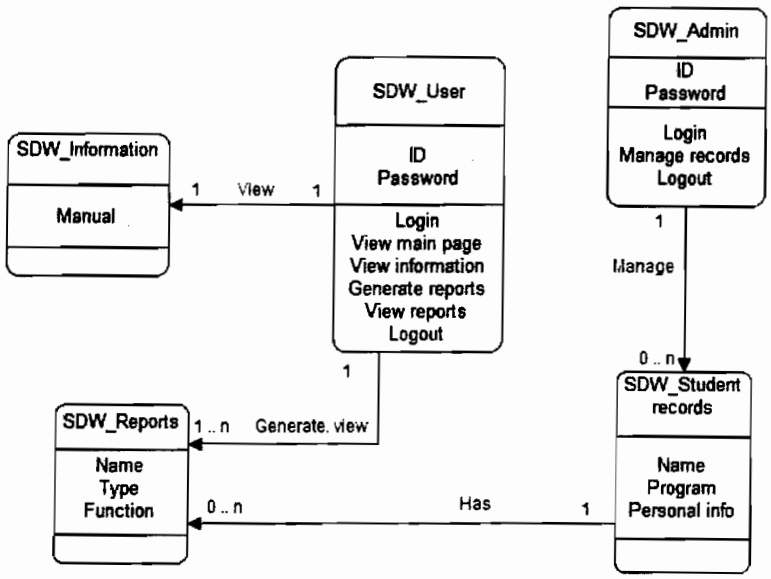


Figure 4. 16: SDW class diagram

The class diagram presented in (figure 4.16) is to show the actors playing role in the SDW system where every rectangle is divided to three parts the first represents the actor, the second part represents the attributes that the actor has and the third part represent the action that each actor can do (Bennett, S., McRobb, S., & farmer, 2002).

CHAPTER FIVE

FINDINGS

5.1 Introduction

This chapter illustrates the results of this study and the evaluation that was done to the system performance and activity.

The objectives of this study were four objectives; first is gathering the requirements to build the proposed BI model which was done on chapter four, second is the model prototype which similar to a conceptual model but smaller in its design, third is the system for the proposed model where the user interface are in this chapter and fourth is the evaluation for the system which was done by the questionnaire to the students and the results analysis is in shown in this chapter.

The data warehouse is consisting of five tables forming a snowflake schema the admin can login to the data directly to add, update and delete records while the user have to deal with another interface designed for the purpose of generating and viewing reports from the data warehouse after he/she login to the system.

The model was built from the requirements determined in chapter four, as shown in (figure 5.1) the red path is to the administrator and the green path is to the user data flow.

The BI model is relying on the steps that (Kimball and Ross, 2002) have set to the business dimensional life cycle, the first step into designing a BI model is to prepare the data to the operation that contains extraction, transforming and loading the data from the various resources in to the data warehouse, the data set can be driven from the requirements gathered in this study from the interview of the student affairs principal in UUM and by knowing the things that are valuable to the managers to get from the data warehouse, the questions have set the final selection of data sets to be delivered to the data warehouse, after the ETL operation the data warehouse should be designed in its dimensional model which is in this case represented by the star schema, after that it will be uploaded to the data warehouse.

The second step is for the business users to determine the requirements from the data warehouse which is here represented by the reports that will be extracted from the data warehouse.

The third step is represented by the data analyzing, which in this case will represent to the user all the generated reports and the ability to view them by storing these reports in the data warehouse, at last the data warehouse will be updated by the administrator and the reports comes from the BI tools where it goes after that to the first stage of the life cycle which has been described in Kimball book as the project planning that is represented here by the data warehouse server, then the operation goes on and on where the server is connected to the list of requirements that are wanted by the business users.

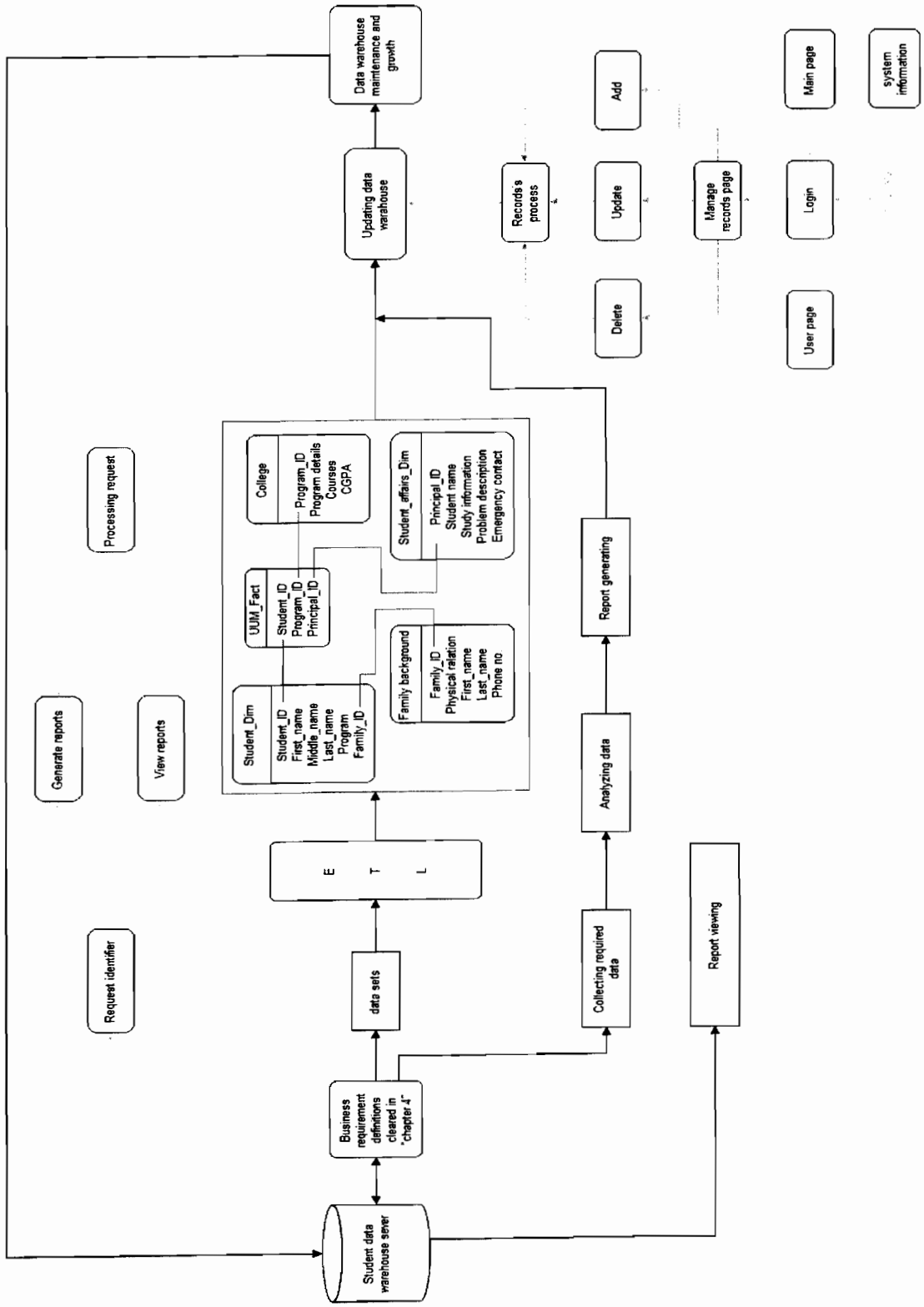


Figure 5. 1: Business intelligence model for student data warehouse

5.2 The results analysis of questionnaire

The questionnaire is tagged in the appendix, the respondents were all students studying in UUM the number was 30 respondent and we have taken the mean of the respondent number in this statistic analysis, this analysis is for section A in the questionnaire as shown in (table 5.1), the analysis for the respondents has shown that 70% of the respondent's age was from 18 to 24 years old, 20% of the respondent were from 25 to 30 years old, 6.67% of the respondents were from 31 to 40 years old and 3.33% of the respondents were over 40 years old as shown in (table 5.2) and (figure 5.2), the gender rate of respondents was 66.67% of the respondents were males and 33.33 were females as shown in (table 5.3) and (figure 5.3).

Table 5. 1: Descriptive statistics for section A (respondents' gender and age).

	N	Minimum	Maximum	Mean	Std. Deviation
Gender	30	1	2	1.33	.479
Age	30	1	4	1.43	.774

Table 5. 2: Descriptive statistics for respondents' gender

Gender	Frequency	Percent	Valid Percent	Cumulative percent
Male	20	66.7	66.7	66.7
Female	10	33.3	33.3	100
Total	30	100.0	100.0	

Table 5. 3: Descriptive statistics for respondents' age

Age	Frequency	Percent	Valid Percent	Cumulative Percent
18-24	21	70.0	70.0	70.0
25-30	6	20.0	20.0	90.0
31-40	2	6.7	6.7	96.7
Over 40	1	3.3	3.3	100.0
Total	30	100.0	100.0	

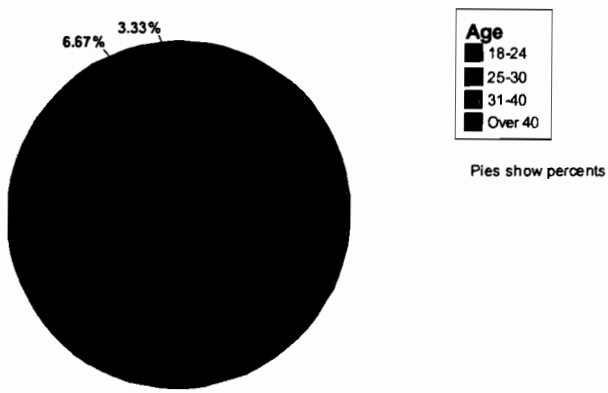


Figure 5. 2: Respondents' age ratio

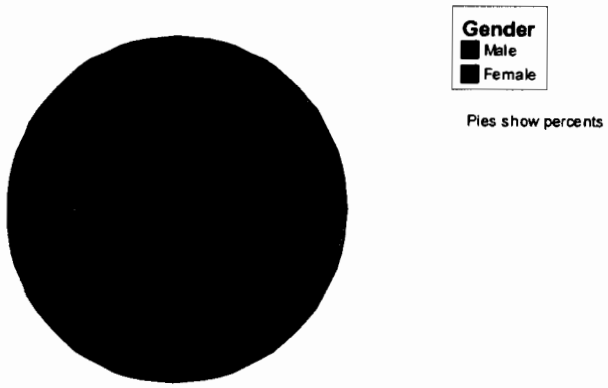


Figure 5. 3: Respondents' gender ratio

Section "B" of the questionnaire was about the system performance and the problems facing the students in the university, this section contain nine questions, the descriptive statistics (mean) are shown in (table 5.4).

Table 5. 4: Descriptive statistics (mean) for the questions in section "B"

Question	N	Minimum	Maximum	Mean	Std. Deviation
Q1	30	1	2	1.43	.504
Q2	30	3	5	4.47	.730
Q3	30	1	3	1.43	.626
Q4	30	1	3	1.67	.547

Q5	30	1	2	1.23	.430
Q6	30	1	3	1.63	.809
Q7	30	1	4	2.13	.819
Q8	30	1	2	1.10	.305
Q9	30	1	5	1.60	.894

The analysis for question one as shown in (table 5.5) and (figure 5.4) illustrates two kinds of response the first is 56.7% for "strongly agree" and the second is 43.3% for "agree".

Table 5. 5: Descriptive analysis for question one

Response	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	17	56.7	56.7	56.7
Agree	13	43.3	43.3	100.0
Total	30	100.0	100.0	

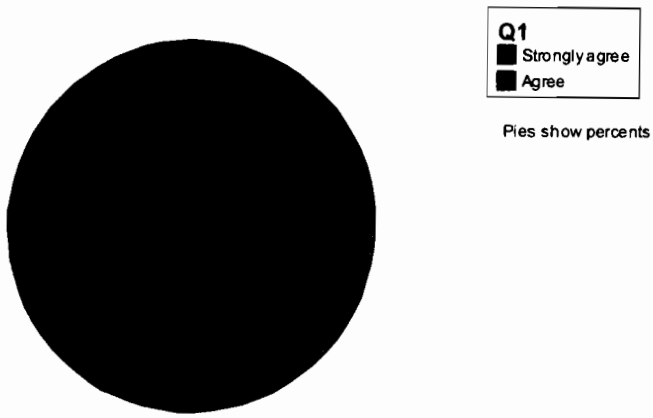


Figure 5. 4: Question one analysis ratio

The analysis for question two as shown in (table 5.6) and (figure 5.5) illustrates three kinds response the first is 13.3% for "not sure" , the second is 26.7% for "disagree" and the third is 60.0% for "strongly disagree"

Table 5. 6: Descriptive analysis for question two

Response	Frequency	Percent	Valid Percent	Cumulative Percent
Not sure	4	13.3	13.3	13.3
Disagree	8	26.7	26.7	40.0
Strongly disagree	18	60.0	60.0	100.0
Total	30	100.0	100.0	

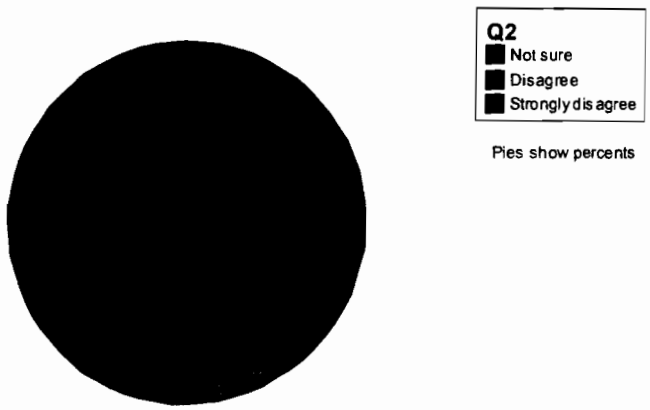


Figure 5. 5: Question two analysis ratio

The analysis for question three as shown in (table 5.7) and (figure 5.6) illustrates three kinds response the first is 63.3% for "strongly agree" , the second is 30.0% for "agree" and the third is 6.7% for "not sure"

Table 5. 7: Descriptive analysis for question three

Response	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	19	63.3	63.3	63.3
Agree	9	30.0	30.0	93.3
Not sure	2	6.7	6.7	100.0
Total	30	100.0	100.0	

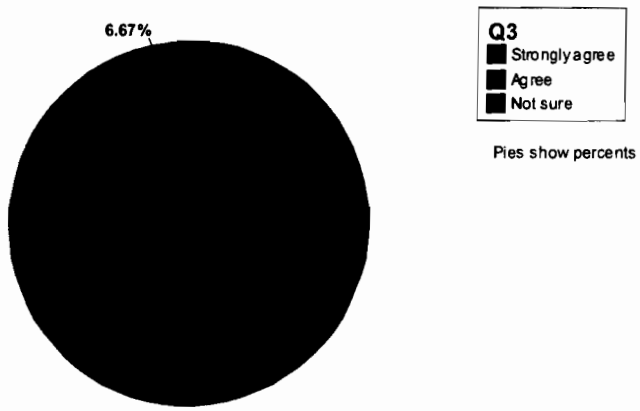


Figure 5. 6: question three analysis ratio

The analysis for question four as shown in (table 5.8) and (figure 5.7) illustrates three kinds response the first is 36.7% for "strongly agree" , the second is 60.0% for "agree" and the third is 3.3% for "not sure"

Table 5. 8: Descriptive analysis for question four

Response	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	11	36.7	36.7	36.7
Agree	18	60.0	60.0	96.7
Not sure	1	3.3	3.3	100.0
Total	30	100.0	100.0	

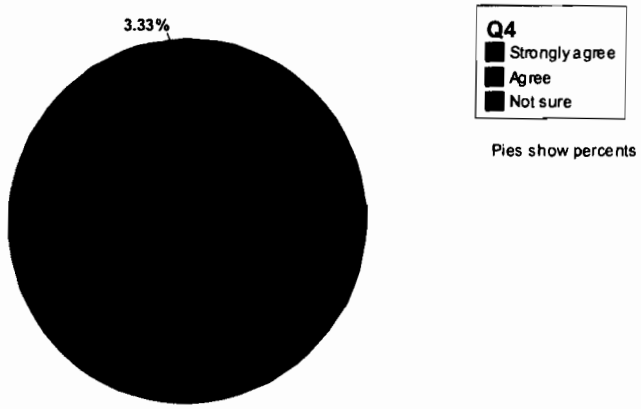


Figure 5. 7: question four analysis ratio

The analysis for question five as shown in (table 5.9) and (figure 5.8) illustrates two kinds response the first is 76.7% for "strongly agree", the second is 23.3% for "agree".

Table 5. 9: Descriptive analysis for question five

Response	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	23	76.7	76.7	76.7
Agree	7	23.3	23.3	100.0
Total	30	100.0	100.0	

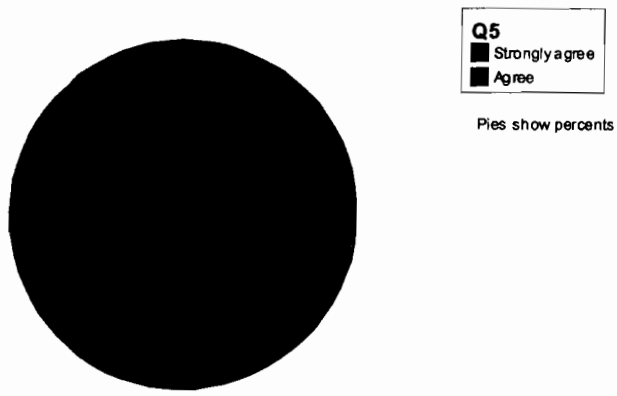


Figure 5. 8: question five analysis ratio

The analysis for question six as shown in (table 5.10) and (figure 5.9) illustrates three kinds response the first is 56.7% for "strongly agree" , the second is 23.3% for "agree" and the third is 20.0% for "not sure"

Table 5. 10: Descriptive analysis for question six

Response	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	17	56.7	56.7	56.7
Agree	7	23.3	23.3	80.0
Not sure	6	20.0	20.0	100.0
Total	30	100.0	100.0	

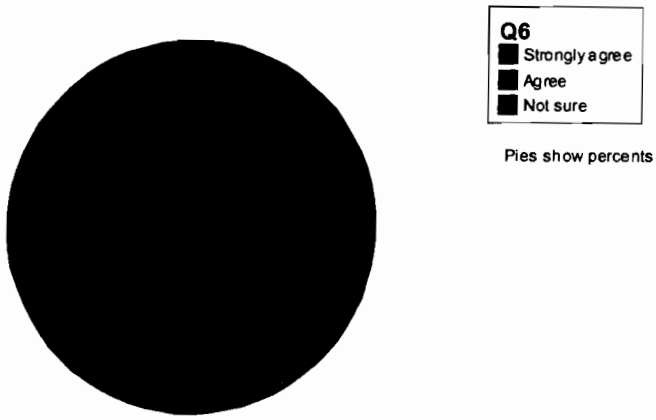


Figure 5. 9: question six analysis ratio

The analysis for question seven as shown in (table 5.11) and (figure 5.10) illustrates four kinds response the first is 20.0% for "strongly agree", the second is 53.3% for "agree", the third is 20.0% for "not sure" and the fourth is 6.7% for "disagree".

Table 5. 11: Descriptive analysis for question seven

Response	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	6	20.0	20.0	20.0
Agree	16	53.3	53.3	73.3
Not sure	6	20.0	20.0	93.3
Disagree	2	6.7	6.7	100.0
Total	30	100.0	100.0	

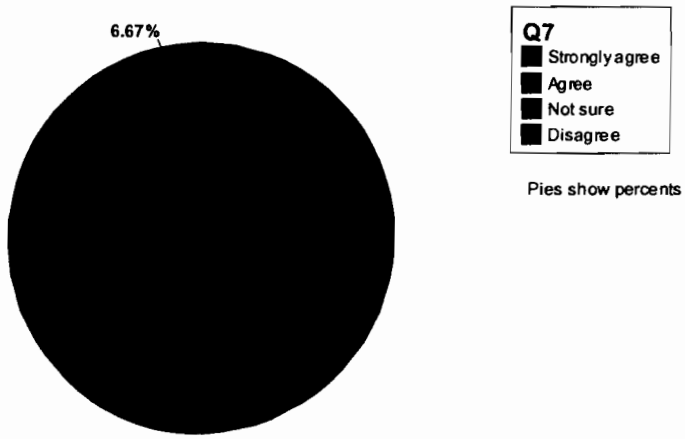


Figure 5. 10: Question seven analysis ratio

The analysis for question eight as shown in (table 5.12) and (figure 5.11) illustrates two kinds response the first is 90.0% for "strongly agree" and the second is 10.0% for "agree".

Table 5. 12: Descriptive analysis for question eight

Response	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	27	90.0	90.0	90.0
Agree	3	10.0	10.0	100.0
Total	30	100.0	100.0	

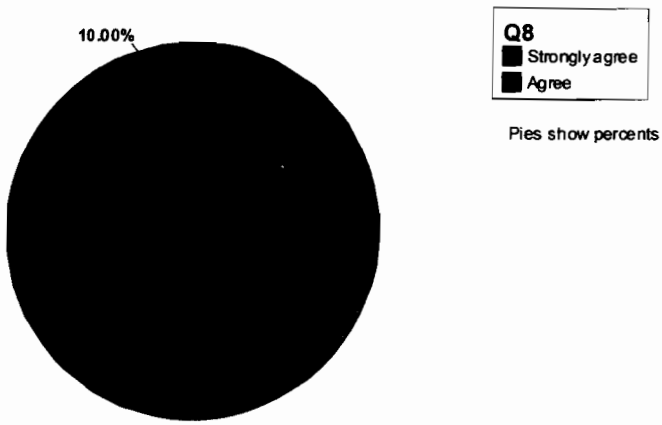


Figure 5. 11: analysis ratio for question eight

The analysis for question nine as shown in (table 5.13) and (figure 5.12) illustrates four kinds response the first is 56.7% for "strongly agree", the second is 33.3% for "agree", the third is 6.7% for "not sure" and the fourth is 3.3% for "strongly disagree".

Table 5. 13: Descriptive analysis for question nine

Response	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	17	56.7	56.7	56.7
Agree	10	33.3	33.3	90.0
Not sure	2	6.7	6.7	96.7
Strongly disagree	1	3.3	3.3	100.0
Total	30	100.0	100.0	

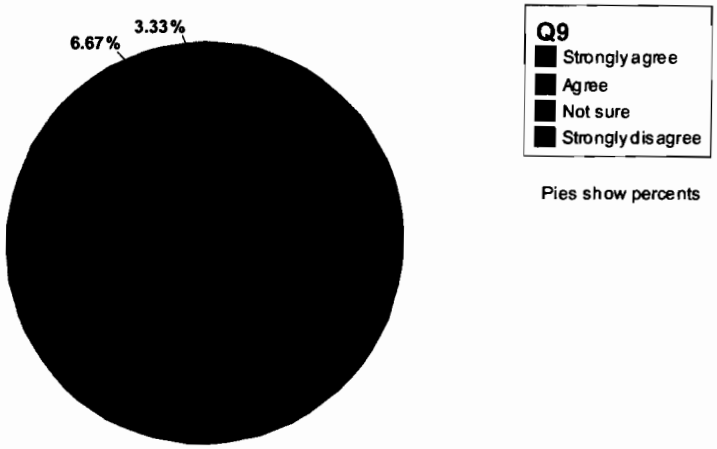


Figure 5. 12: Analysis ratio for question nine

The questionnaire was distributed between the students and respondent samples were collected from the students that answer the questions of the questionnaire, the total samples distributed were 57 sample on different kinds of students in them UUM, and as shown in (table 5.14) "valid" is representing the fields filled by the students and "missing" is representing the students that didn't answer a certain field.

Table 5. 14: The valid and the missing values for the questionnaire

N	Gender	Age	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Valid	30	30	30	30	30	30	30	30	30	30	30
Missing	0	0	0	0	0	0	0	0	0	0	0

(Table 5.15) is showing all the objectives, outcomes and the methods taken to achieve the outcomes.

Table 5. 15: Objectives, outcomes and methods

Objectives	Outcomes	Methods
Determine the requirements needed to build the BI model	Requirements' analysis	- UML analysis - Literature review
To build the proposed BI model for the UUM data warehouse	BI model prototype	- Literature review - Preliminary study
Build a system for the proposed BI model	Project application	- Prototyping
Evaluate the system	Evaluation results	- Questionnaire - Data analysis

5.3 Summary

This chapter is showing all the results of this study, the model prototype is shown in this chapter; the system evaluation results analyzed using SPSS, the objectives, the methods to achieve these objectives and the outcomes for each one of them were all described in this chapter.

CHAPTER SIX

CONCLUSION

6.1 Introduction

This chapter discusses and concludes this study, this study aimed to a certain kind of fields which are data warehouse and the abilities of Business intelligence tools that analyze the data and come up with the results to help the organizations and set the path for these organizations by strengthen the bounds between the manager and the customers.

The organization was chosen in this study is "Universiti Utara Malaysia" for the study to be applied on it, where the manager is the manager staff of the university and the customers where the students studying in this university, by solving the problems facing the students in the university to achieve the maximum satisfaction from it.

The study aims to design a model for the university to the users that is represented by the manager staff, the manager staff is the group of people responsible for managing and take the decisions in the university and they are represented by the hierarchy management staff from the dean of college up to the vice chancellor, while the customers can be known as the students of the university.

6.2 Study strength

The model presented in this study has three stable benefits which are the ability to control the data warehouse from the decision makers in the university, the ability to maintain the data warehouse by the person called admin and the easy and significant business intelligence tools provided to the decision makers to achieve the model goals.

The system was designed and implemented by using two kinds of languages, the first is for designing and programming the data set is My SQL programming language and the second is for designing and programming the user interface and connect it to the data warehouse which is JSP.

The system give the user two kinds of report possibilities and they are the digital report that contain two kind of reports (two dimensional report and three dimensional report) and the graphical report that is represented by a graphic draw contain all the statistic bars.

6.3 Study limitations

This study was limited by the time and data set availability where the data was entered manually and the time was so short to make it perfect, also there was a problem with connection between the java and the data warehouse because the unstable compatibility between them.

6.4 Summary

The study was involving the matters of defining a certain kinds of requirements to design a business intelligence model for the student data warehouse, the requirements has been gathered and represented by this study and then the model was done based on these requirements, also the system has been done for the data warehouse with the ability to generate reports from it to serve as a BI tool for the users, finally the system was evaluated and successfully implemented.

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Appendix A (Questionnaire)

Business Intelligence model for a student data warehouse in UUM environment

Section A: Respondent's background

1- Name: .....

2- Gender:

[ ] Male

[ ] Female

3- Age:

[ ] 18 – 25

[ ] 25 – 30

[ ] 30 – 40

[ ] Over 40

Section B: system usefulness

1- The system is well done and displaying no error messages?

[ ] Strongly agree [ ] Agree [ ] Not sure [ ] Disagree [ ] Strongly disagree

2- The system interface was confusing and hard to be understood?

[ ] Strongly agree [ ] Agree [ ] Not sure [ ] Disagree [ ] Strongly disagree

3- The information guide inside the system made it clear for me the system capabilities?

[ ] Strongly agree [ ] Agree [ ] Not sure [ ] Disagree [ ] Strongly disagree

4- Do you think (in your opinion) that this system can help the students and solve their problems?

[ ] Strongly agree [ ] Agree [ ] Not sure [ ] Disagree [ ] Strongly disagree

5- Are you satisfied with the system that I have designed?

[ ] Strongly agree [ ] Agree [ ] Not sure [ ] Disagree [ ] Strongly disagree

6- Do you think that the staff can get a good help from the system while solving your problems as students?

[ ] Strongly agree [ ] Agree [ ] Not sure [ ] Disagree [ ] Strongly disagree

7- Are you facing any problems in the university?

[ ] Strongly agree [ ] Agree [ ] Not sure [ ] Disagree [ ] Strongly disagree

8- Do you see that it is difficult to communicate with the vice chancellor and the managing staff to get their help?

[ ] Strongly agree [ ] Agree [ ] Not sure [ ] Disagree [ ] Strongly disagree

9- If you have a system to communicate directly with the vice chancellor or the dean of your college, do you think the vice chancellor or the dean of your college will help more in your problems?

[ ] Strongly agree [ ] Agree [ ] Not sure [ ] Disagree [ ] Strongly disagree

Thank you for spending the time to fill this questionnaire; if you need to contact me please do not hesitate to send me an E-mail on harith_alyawer@yahoo.com

Harith Azam Abdullah