

The Role of Information Visualization (InfoVis) in creating Multi-dimensional View of Student Report System with the use of Business Intelligence

By

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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
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Approved by,

(Dr. Suziah Bt Sulaiman)

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

(NUR HAFIZAH BT KHALID)

ABSTRACT

Information Visualization (InfoVis) deals with data that is usually abstract, high-dimensional, and structured in a complex way. InfoVis enable viewer to gain knowledge about the internal structure of the data and causal relationship in it. Normally, it's compact graphical presentation and user interface for manipulating large numbers of items and possibly extracted from far larger datasets. Parallel to this, InfoVis enables users to make discoveries, decisions, or explanations. By implementing the features of InfoVis to the student coursework reporting, it will help students in decision making of their studies, explanations on their academic performance, and increasing their interest and awareness to their academics performances.

ACKNOWLEDGEMENT

To reach until this part of my final year project II, I am very grateful to Allah s.w.t for guiding me through all the hardships coming. I took the hardships as for testing my credibility and patient in going through the real project development by my own.

Special Credit to Dr.Suziah Sulaiman acts as my project supervisor, for the valuable guidance and advice. She inspired me greatly to work in this project and showing me some example that related to the topic of my project which helps me best in developing my project. Thus, I would like to thank her for her willingness to motivate me that contributed tremendously to my project.

Moreover, would like to express my special gratitude and thanks to Business Intelligence consultant from Fujitsu Malaysia, Miss Nazrin Fazri for giving me such attention and time in providing the MicroStrategy9 application software that useful for my project development and also with her helps and guidance in handling the application throughout the whole project development.

Not to forget, special thank to those involved directly or indirectly from project development part, user system testing and interviews session by shared their knowledge, their ideas, and numerous tips all of which culminated in the completion of this project. Finally, an honorable mention goes to my families and friends for their understandings and supports in completing this research project.

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INTRODUCTION

1.1 BACKGROUND

Research on visualization of information will be the primary research element for the entire project development. The research base on how the visualization of the report may increase the student interest and awareness to their academic performances. Thus, the study of visualization concerned on how the does visualization work and what are the tools and skills to improve and identify the uses of imagery, to change a student emotion which changes their feelings and turns into physical sensation that can relieve or eliminate symptoms.

Business intelligence normally refers to computer-based techniques that used in analyzing data, data performance, and benchmarking for some decision purposes. Its world widely used for business users, as medium for data storing, analyzing data to help user make better business decision and to get any related performances. The role of information visualization (InfoVis) in creating multi-dimensional view of student report with the use of business intelligence is main objective of the entire project development.

Base on this reporting approach, the main focus is to develop a system that provide institution with standardize and personalize reports viewing via web using MicroStrategy9 desktop software that installed. Base on MicroStrategy9 features provided, lectures (or administrator) are able to upload the spreadsheet (i.e .xls or excel file) contains student's marks, and the system will automate all the calculations precise to their needs. In the same time, students are able to access the reports shared by the lecturers through the web. As result, this report allows students to have their own academic performances and overall class performances report that graphically presented, easily understood, and visually manipulated.

1.2 PROBLEM STATEMENT

The problems usually arise when students are facing a problem in obtaining their courses marks, such as tests, quizzes, or assignments marks. Base on research, not all lectures make used of e-learning as their main medium to publish the students marks. Thus, most of the universities still using the manual approach such as paste the mark on the board or hand it out during class hour. Interviews had made between students in other universities in way to find their university approach/methods in distributing students' coursework mark.

University	Comments
Universiti Teknologi Petronas (UTP)	<ul style="list-style-type: none"> Lectures will attach the coursework to university E-Learning website.
Universiti Malaya (UM)	<ul style="list-style-type: none"> Normally student will compile their own coursework marks base on result given by lecturer in class Some of the lecturers just paste the result on academic board.
Universiti Teknologi MARA (UiTM)	<ul style="list-style-type: none"> They have no consistent tools/Portal in publishing student's coursework marks. Students have to check their marks to lecturer's room.
Universiti Teknologi Malaysia (UTM)	<ul style="list-style-type: none"> Some of the lecturers will give the marks in the class before the semester end.
Universiti Selangor (UNISel)	<ul style="list-style-type: none"> Some of the lecturers will give the marks in the class before the semester end. Some of lectures use the method of emailing the students mark.
University of Liverpool	<ul style="list-style-type: none"> Lecturers will attach the coursework to University website/subject. Not really focusing on coursework mark because most of the final paper will be 100% for final mark.

Table 1 Problem Statement: Result on student interviews

Students nowadays lack of awareness to the importance of coursework mark in their academic performances. Research has made that standard total coursework in most subjects it represents 40%-60% of the total marks available. The marks a student obtains for their coursework is actually make a big difference to the final grade they obtain in a subject. Good coursework will considerably increase student chances of success in the course.

As conclusion, it is important for institution to ensure students performances are maintained to provide best quality of students. A standardize and personalize reporting platform is important for one institution in way to improve the current methods of distributing student coursework mark. In way to solve these problems, the study of Visualization Information (InfoVis) into the student report using the business intelligence reporting platform was implemented. This is to ensure the report allows viewer to gain knowledge about the internal structure of the data to create their awareness of their performance in studies.

1.3 OBJECTIVES

The main objectives or an aim of this project is to design and develop a reporting platform for student coursework that provide the relevant multi-dimensional views with study the roles of visualization of information in creating student awareness towards their academic performances.

1.4 SCOPE OF STUDY

For this project, the scope of study will be focus on finding the most suitable technology or approach to develop this report and also searching the right platform for development phase. Since the reporting platform via web-based still new in technology, there are still many research need to done in order to smoothen the design and development phase. This is important, as this will determine the effectiveness and efficiency of the system. As where for this report system, microstrategy9 desktop software was used as my report development tool.

For scope of users, this report will focus on the student and lecturers. Related to how this reporting system may help students to obtain their own study report, and lectures obtain their student performance in studies which is actually important in succeeding on a variety of courses. For the report development, the scope of raw data (coursework marks) is correlated to Information Communication Technology (ICT) students, which consist of certain subjects, which are Network Security, Software Engineering and Distributed Computing.

For scope of study, the research on visualization of information will be the research element all over this entire project. The research base on how the visualization of the report may increase the student interest and awareness to their academics performances. The study on how the does visualization work and what are the tools and skills to improve and identify the uses of imagery, to change a student emotion which changes their feelings and turns into physical sensation that can relieve or eliminate symptoms.

1.5 RELEVANCY OF PROJECT

As stated in the problem statement, this project aim is to overcome all the difficulty faced by the students to attain their academic performance report. In The same time, this reporting approach will encourage students in achieving their targets or goals in studies and visualizations information research study may helps to create awareness on their academic performances.

1.6 FEASIBILITY OF THE PROJECT

1.6.1 Technical feasibility

Technical feasibility means “achievable”. This has to be proven without building the system where the technical feasibilities are defined by the technical aspects that can be taken into consideration before starting the development phase. Technical feasibility also determine the sensible and practicality of the whole system. For this, there are a few risk areas that should be considered:

1.6.2 Familiarity of the technology

For this project, the technology involved is the automation of report base on the raw data or spreadsheet provided. This technology mostly similar to business intelligence report viewing. For this, the risk slightly high because not every user is aware of this reporting platform since this report normally used by business people, not student either lectures.

1.6.3 Familiarity of the system

For this system feasibility, the MicroStrategy9 desktop will be use as the base for this application. MicroStrategy9 will helps to develop the report enable up to 500 users. Since Microstartegy9 is a user friendly and easy to learn base on the user guide and I information provided. Moreover, I had been used this tools for my main project during my internship.

1.6.4 Compatibility of application

MicroStrategy9 is a multiplatform compatible system. This is one of the advantages for this project where Microstrategy9 is compatible with any desktop regardless their operating system. For this, only the developer of the report should install the MicroStrategy9, yet the users (i.e lecturer) who are going to shared the file or spreadsheets, or users who want to look upon the reports (students) , they may have to login to the web.

1.6.5 Operational feasibility

MicroStrategy9 is a fully integrated Business intelligence platform that makes business intelligence faster, easier, and more user-friendly. The features available on microstrategy9 are clearly stated and easy to understand so it's really helpful to new users likes lectures and student.

1.6.5.1 Economical feasibility

Looking on the economical or cost efficiency of this project, the risk is low since, the MicroStrategy9 can be downloaded for free form the web, [1] for free trial version up to 1 year. By this, the availability of this system is huge because users only have to login to the web for report viewing, and the developer can install the microstaegy9 desktop for free.

1.6.5.2 Time feasibility

The features available in MicroStrategy9 are clearly stated and easy to understand really helpful in way to minimize time to develop the report. Yet, for the developer, to download and install the MicroStrategy9 to desktop really needs time where it required up to 3G space memory in disk. From this, more effort and development hours has to put in to ensure the report system can be done due to time constraint.

LITERATURE REVIEW

Talking about system development is more towards the technical side or more synonyms to the people with IT background. As MicroStrategy9 is one of the tools that provide a platform for report development where it is one of the products lay under business intelligence. A report is a textual word that is really related to some key performance indicators where it used to display the result of an experiment, investigation, or inquiry and normally used in government, business, education, science, and other fields. [2] Before discussing more about this subject or terms, it is wise to prepare the fundamental understanding of the visualization information act as research elements for this project that can provide a better overview of the subjects.

2.1 Visualization Information and goals

Information Visualization (InfoVis) deals with data that is usually abstract, high-dimensional, and structured in a complex way. InfoVis enable viewer to gain knowledge about the internal structure of the data and causal relationship in it. Normally, it's compact graphical presentation and user interface for manipulating large numbers of items and possibly extracted from far larger datasets. Thus, InfoVis enables users to make discoveries, decisions, or explanations. [3]

2.1.1 Graph visualization

Information visualization research dealing with unstructured data has a distinct flavor. Graph visualization has many areas of application which means that we will approach the results of graph drawing for a student report card from a different perspective measured. In this section we present a set of principles to keep in mind when designing a visualization tool. These principles are

- Primary goal in constructing an academic visualization is to instruct, not to entertain. Although we may want to use graphic 'tricks' to grab students' attention, we only keep their attention if the graphics truly lead to better understanding of the material.

- Provide the user with simultaneously identical views of different report presentation by manipulating the same data: this principle is the ‘dual’ to the preceding one. When comparing different reports, it is imperative that the student be able to watch how each would operate using the same data set. Such a comparison should be carried out by presenting the same view of the two KPI report in different views by comparing the KPI by table views or graph views and identify the students awareness towards this process. [4]

According to Miller in [5] “It is much easier to draw a visually attractive picture than it is to draw a useful one. Provide the user with a multi-dimensional view of report to manipulate within this learning curve can be greatly reduced by presenting the user with different views of the data and results.

2.1.2 How Visualization Helps You Reach Your Goals

Albert Einstein said, "Imagination is everything. It is the preview of life's coming attractions." Visualization is the act of recalling or forming mental images or pictures in your mind. It is one of the most powerful tools you have in turning your dreams, goals and desires in to reality. Related to this project, it will focus on how the visualization of report will helps student in achieving their goals in studies. Using this technique will greatly expedite the achievement of any goal you may have. The three ways in which visualization helps us realize our dreams are [6]

- It activates the creative powers of your subconscious mind.
- It focuses your brain by programming its reticular activating system, or RAS, so that it notices the resources that are always available to you but likely unnoticed.
- It magnetizes and attracts to you everything you need to achieve your goal such as resources, people and opportunities.

For my project, I will focus more on statistical indicators and information measurements, information and the results and information about users’ perceptions categories. These categories help to identify how the used of colors, designs and

types of visualization into users response and awareness. Table below shows the examples of information used in visualization.

















Information categories	Examples
Information about the input data	
Abstract geometric and temporal characteristics	Skeletons, features, events
Topological properties	Contour tree for volume data, vector field topology, tracking graph for time-varying data
Statistical indicators and information measurements	Histogram, correlation, importance, certainty, entropy, mutual information, local statistical complexity
Information about the results	Color histogram, level of cluttering
Information about the process	Interaction patterns, provenance
Information about users' perceptions	Response time, accuracy

Table 2 : Information categories in visualization

2.1.3 Types of visualization implemented in the project

Base on my literature review study, below are different types of views that implemented in my project to support visualization feature to user. They are

- Colors schemes

<p>Report interface</p>	<ul style="list-style-type: none"> • ppearance of stability is important for report sites. The family of turquoise and gray was chosen to represent the formality of the report. 																		
<p>Graph color schemes</p>	<ul style="list-style-type: none"> • Color schemes on gauge/ metering graph represent student's rank/standing performance in class. <table border="1" data-bbox="707 1749 1251 2024"> <thead> <tr> <th>Mark</th> <th>Color</th> <th></th> </tr> </thead> <tbody> <tr> <td>0-14</td> <td>Red</td> <td></td> </tr> <tr> <td>15-29</td> <td>Orange</td> <td></td> </tr> <tr> <td>30-34</td> <td>Yellow</td> <td></td> </tr> <tr> <td>35-49</td> <td>Light Green</td> <td></td> </tr> <tr> <td>50-60</td> <td>Green</td> <td></td> </tr> </tbody> </table>	Mark	Color		0-14	Red		15-29	Orange		30-34	Yellow		35-49	Light Green		50-60	Green	
Mark	Color																		
0-14	Red																		
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30-34	Yellow																		
35-49	Light Green																		
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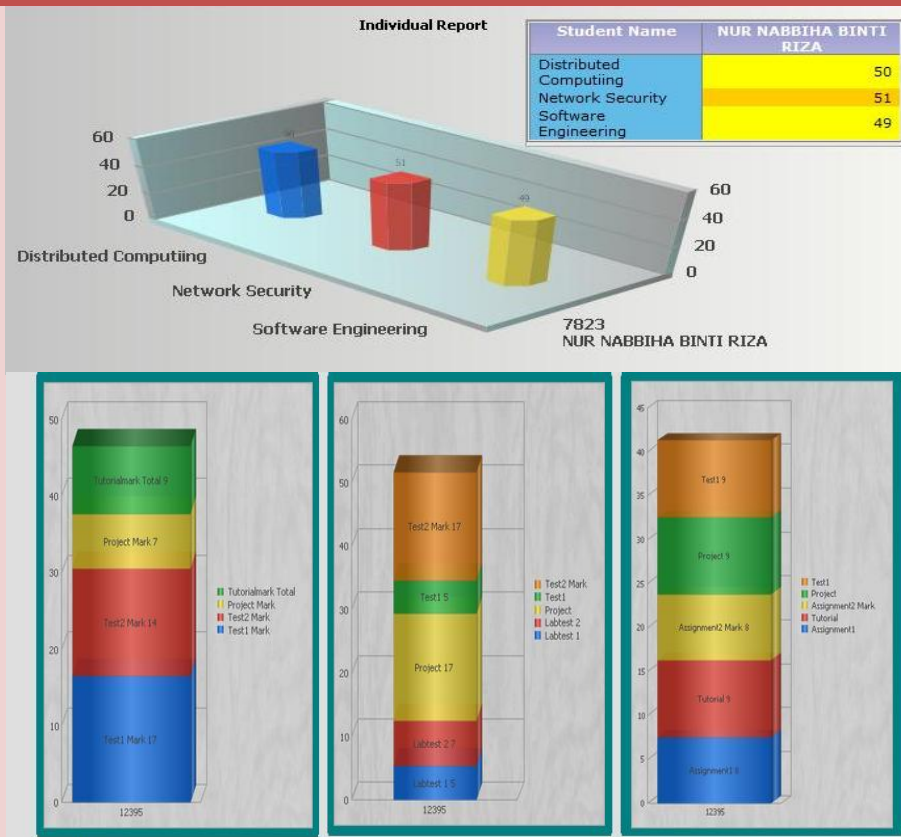
- Graphical views

Table

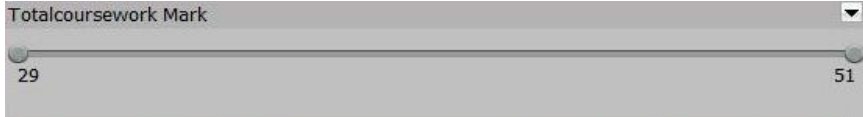
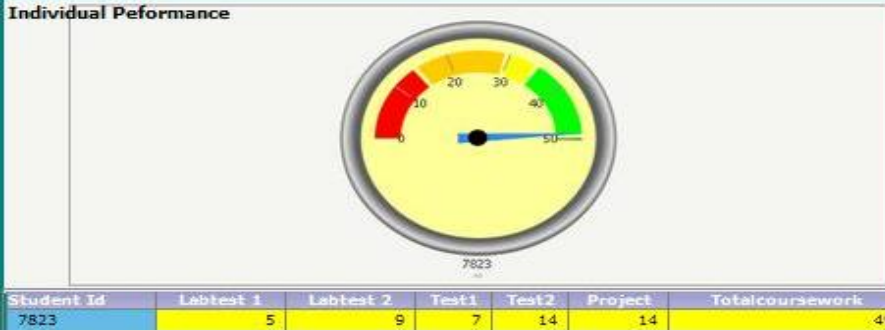
Student Id	Labtest 1	Labtest 2	Test1	Test2	Project	Totalcoursework
7823	5	9	7	14	14	49
8296	7	7	7	18	13	52
8807	7	9	5	11	11	43
8808	9	9	7	8	17	50
8811	7	7	7	7	17	45
8853	7	5	5	8	14	39
8925	5	5	5	7	18	41
9229	5	5	7	8	11	37
9244	5	5	5	9	15	40
9316	7	7	7	9	17	47
9556	7	7	7	9	15	44
10050	7	5	5	8	13	38
10398	5	5	7	9	11	37
10860	9	7	5	15	15	51
10863	9	5	7	13	13	47
10894	7	5	7	18	18	55

- Table allows showing the relationship of data with organized rows and columns. All data are represented in the simple way makes the information easier to be obtained.

Bar Graph



- A bar graph is a visual display used to compare the amounts or frequency of occurrence of different characteristics of data that allows quick generalizations about the data.

<p>Ranking method</p>	 <ul style="list-style-type: none"> • Ranking grades (rank base on mark value or rank from highest to lowest value) on a simple best-to-worst scale to develop a quality student • Ranking scales can make it easy for those who gather and tabulate the results. 														
<p>Metering/ Gauge</p>	 <table border="1"> <thead> <tr> <th>Student Id</th> <th>Labtest 1</th> <th>Labtest 2</th> <th>Test1</th> <th>Test2</th> <th>Project</th> <th>Totalcoursework</th> </tr> </thead> <tbody> <tr> <td>7823</td> <td>5</td> <td>9</td> <td>7</td> <td>14</td> <td>14</td> <td>49</td> </tr> </tbody> </table> <ul style="list-style-type: none"> • The gauge level/curves that result changes in student behavior represent their level of performance in class 	Student Id	Labtest 1	Labtest 2	Test1	Test2	Project	Totalcoursework	7823	5	9	7	14	14	49
Student Id	Labtest 1	Labtest 2	Test1	Test2	Project	Totalcoursework									
7823	5	9	7	14	14	49									

2.1.4 Visualization viewpoints

Refer to this student KPI report, data's that representing the student marks may interpreted to the information and knowledge which will be represent in multi-dimensional views of report to visualize a the information to the user's. In visualization, the terms of data, information, and knowledge extensively used in interrelated context. Visualization is concerned with exploring data information where its primary objective is to gain insight into information space and information visualization (for data mining and knowledge discovery). [7]

2.1.4.1 A Visualization Process Is a Search Process

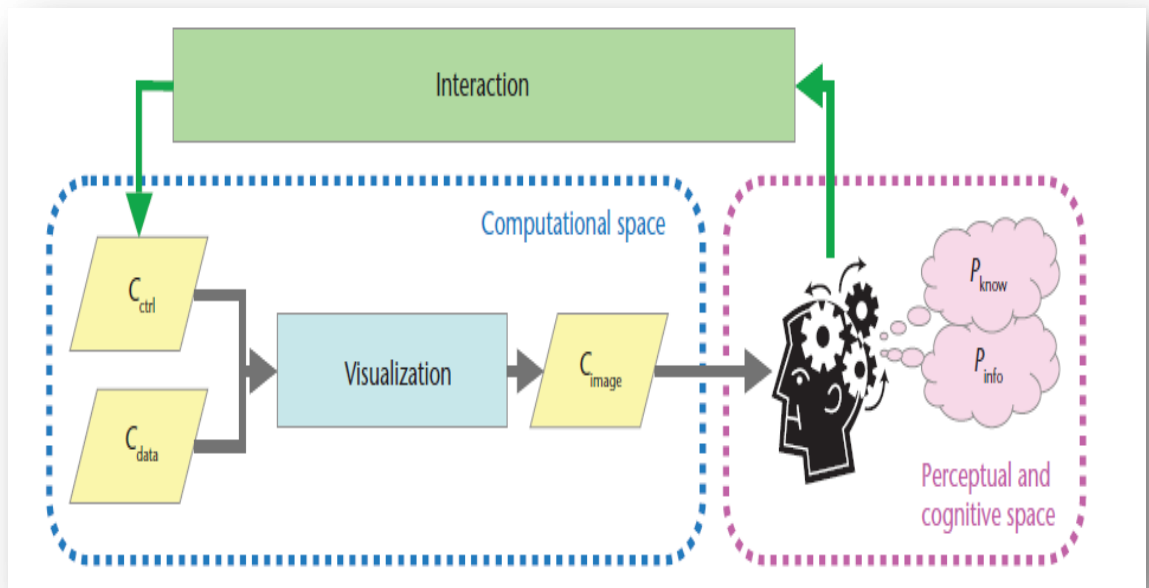


Figure 1: Visualization process

A typical visualization process, where interaction provides the primary means for reducing the search space in visual exploration C_{data} , C_{ctrl} , and C_{image} denote input data, control parameters and visualization results stored in computer memory, respectively. P_{info} and P_{know} represent the information and knowledge.

- C_{data}
 - User first makes decisions about which visualization tools to use for exploring the data set. The user then experiments with different controls, such as styles, layout, viewing position, color maps, and transfer functions, until he or she obtains a satisfactory collection of visualization results,
- C_{image}
 - Depending on the visualization tasks, satisfaction can come in many forms. For example, the user may have obtained sufficient information or knowledge about the data set, or may have obtained the most appropriate illustration about the data to assist others in the knowledge acquisition process.

- *Pinfo*
 - The perceptual and cognitive space that obtained by the receiver of a message is related to the amount by which that message reduces the receiver's uncertainty about some aspect of the universe of discourse.

- *Pknow*
 - Understanding, awareness, or familiarity of the visualization by acquired through education or experience. Anything that has been learned, perceived, discovered, inferred, or understood. The ability to use information [*Pinfo and/or Cinfo*]

2.1.5 Visualization support cognition

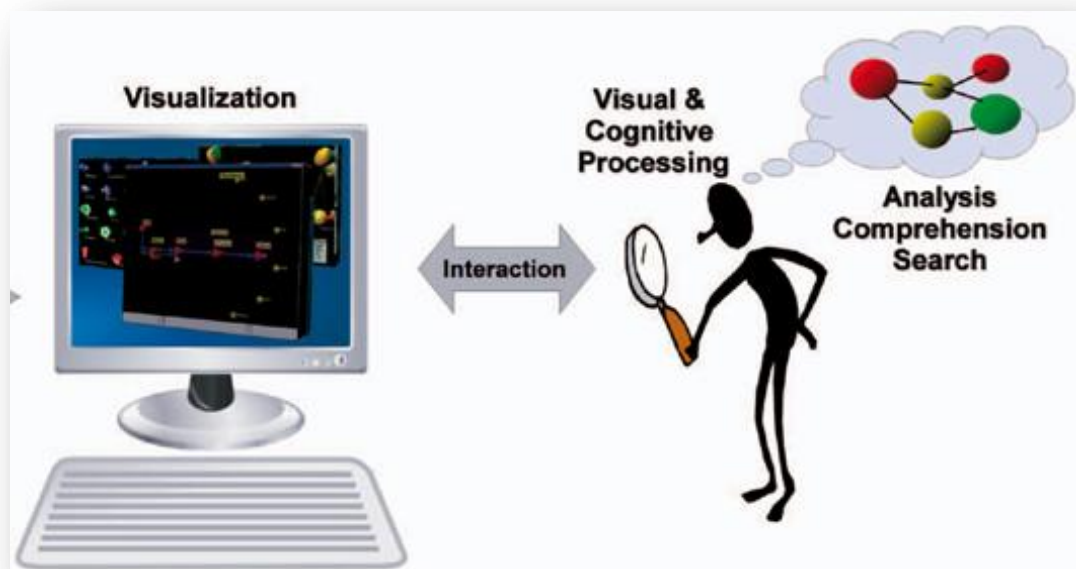


Figure 2 : Visualization support cognition

In science, cognition is a group of mental processes that includes attention, memory, producing and understanding language, learning, reasoning, problem solving and decision making. Cognition is a faculty for the processing of information, applying knowledge, and changing preferences. [8] How InfoVis support cognition are bases on these perspectives: [9]

- **Enhanced Recognition**
 - Recognizing information presented visually that is easier than recalling information. (i.e table)
 - Abstraction and aggregation for selective omission and aggregation of data which allow a higher level pattern to be recognized. (i.e metering view)
- **Reduced search**
 - Grouping for easier search and access. (i.e pie chart)
 - Structured data and tasks that can reduce task complexity.
 - High data density by represent a large quantity of data in a small space.(i.e histogram)
- **Increased resources**
 - External memory- visualization are external data representation that can reduce demands on human memory.
 - Parallel processing by the visual system can increase the bandwidth of information extraction from the data.
 - Increased storage and accessibility with large amounts of information in an easily accessible form.
- **Manipulate medium**
 - Allow interactive exploration through manipulation of parameter value. (median/average/mode)
 - Structural organization of data allows different patterns to be recognized. (lowest to highest rank to value)

2.2 Introduction to Business intelligence (BI)

2.2.1 What is BI

Refer to the Business intelligence (BI) has different definitions from different fields of experts. Basically, BI describes the result in-depth analysis of details business data, including database and application technologies that much broader [10]. According to [11] BI is a term that encompasses a board range of analytical software and solution for gathering, consolidating, analyzing and providing access to information in way that is supposed to let

an enterprises users make better business decisions. BI normally refers to the use of technology to collect and effectively use information to improve business efficiency. An ideal BI system may give an organizations, employees, partners, and supplier to easy access to the information needed to their jobs and the ability to analyze and easily share the information with others.

2.2.2 Functionality of BI

Based on [12] Business Intelligence research on Operational of BI, Colin White has identified that the functionality of BI are base on these three considerations, which are business, technology and cost.

- *Business Considerations*

BI is concerned with making the organization more agile where it most priority in building an operational BI system is to satisfy the business needs of the organization. This agility is not achieved by simply deploying real-time BI applications, but has to build operational BI applications that meet the right-time needs of business users of new BI technologies. Operational BI, however, does not come free of charge even though it a compromise between IT costs and business benefit

- *Technology Considerations*

An operational BI environment requires the BI system to be tightly integrated with operational systems. The direction of IT is to build an integrated business environment around a service-oriented architecture (SOA). In an SOA environment, business process, business application, and data activities and operations are broken down into individual services that can interact with each other. An SOA is useful in an operational BI because it enables data integration and BI processes to be encapsulated and defined as a set of services.

- **Cost considerations**

Some hardware and software in technologies on the market may help in reduce the cost of operational BI. BI environment can be broken down into three main components:

- A data integration services component that provides right-time data integration.
- A data management services component for storing, managing, and processing business information and operational intelligence.
- An analysis services component that supports operational BI reporting, operational BI performance management, and decision automation.

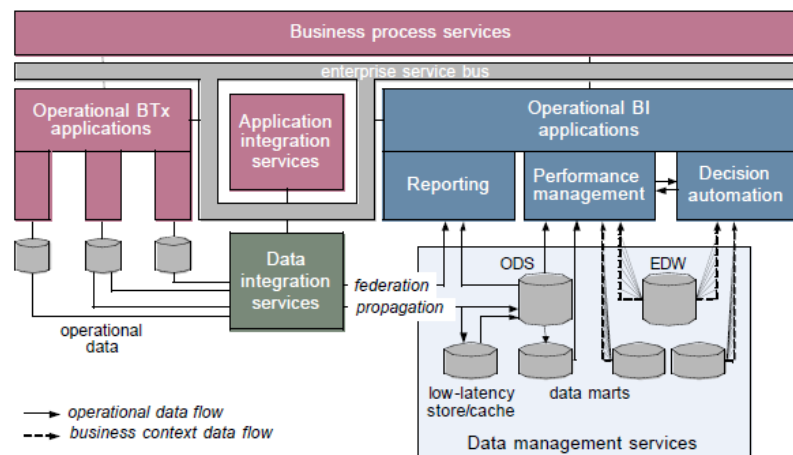


Figure 3 : BI Components

2.2.3 Business Intelligence using MicroStrategy9

MicroStrategy9 is a fully integrated BI platform that makes Business Intelligence faster, easier, and more user-friendly [13]. Microstrategy9 has explained the functionality of the business intelligence the four main functions, which are basic objects, schemes object, application objects, developing report and formation report. MicroStrategy was chosen base on several criteria's that makes this application software stand up compare to the others. Refer to the diagram below, shows that Micro strategy is the best business intelligence products compare to its competitors such as IBM, Oracle, Microsoft SQL and etc. Thus, MicroStrategy customers rated their

overall product support quality nearly 100% higher than others products base on their largest amounts of data, to a median of 6.6 GB overall (with 15,000,000 raw data in 1 excel sheet) and able to handle large & detailed applications. Moreover, it is the most suitable for software for web deployment and more widely deployed via the Web than any other product. Refer to the standardization of the products; it is easy to use suitable for a wide range of BI applications that is providing the full range of BI functionality [14]

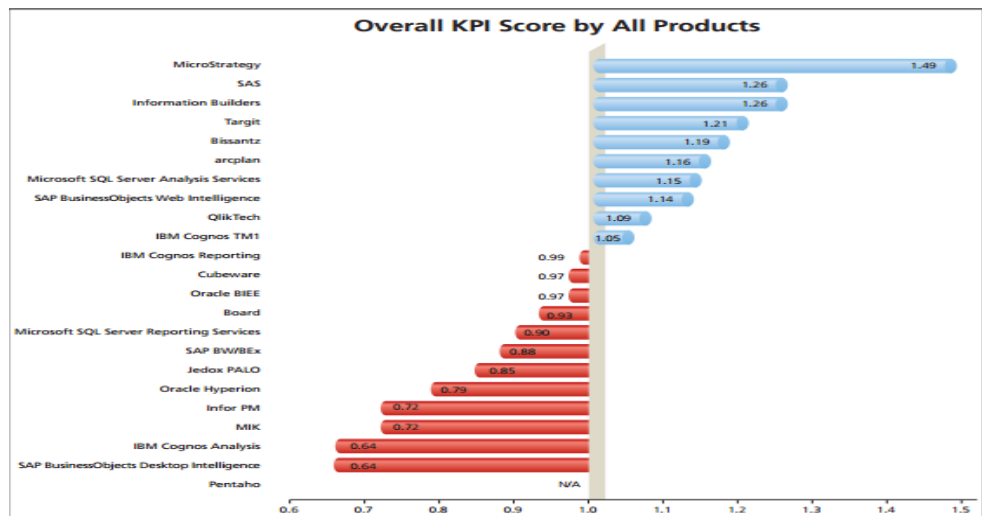


Figure 4: BI products score

2.2.3.1 Web Delivery

- Microstrategy is the most suitable for software for web deployment that is more widely deployed via the Web than any other product.

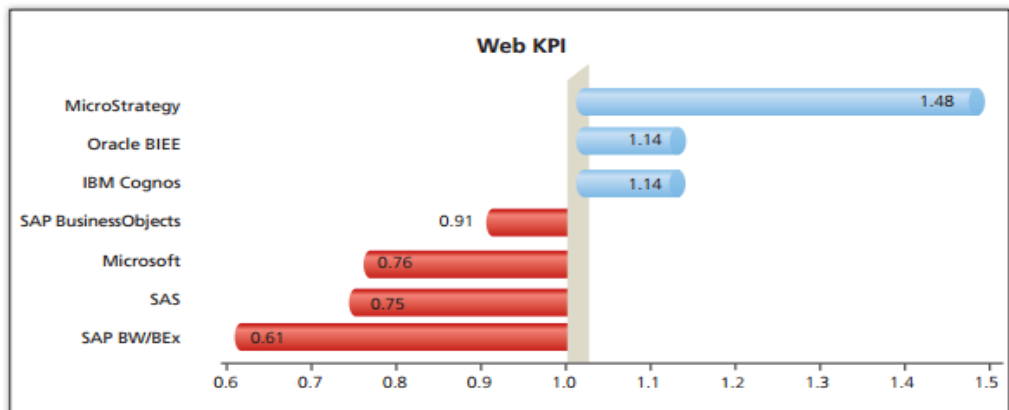


Figure 5: Microstrategy web KPI

2.2.3.2 Product to Standardization

- Microstrategy products that are good candidates for standardization because it is easy to us, provide the full range of BI functionality and suitable for a wide range of BI applications.

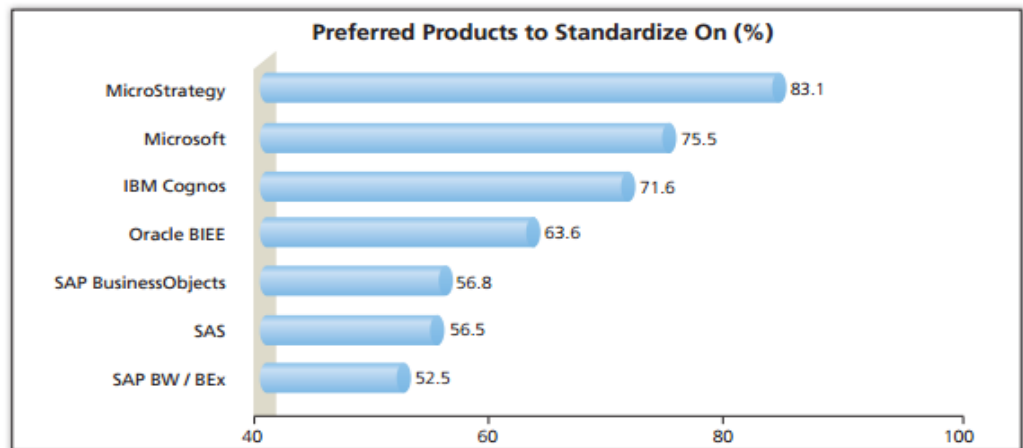


Figure 6: Microstrategy Product to Standardize

2.2.3.3 Data Volumes

- MicroStrategy analyzed by far the largest amounts of data, to a median of 6.6 GB overall (with 15,000,000 raw data in 1 excel sheet) which able to handle large & detailed applications

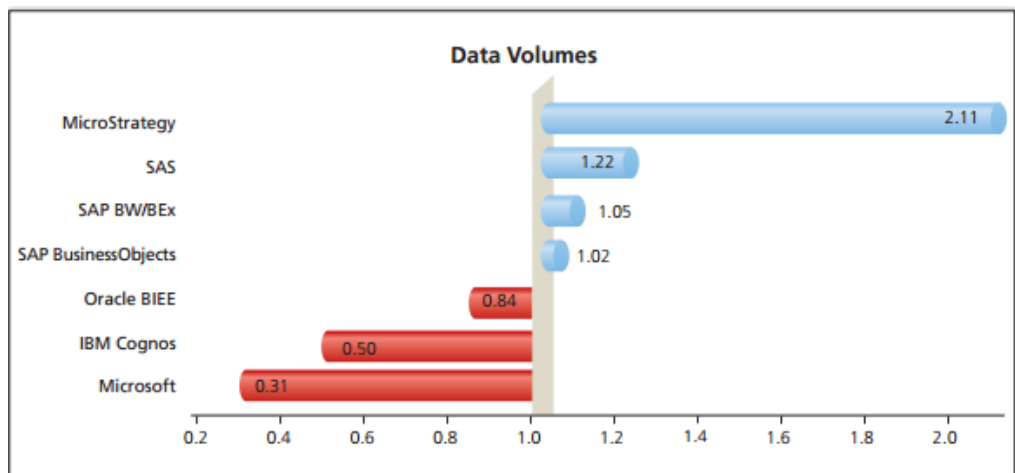


Figure 7 : Microstrategy data volumes

2.3 Key Performance Indicator (KPI)

A performance indicator or key performance indicator (KPI) is an industry jargon for a type of performance measurement. KPIs are commonly used by an organization to evaluate its success or the success of a particular activity in which it is engaged. [15] Key performance indicators (KPI's) are one of the most importance measurement elements to measure performances of any effective services to user relationship management framework. Normally KPIs being prepare to the report and generated on a periodic that should cover the key targets of customers/users level, quality of service, cost and efficiency.

Journal of institution Research of South East Asia, [16] stated that an education has become as necessary tool for improving, and sustaining human capital. Case study was through on institutional planning that strives to achieve evidence of teaching and student learning. An integrated planning process was developing to maintain university's strategic plan and their short-term planning objectives, reviewing key performance indicators for the strategic plan and assessment to accomplish of the long term goals.

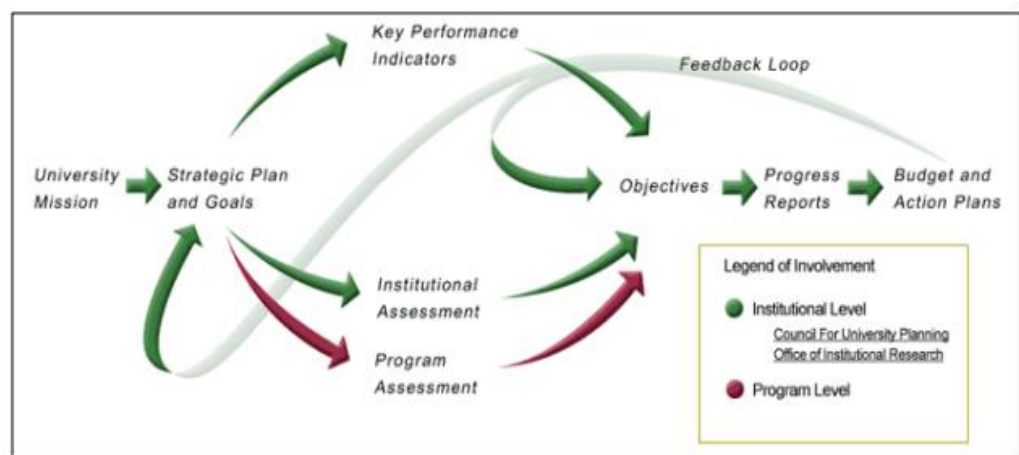


Figure 8: Integrated planning process in education

Refer to figure above, key performance indicators are defined to describe the scope of concern and expectation, it's directly related to set of goals. Basically the KPI's provide a summary that Enable University's to

compare the current KPI to previous measurement period as means of documenting trends and tracking process. Moreover, the progress report is prepared that is include updated key performance indicator information's. Based on the evidence in progress report, action plan is develop to describe the working group recommendations.

2.3.1 Students perspective on report card in students education

The purpose of this thesis study by [17] is to examine the relationship between learning and reporting and to explore the student perception as to whether the written report card supports and encourages in the student learning. Base on the finding form the interview and questionnaires.

1. Is the report card informative and useful to students?

Most of the interviewed students felt happy about the report card and fount it useful, especially on the structured written comment section which describes a student's areas of strength and areas in need of improvement. Generally, student felt the purpose of report card is important in way to motivate and improve themselves.

2. Does the report card support student learning?

Report card served as a tool for student self-motivation to their self-motivated performance. Student basically felt that comments and letter grades supported student learning by describing progress, complimenting achievement, and explaining that needed to be improved. Most students felt that structured written on comment section best explained what they had learned or not learned. Most students said that the report card provided compliments that essential to them, to be alert to the improvement that needed to be made.

3. Does the report card encourage learning?

For student, the letter grade as a signal for acceptable or unacceptable progress. Student who understand them (letter grades), they will help you to know you're at a good level or not. They found that letter grades encourage

students to learn for two reasons, comparison and competition. This is useful to monitor success by comparing letter grades received to method of study used. However, the report card tended to be discouraging, rather than encouraging, for low achieving student because no matter how hard they tried. This is where the comments of courage's form the report card is important

METHODOLOGY

3.1 Visualization Information Research Methodology

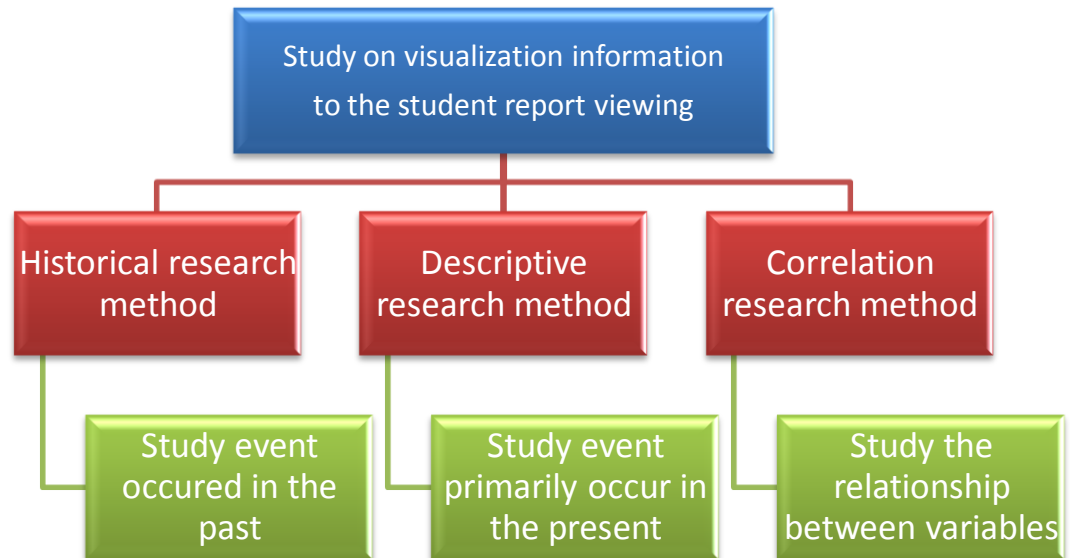


Figure 9: Research methodology

Refer to figure 8; visualization of information element was used through the complete project development. With study on “when” and “where” the visualization information may helps users to be aware and attracted to the visualization, study on “how” the does visualization work and what are the tools and skills to improve will be carry out to identify the uses of imagery which changes their feelings into physical sensation that can relieve or eliminate symptoms and the study on “who” are our targeted users and what types of visualization fitting best to them. The methods of this project are base on three types of research methods, which are historical, descriptive and correlation research.

- Historical research comprises the techniques and guidelines by which historians use primary sources and other evidence to research and then to write histories in the form of accounts of the past. The question of the nature, and even the possibility, of a sound historical method is raised in the philosophy of history as a question of epistemology. The study of historical method and writing is known

as historiography. [18]. The study of historiography of visualization information to this project as discusses in the literature reviews part will be conducted to identify particulars facts that may helps to apply in the project.

- Descriptive research method does not fit neatly into the definition of either quantitative or qualitative research methodologies, but instead it can utilize elements of both, often within the same study. The term descriptive research refers to the type of research question, design, and data analysis that will be applied to a given topic. Descriptive statistics tell what is, while inferential statistics try to determine cause and effect. [19]. For further details of descriptive analysis will be explained in the project methodology part as below.
- Correlation research is a form of analysis in which you correlate one variable with another to determine if there is a relationship between them. Correlation research is used as a first step prior to experimentation when experiments cannot be conducted (for ethical or practical reasons). The information gathered through surveys, observation and questionnaires to achieve various goals. [20] Results for correlation research will be explain more to the result and finding part in chapter 4.

3.2 Project methodology (Throwaway Methodology)

In this project, throwaway methodology was used for system development method. Start with planning phase on the identification by the project developer towards a need or an opportunity. Next was project analysis and followed by the project design. Prototype was developing in design phase, but the prototypes actually do nothing but it helps user visualize the system being built. Building dummies is considered easier and less time consuming than building working prototype Based on user comments, the next prototype continuously build until it can visualize the real working system. This method, best if possible to do a thorough initial analysis before develop the dummy prototype that needs to contain enough details about the real system. Throwaway methodology helps to deliver the complete system very quickly with shorter project timeline at design system flow phase. The

system was implemented with the working functions system after the system designs are ready.

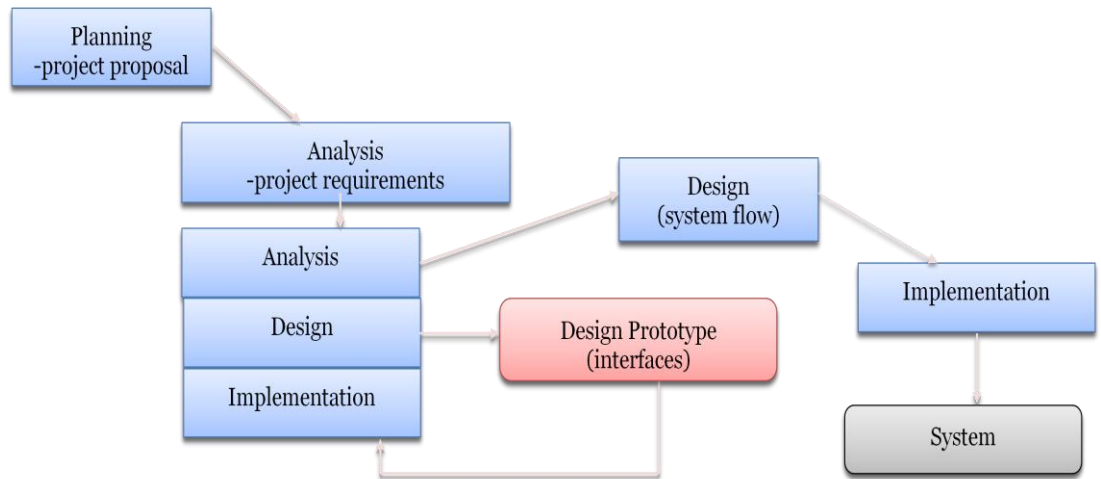


Figure 10: Throwing away methodology

3.2.1 Planning

Planning phase begins with the identification by the project developer towards a need or an opportunity. The need is identified by recognizing the relevancy of having a system that could be developed in order to fulfill the flaws from existing systems. The relevancy of the project is to familiarize the reporting system to students and lectures. A proposal is created in this initiation phase containing the objective of the project, the project overview, the problem that could be state based from the analysis earlier, and the skill and technology that could be needed in order to develop this system.

- Research hypothesis for this project are:
H1: This reporting system enable student to create awareness on their academic performances base on visualization information approach.

The planning documents developed in this phase. Planning documents include the Gantt chart of the project, the timeline, the cost needed in this project, who is involve, future system outcome and data gathering.. There are several tasks in planning phase. They are:

3.2.1.1 Developing the solution design and architecture

The design process was developed that consists of the solution design and architecture. A current or exiting business report was used as a guide line and references.

3.2.1.2 Validating the technology

Technologies validation will be examined in order to make sure they meet the business needs for specific solution.

3.2.1.3 Creating functional specification

This task includes a functional specification that describes the solution requirements, its architecture, and the detail design for the features. This task will be the bridge between the user and the developer.

3.2.1.4 Creating the project schedule

The developer will create milestone-driven schedules for the time taken to develop this project and each role. For the first past of final year project 1 (FYP1), the main activities are more focusing research and also running the user acceptance data collections to make sure that the system will be develop in final year project 2 (FYP2) are visible and will be useful to the user. Below are the highlights or milestone of the FYP1 and FYP2

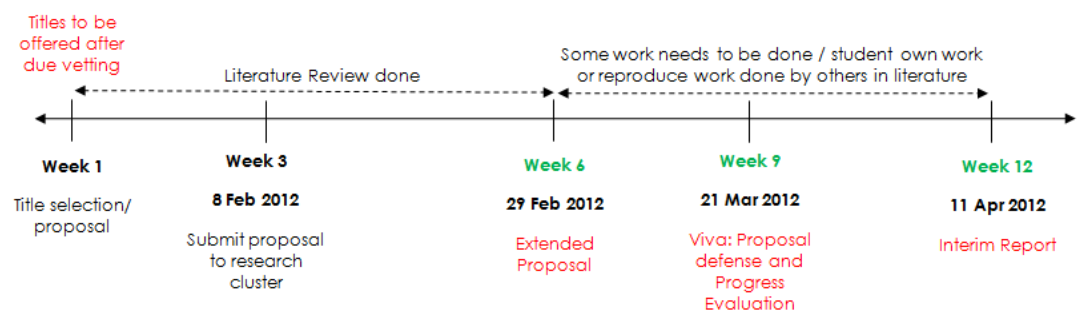


Figure 11: Project timeline FYP1

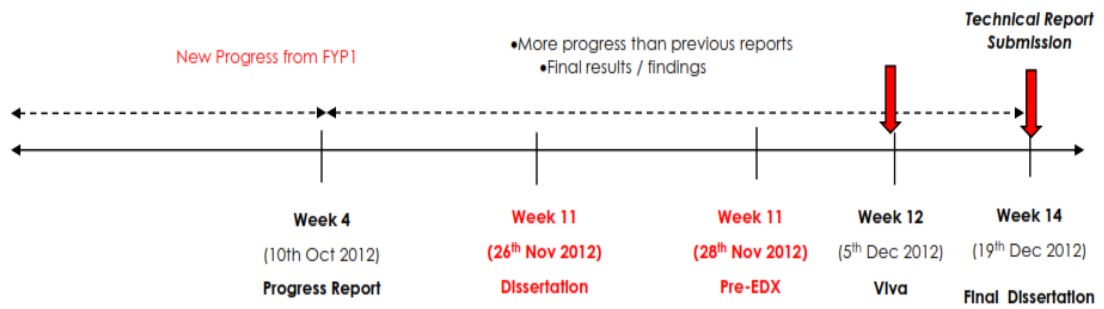


Figure 12 : Project Timeline FYP2

3.2.1.5 Gantt chart

Gantt chart is a useful tool for planning and scheduling project and also helpful in way to monitoring a projects progress. It's a graphical approach to visualize the planning of how to achieve the goals of the projects. It is important to avoid from any unforeseen circumstances and challenges. Below is the chart that have been planned throughout final year project 1 (FYP1) and continued with final year project 2 (FYP2) proposed plan.

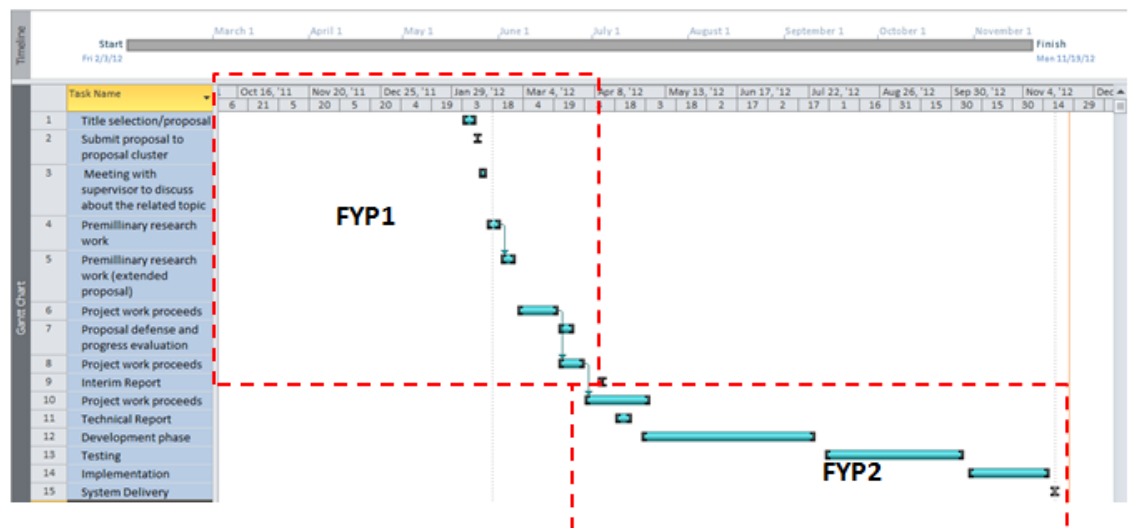


Figure 13: Project Gantt chart

3.2.1.6 Close the planning phase

Planning phase will be completed along with the approval process for the project plans.

3.2.2 Project Requirement Analysis

Requirement analysis will involve the activities like collecting the user needs and requirements. Information collections done by interviewing the user in an organization, study the taxonomy of the organization, and read the annual report with regard to this patenting and protecting issue. Instead of collecting data for the user, software/hardware requirements should take into considerations.

3.2.2.1 Software/ hardware Requirements

- Desktop (Laptop or PC)
- Microstratgey9 desktop software
- Server to store data of the application (Microsoft Access/ Microsoft Excel files)
- HTML language for programming & SQL Script

3.2.2.2 User Requirements

➤ Methods of Data Collection

Data collection is one of the Qualitative research approaches. There are 2 types of data, which are Primary and Secondary data. Raw or primary data is a term for data collected from a source. Raw data has not been subjected to processing or any other manipulation. [21]Secondary data is data collected by someone other than the user. Common sources of secondary data for social science include censuses, surveys, organizational records and data collected through qualitative research methodologies [22] For this project, 2 types of data are to be collected:

- Online survey was conducted to the target users which are lectures and students. Data ask in the questionnaire will be the key to the analysis phase where it is the quantitative data type. From these data,

various analyses can be produce. Thus, research on journal, articles and papers available on the internet regarding on the related topics of the projects.

➤ Sample Design (Population)

A population is the full set of cases that the evaluators have a question about. In sampling, this includes defining the population from which our sample is drawn. A population can be defined as including all people or items with the characteristic one wish to understand [23]. In this project, the population is the number of:

- Students of UTP itself including the local and international students, the Foundation, Degree, Masters and PHD students.
- Lecturers of UTP, which covers all the lecturers, form the entire department available in UTP such CIS, Civil, Mechanical, Chemical and others.

3.2.3 System Architecture

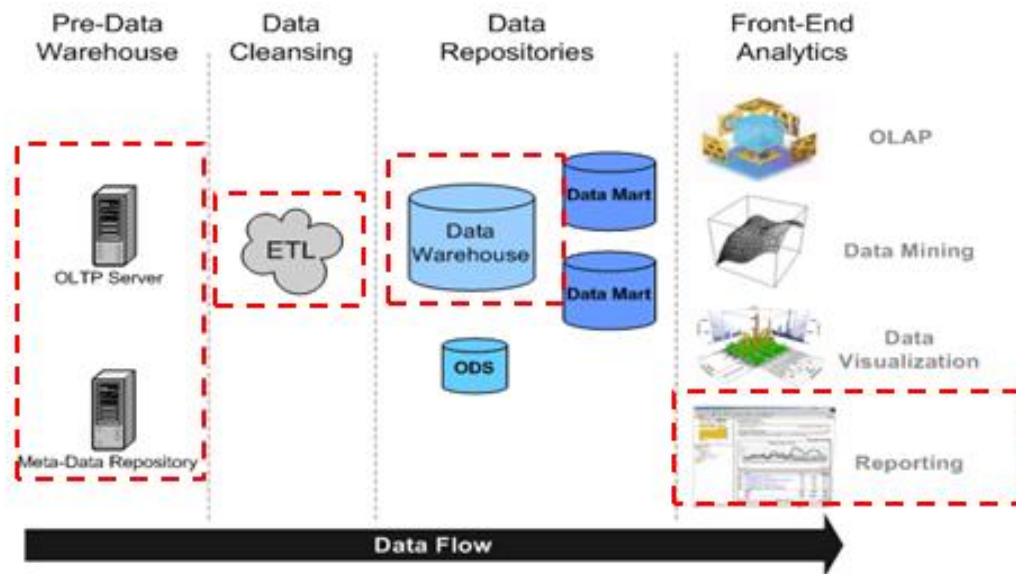


Figure 14: Microstrategy9 system architecture

Figure above shows the flow of business intelligence which implemented in Microstrategy9, where it builds from four main application objects which are:

- Pre-Data Warehouse
 - Microstrategy9 server was used because it is one of business intelligence product.
- Data Cleansing
 - Extract, transform and load (ETL) is a process in database for
 - Extracting data from outside sources
 - Transforming it to fit operational needs
 - Loading it into the end target (database or data warehouse)
- Data Repositories for my project will involve:
 - Data warehouse is a data stored in an electronic format, structure conducive to high speed analysis and summary reporting
 - Designed to provide fast, effective reporting with raw data collected from many sources

- Front-end Analytics
 - Report was created from data warehouse. This is one of web database development gained by utilizing summarized data warehouse information by using of tools such as charts, graphs that can be customized to the precise needs of the user.

3.2.4 System Flow and Design

The reason of design studies is to improve the effectiveness of this application system throughout its development timeline. The scope and boundary of this system will be defined in this phase. A study the concept of the development may help developer in implementation phase to ensure the project meets user satisfactions. Design for the project was based on dummy prototype which has been discussed in throwaway methodology. The best design prototype leads to easier project implementation but, the clear understanding and analysis through project flow must be identified before enter to design and implementation phase.

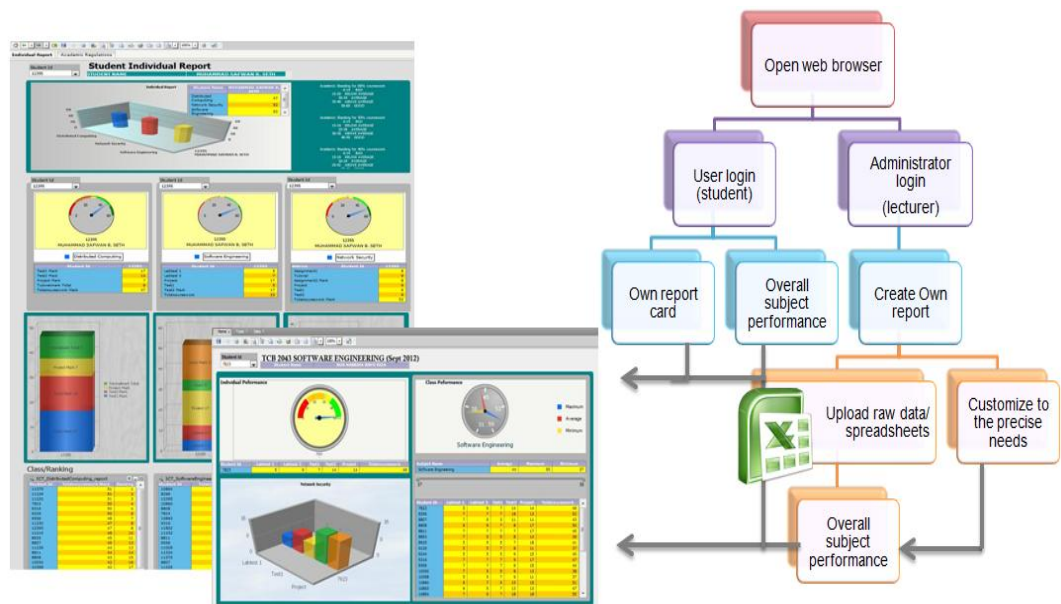


Figure 15 : System flow

3.2.5 System Implementation



Figure 16 User login interface

Users will login to the report from the website using the Universal Resource Locator (URL) created. The URL can be created from the developer laptop/desktop IP address, which is mean the developer laptop/desktop will act as development server. This can be done, downloading Apache Tomcat and the laptop/desktop must always be connected to internet. Moreover, developer is allowed to rename their IP address to the URL that is easier to be share to among the users. Furthermore, instead of using the IP address from the developer, this website URL can be created by combining this report to the university portal which more easier because users can directly link to the report when and if they open to the university portal.

There will be to types of user login. They are students and lectures. Lectures will login as administrator login because they are the persons who will upload the spreadsheets that contain student marks and able to create their own report base on the subjects' teaches. Administrator is allowed to customize to their own needs on what details to be display to students.

In the same time, students who are login to the report are able to view the marks uploaded by the lectures. They can view the report base on the class or their individual report. For their individual report is directly retrieve base on the student ID matrix/column form the spreadsheet file uploaded by the lectures. The report was represented with multi-dimensional view which user friendly and feasible to the end-users.

This project was implemented using the Microstrategy desktop base on three mains part of implementation which are user authentication, data warehouse and report design and formats. The implementation processes was explained in details at next subtopic.

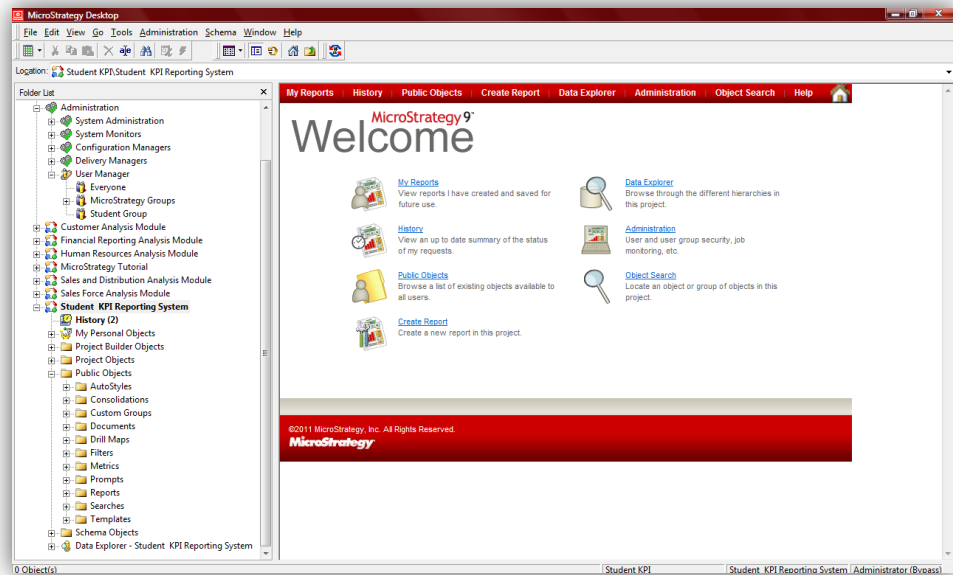


Figure 17 Microstrategy FrontPage interface

3.2.5.1 User Authentication

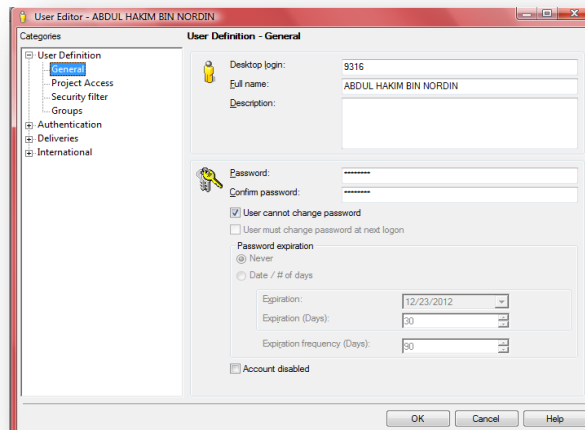


Figure 18 : User Authentication

20 samples of students were involved in this project development. Each student's ID was created which enabled them to log into the system and view their report through the web. In order to ensure report privacy and confidentiality for individual students, students are only allowed to view reports that are shared by administrators and reports that contain their own student ID. This means that students have to log into the system with their own student ID, and then the system will directly retrieve the ID and compare it to the student ID at matrix/column form in the spreadsheet file (database) in the data warehouse.

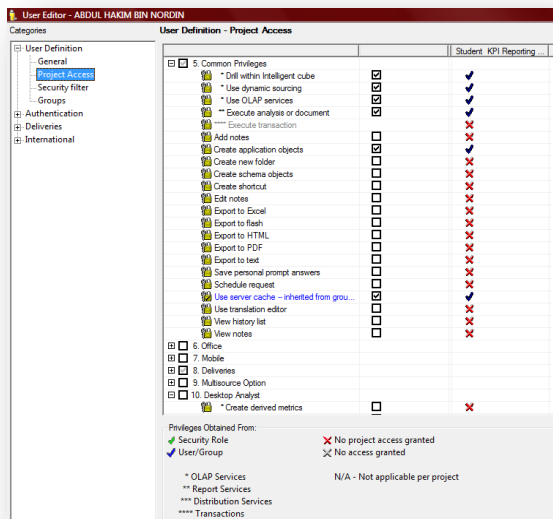


Figure 19: User Access Grant

In addition, administrators will filter the project accessibility and limitation of the shared report in the “User Definition” setting, in order to maintain the confidentiality and integrity of the individual report. There are certain limitations which are granted to students where they can only view and export or download reports but not change reports that are shared to them.

3.2.5.2 Data Warehouse

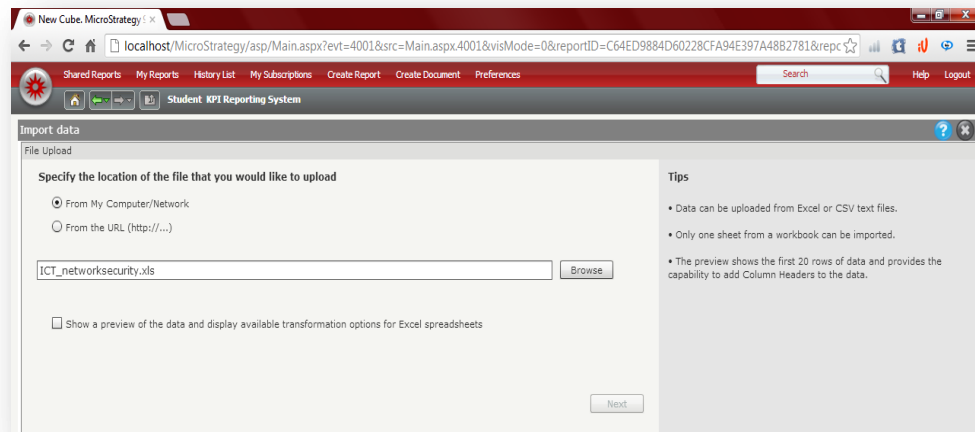


Figure 20 : Data Warehouse field

Data warehouse is where a data stored in an electronic format, structure conducive to high speed analysis and summary reporting. It designed to provide fast, effective reporting with raw data collected from many sources. For this project, spreadsheet of student coursework mark from microsoft excel (.xls file) was uploaded to the system. Once it uploaded, administrator will decide which collums from the excel file will act as a metric and an attribute in dataset before the report was created. Student ID, student name and course name act as attribute and all collums that related to students mark will act as metric in dataset.

Several subjects from IT department was chosen for this proeject. It involves of three subjects related to IT course, which are Network Security, Software Engineering and Distributed Computing. As result, all student marks related to these subjects was uploaded from the intelligence cube and saved in report format.

3.2.5.3 Report Design & Formats

Student report was designed and created using all the data saved in data warehouse. With the complete features and functions provided under Microstrategy9 desktop, a multi-dimensional view of report is able to be created. For each report, it required a dataset/datasets (contain raw data of student coursework mark) along with it metrics and attributes. Attributes and

metrics' were chosen and dragged into grid in the report panel. The grid was customized to ensure it represented in multi-dimensional views to create information of visualization to the users which parallel the main objective of this project. Related to our literature review; in way to support cognition in visualization, the criteria's of reports were implemented as below:

- Bar Graph of coursework mark reduced task complexity.
- Gauge/Metering of total accumulated coursework mark creates awareness towards performances in studies.
- Pie Chart represents a summary coursework mark for all subjects taken.
- Ranking of coursework mark value for easy search and access of data.
- Median, average and mode value of mark for each subjects allows interactive exploration through manipulation of parameter values
- Structural organization of data in the report, allow different patterns to be recognized, data easily accessible and remembered.

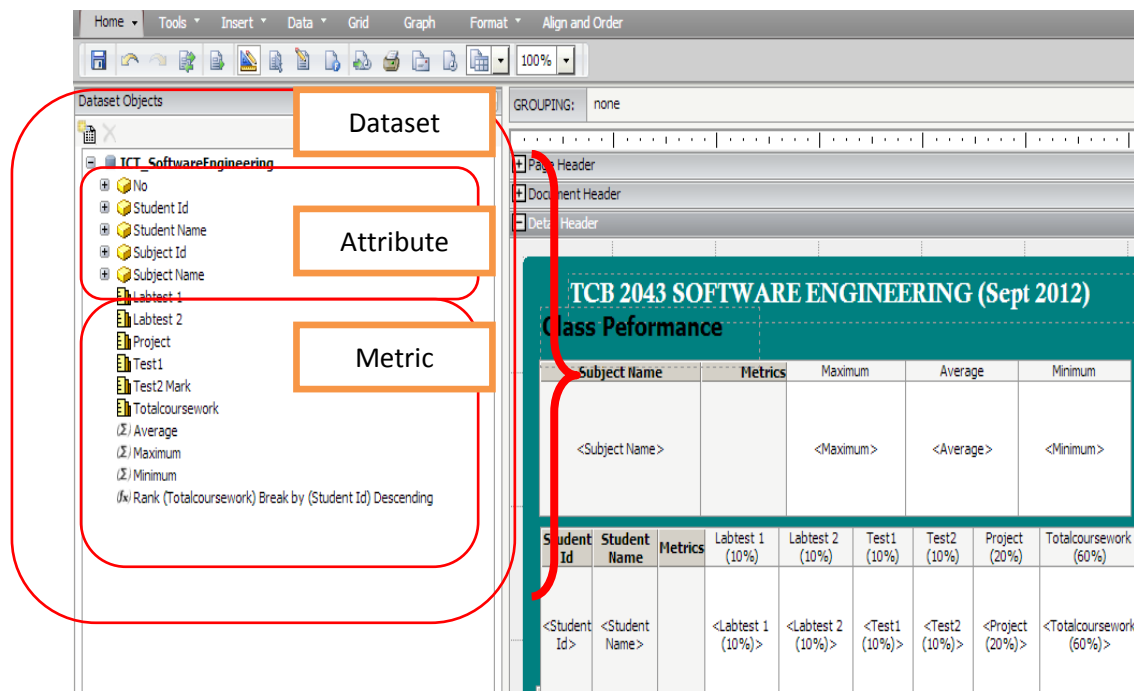


Figure 21 : Report editor field

Report formats were customized to ensure the accuracy of the output data, especially in ensuring representing the correct mark to the right student. Thus, the precise functions and algorithm desired to ensure the calculation taken in the report produces the precise values for example in calculating overall subject median, average and mode values. All these formats and features are available in the Microstratgy9 desktop for easier report development. Some of the features are:

- Design and formats in selecting the suitable types of graph to be represented in the report. The categories, layout, background display and types of frame can be customized from this properties preference.

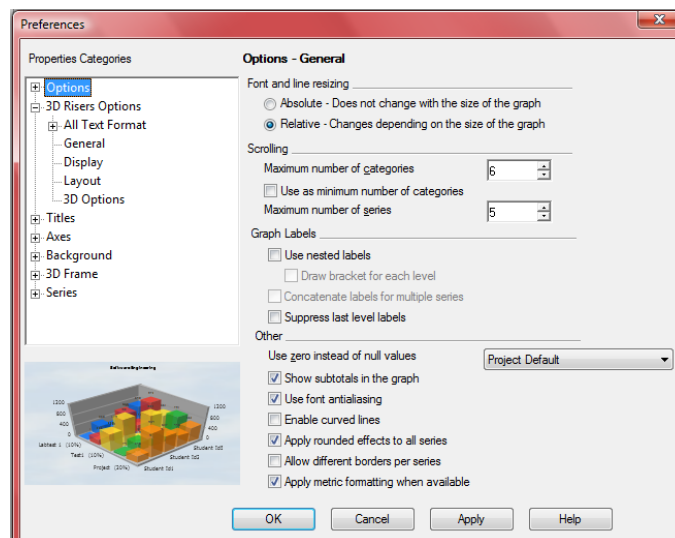


Figure 22 Format and Properties (Graph)

- Functions for all manipulated values were customized from this selection (Select Function) such as to calculate maximum, median, mode and average coursework mark accumulated for each subject in class.

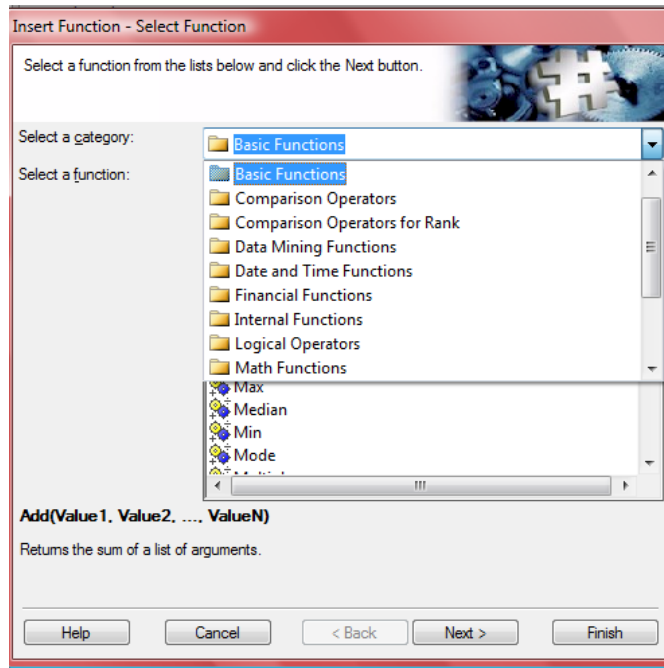


Figure 23 Format and Properties (Data function)

- Part of the project objective is to create awareness among the students towards their performances in study. Base on study, by implementing the metering or gauge graph in the report enable to visualize student ranking and explain their performance in the subject. Moreover, with the add-on features such as color apply to the gauge; it helps to visualize the report more clearly. Each colors represent of certain range of values. Red color shows the lowest ranking and dark green color shows the highest ranking.

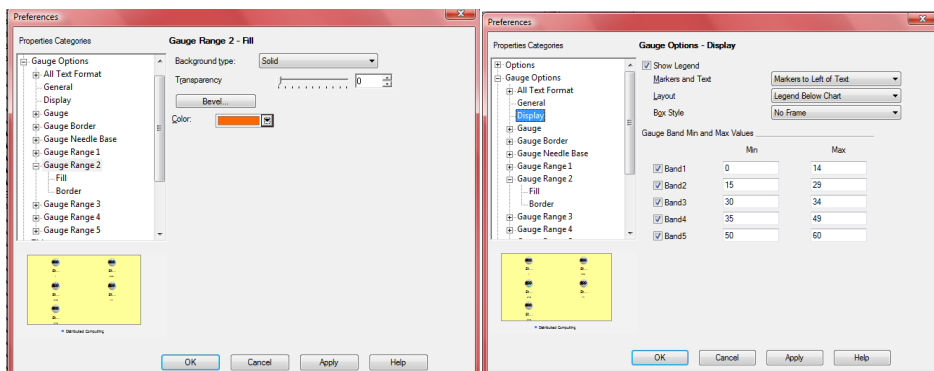


Figure 24 Format and Properties (Gauge)

- To ensure the element of multi-dimensional view of report, select button was implemented, which allow users to view the report by selecting their student ID from the drop down button. The properties of drop down button were customized base on the actions and their selected targets.

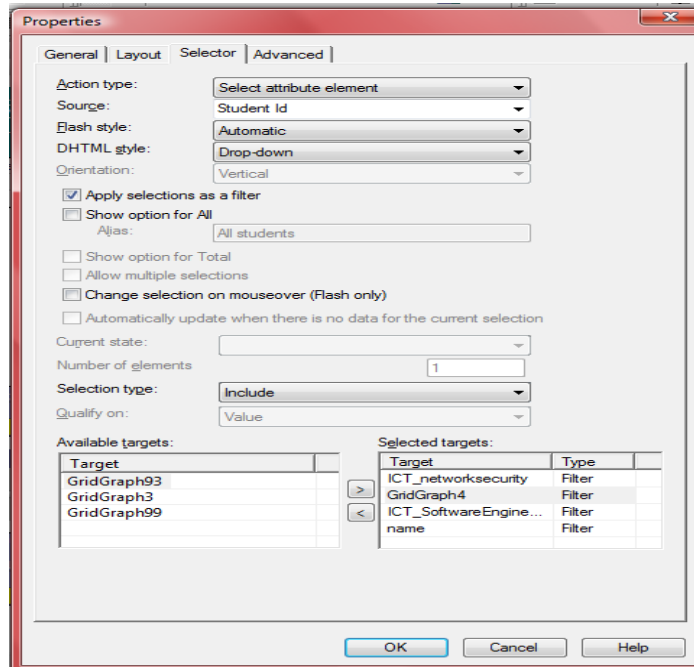


Figure 25 Format and Properties (Drop down button)

RESULTS AND FINDINGS

Survey has been conducted on the lectures and students of universities, with 40 numbers of students were participated for questionnaire survey that consists of 4 primary questions related to the main problems and objectives of project to verify. Students from other universities were participated for an interview. The interviews were carried by discussion of finding and identify the system used in their universities in publishing their coursework mark and problem solving related the student reporting. The summary and interpretation of the results are as below.

4.1 Data collected

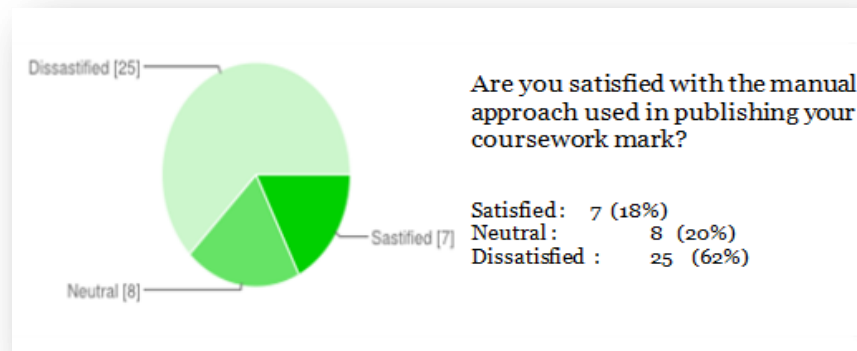


Figure 26: Result on student satisfaction towards approach used in publishing coursework mark

Base on problem statement stated to this project, problem arise when student do not have a consistent platform to obtain their coursework marks. Thus, this problem gives more difficulties to those students who are really aware on their coursework marks for benchmarking their performance in certain subjects. From the survey of UTP Students, 62% of students do not satisfied with the manual approach used in publishing their coursework marks.

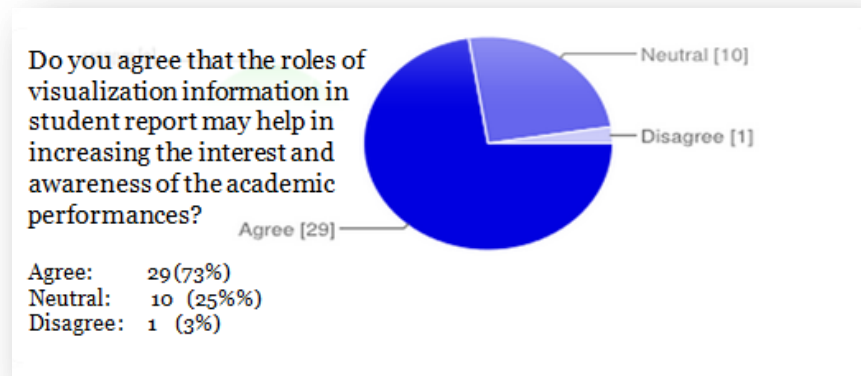


Figure 27 Result on role of visualization information in student report

More than 70% students agree that InfoVis to the student academic reporting, it will helps them in decision making of their studies, explanations on their academic performances, and increase their interest and awareness to their academics performances.

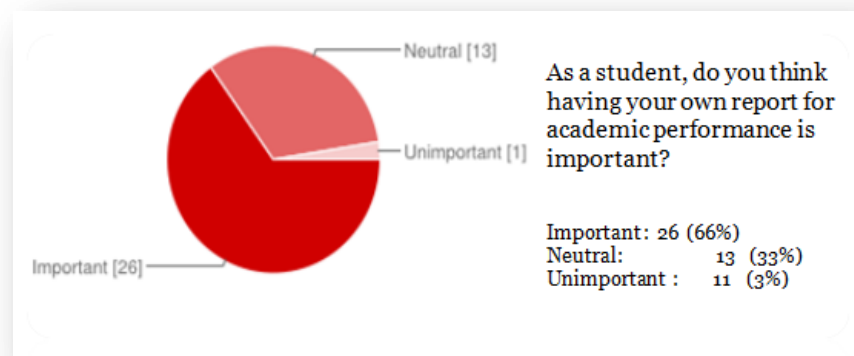


Figure 28: Result on student perspective in academic reporting

26 students (66%) agreed that to have their own coursework mark is important. As students, this is significant for them to have their academic performances in way to describe their areas of strength and areas in need of improvement. However, the report tended to be discouraging, rather than encouraging, for low achieving student no matter how hard they tired. This is for 11 students who fell that this KPI is not important. With the research study of visualization of information which to be implement to this report, it

will help build the student interest to be aware of their study performances on their report.

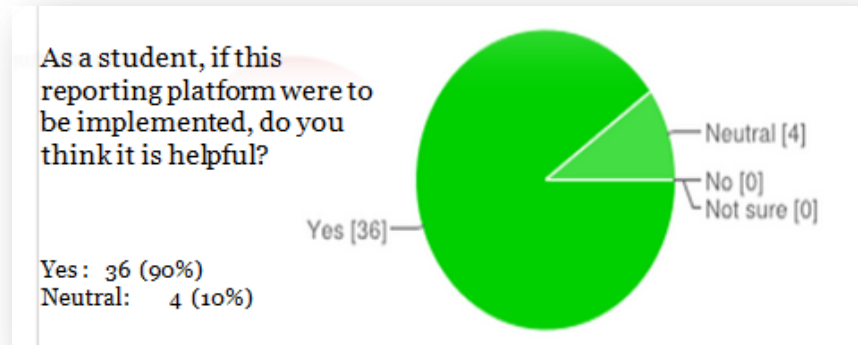


Figure 29: Result on project relevancy

Based on survey, most of the students (36 students) agree that, this web-base reporting platform really helpful if implemented to the universities. Base on research, there have no other universities who provide their student with this approach of reporting, specially using the business intelligence advance. As result, this question may help to give a strong point to my project objective , is to provide students a multi-dimentional views of coursewotk mark report with the role of visualization of information in creating student awaraness towards their academic performances.

4.2 System Usability Scale (SUS) testing

Usability recovers effectiveness in ability of users to complete tasks using the system and the quality of the output of those tasks, efficiency to level of resources consumed in perfuming tasks and satisfaction to user's subjective reaction in using the system. [24] System Usability Scale (SUS) testing was chosen for system testing for this project. SUS is a reliable, low cost usability scale that used for global assessments for system usability. It was obtained through the use of questionnaires (10 questions) with attitude scale after the respondent has had an opportunity to use the system evaluated.

	Strongly disagree					Strongly agree
1. I think that I would like to use this system frequently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	1	2	3	4	5	
2. I found the system unnecessarily complex	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	1	2	3	4	5	
3. I thought the system was easy to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	1	2	3	4	5	
4. I think that I would need the support of a technical person to be able to use this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	1	2	3	4	5	
5. I found the various functions in this system were well integrated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	1	2	3	4	5	
6. I thought there was too much inconsistency in this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	1	2	3	4	5	
7. I would imagine that most people would learn to use this system very quickly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	1	2	3	4	5	
8. I found the system very cumbersome to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	1	2	3	4	5	
9. I felt very confident using the system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	1	2	3	4	5	
10. I needed to learn a lot of things before I could get going with this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	1	2	3	4	5	

Figure 30: SUS Questionnaires

Respondents are asked to record their immediate response to each item. SUS score was calculated by sum the score contribution from each item. Each items score contribution will range from 0-4. For items 1,3,5,7 and 9 score contribution is the scale position minus 1. For items 2,4,6,8 and 10 the contribution is 5 minus the scale position. The sum of scores finally multiplies by 2.5 to obtain the overall value of SU. [25] Result from this testing to 40 respondents was shown as graph below:

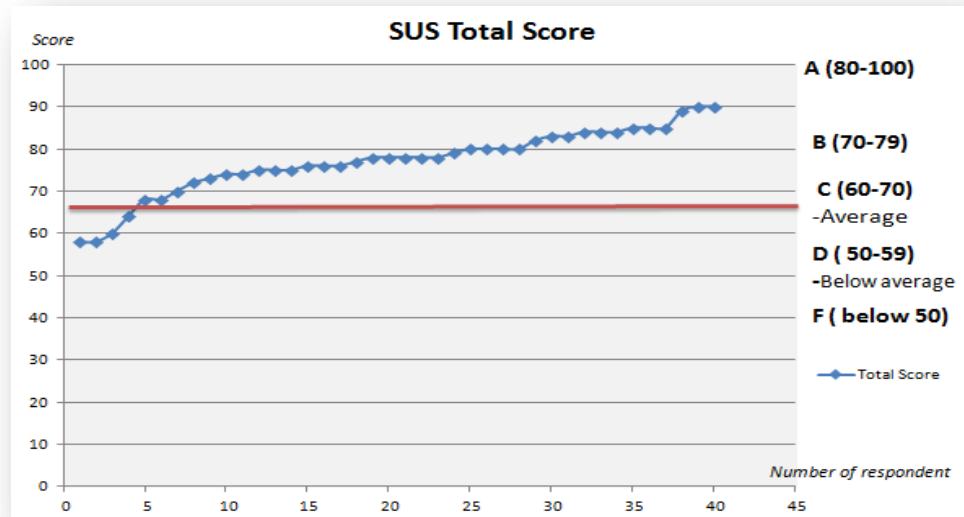


Figure 31: SUS Score

Result shows, 90% (36 of respondents) give the final score above the average score which is above 68. This shows that the system developed meet the usability testing constraint to recovers effectiveness, efficiency and user satisfaction.

4.3 Heuristic Evaluation

Interaction for visualization system must be tested to ensure the system interfaces standard to the usability principles. Heuristic evaluation is the most popular of the usability inspection methods. Heuristic evaluation is done as a systematic inspection of a user interface design for usability. The goal of heuristic evaluation is to find the usability problems in the design so that they can be attended to as part of an iterative design process. [26].

Results from this evaluation shows that this system meets the requirements on general principles for user interface design which related to the visualization. It supports recognition rather them recall, which mean the report minimize the user memory load by making the objects visible, for example sum of total course work mark present in the report make user not have to remember information from one part of data to another (values of coursework from different tests, assignments or tutorials).

Thus instructions for use to the system are visible and easily retrievable when even appropriate (Student may select their student ID from dropdown

button to view their report and student may choose the ranking or range of coursework mark to their needs.

Moreover, heuristic evaluation shows that, this report is consistent and standardize where user should not have to wonder whether different words, action or situation mean the same thing. This is because; users are able to form associations between pieces of information present in the report which helps improve long term memory.

4.4 Risks and Challenges

Through the entire of project development, there have several issues on the risks and challenges faces which effects directly or indirectly in my project timeline and project working hours. The issues concern divided into few parts of risks. They are:

Category of Risk	Reason/Explanation	Impact on Other Tasks	Planned Responses
Technical Risk	Limited technical skills that I have in handling this system application with less supervision by experts. Self learning of the system needed with extra working hours	Project might not be deliverables on time. The result of report may changes due to limitation of understanding in exploring the system features.	Extra effort needed in study the tutorial provided.
Time Constraints	Time management is important to ensure all task can be done and follow project timeline's. As student, I can't focus on developing this project for 24hours due to commitments on class and other tests and assignments.	It might delay the deliverables time of the project. Project output not follows the requirements as needed.	Work extra hours in order to complete each tasks and job. Always update with my project timeline.

Delivery Risk	The accuracy of the output data is the most concern factor. How the report may give the accurate values of coursework mark.	It effects on system reliability and usability. It might create some issues among student and lectures.	Ensure calculation on manually is tally with output values that calculated from the system
External Risk	Who are the persons responsible to control and update this coursework mark report if this report were implemented to the universities.	Lectures may upload or share the datasheet of student marks, but they have no time in updating the report or customize the reports.	University may sign a contract with company that provides business intelligence services but it might be costly.

CONCLUSSION AND RECOMMENDATION

5.1 Conclusion

Based on the research and data gathered on this study in implementing a reporting platform for students is believed to be an effective and efficient in way. This approach should be implemented in the universities to replace the manual approach that is currently used. Research on the visualization of information found that, the development of this report may increase the student awareness towards their studies and served as a tool for student self-motivation to their self-motivated. Parallel to this, business intelligence technology also is the primary back bond of this project since it provides all the features needed in achieving my project objective. The objectives of this project to design and develop a reporting platform for student coursework that provide the relevant multi-dimensional views with study the roles of visualization of information in creating student awareness towards their academic performances were achieved.

5.2 Recommendations

This reporting platform using the aid of business intelligence is the first developed for the student purposes. Base on research and study and result & findings towards this particular project, there are a few recommendations can be made to enhance the project features for betterment in future. The potential enhancements are:

- The report can be directly connected to universities E-learning easier for student to directly catch their report.
- This report may be implemented for student's final semester results in a way to keep track their CGPA/GPA performance for each semester.
- System may be conducted by BI consultant in managing all the University reports

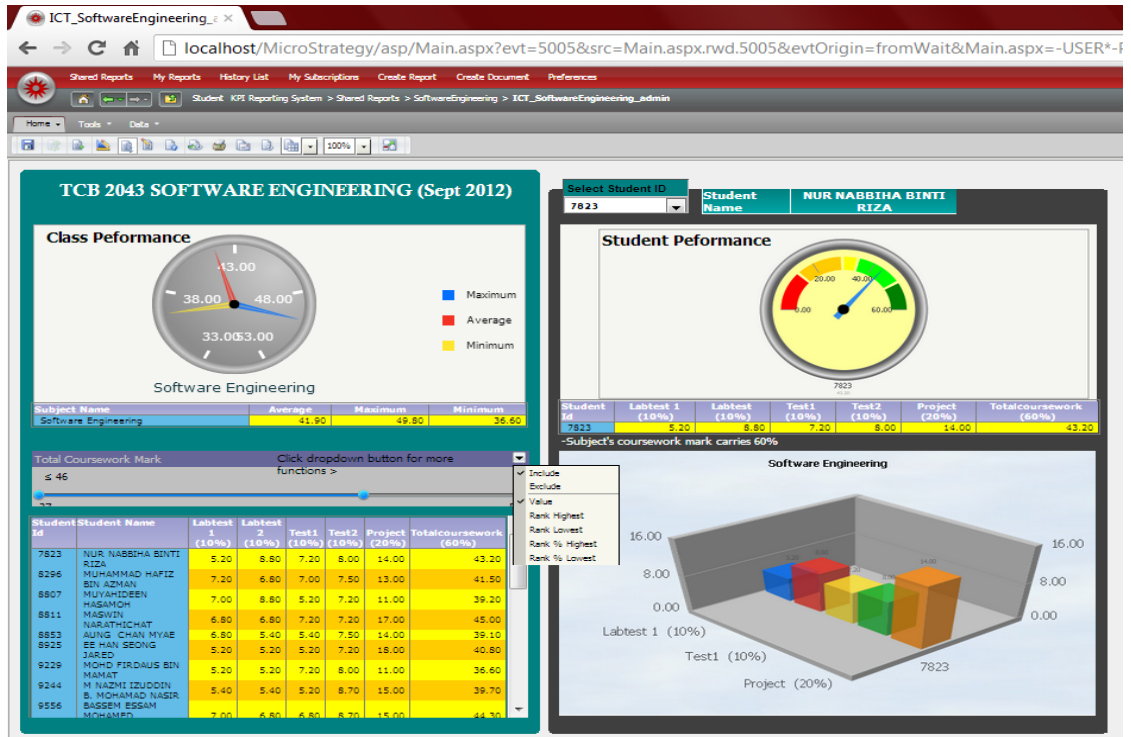
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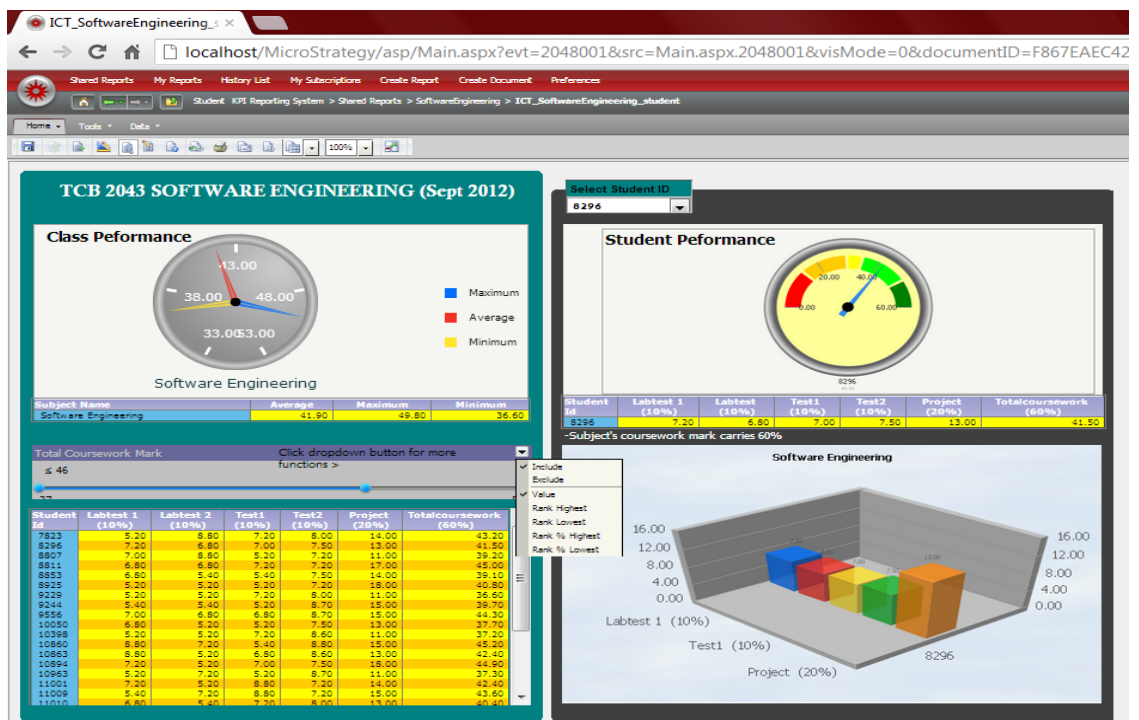
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Appendixes

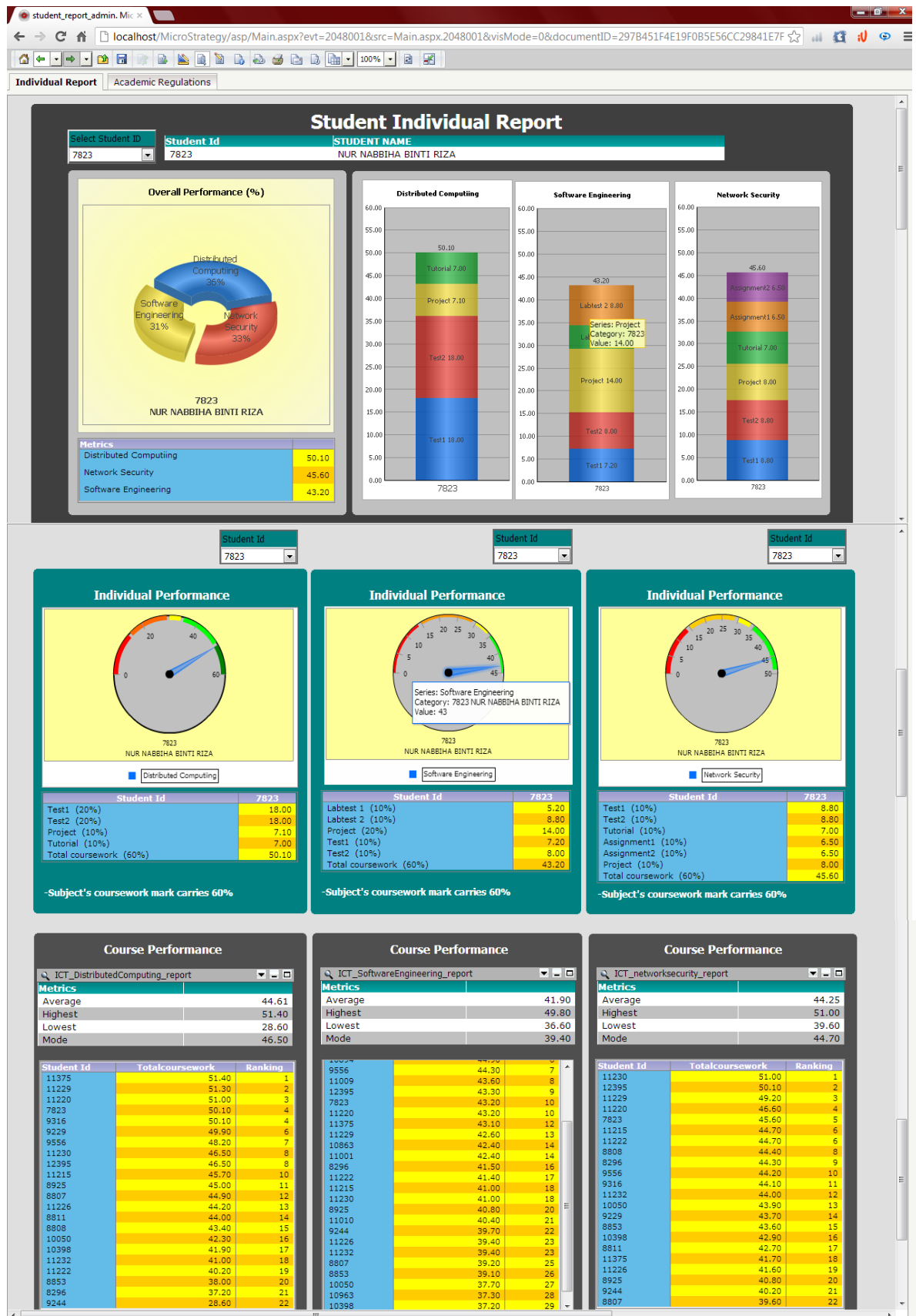
1. Student report base on subject (i.e Software Engineering. Semester Sept 2012) from admin/lecturers view



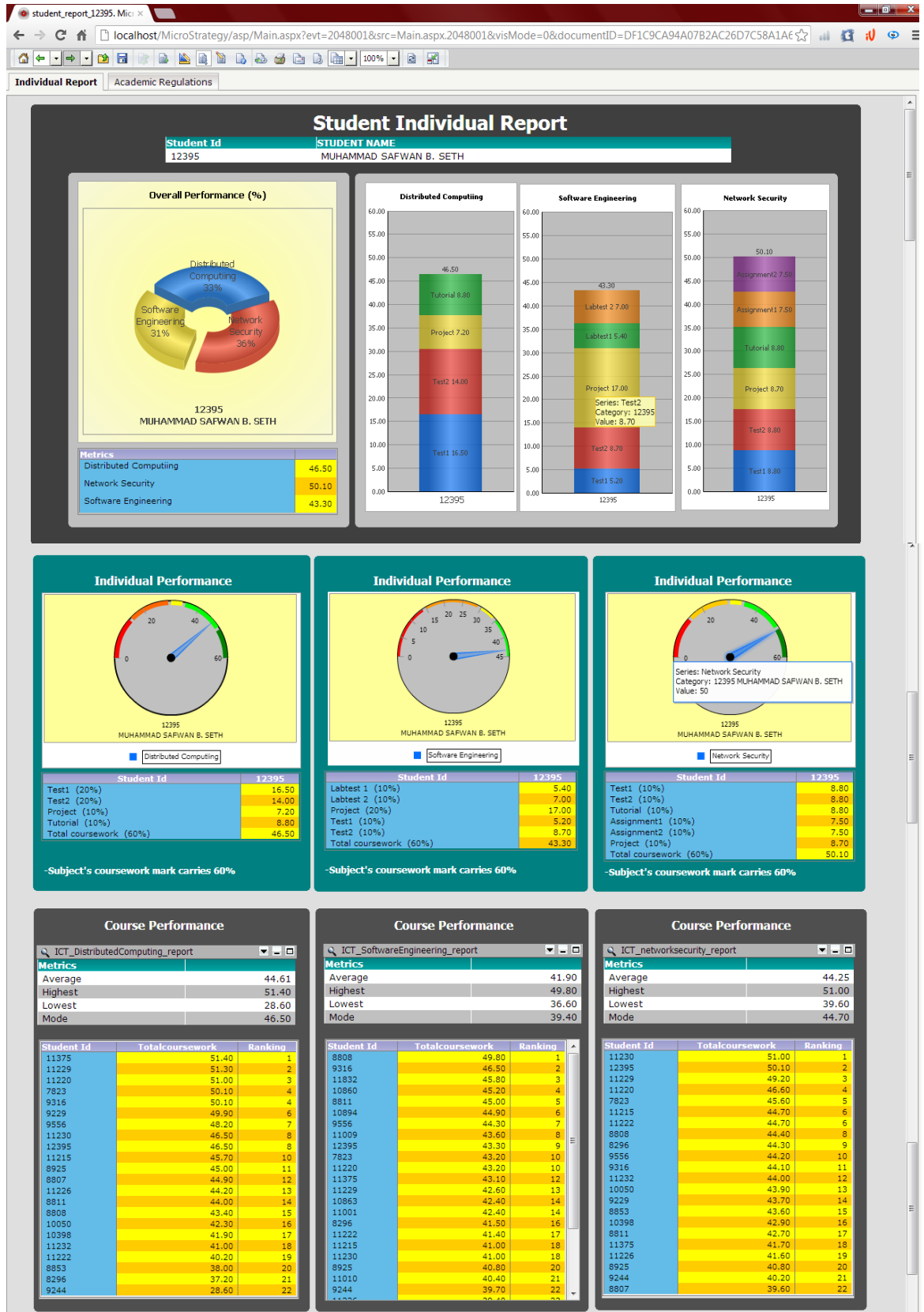
2. Student report base on subject (i.e Software Engineering. Semester Sept 2012) from student view



3. Student individual report base on subjects taken for the whole semester (i.e Semester Sept 2012) from admin/lecturers view



4. Student individual report base on subjects taken for the whole semester (i.e Semester Sept 2012 from student view



5. Academic regulation information

The screenshot displays a web browser window with the URL `localhost/MicroStrategy/asp/Main.aspx?evt=2048001&src=Main.aspx.2048001&visMode=0&documentID=297B451F4E19F0B5E56CC29841E7F`. The browser tabs show `student_report_admin, Mic...`. The page content is divided into two main sections: **Academic Regulations** and **Grade Point Calculation**.

Academic Regulations

- 1. Assessment**
An assessment is a system of rating a student's academic/practical performance through examinations, tests, quizzes, assignments, laboratory work, practical/industrial training and other specified activities.
- 2. Grade**
A grade is an assessment in the form of a letter grade signifying a student's performance in a particular course.
- 3. Examination**
An examination includes any assignment or written or oral/practical work which a student is required to do and which is taken into account in assessing his final results in a course.
- 4. Course Exemption**
A student may apply for course exemption on the basis of recognized academic work in a similar course at other institutions of higher learning, subject to Programme requirement. The exemption will be recorded in the University transcript and the student will be deemed to have earned the equivalent credit hours for the purpose of graduation.
- 5. Repeat**
A student who has failed a course from an earlier semester shall be required to repeat and pass the said course at the earliest possible when that course is offered again.
- 7. Suspension Period**
A suspension period is a period in which a student is suspended from being a student of UTP due to disciplinary or Academic action taken against him. The suspension period may be considered as part of the duration of study at University.
- 6. Probation Period**
A student will be placed under probation period when he fails to attain the minimum GPA of 2.00
- 7. Supplementary Examination**
A supplementary examination may be conducted if deemed necessary by the Examination Committee.

Grade Point Calculation

- Grade Point Average (GPA)**
Sum total of Credit Points Scored in the Semester

Sum Total of Credit Hours Attempted in the same Semester
- Cumulative Grade Point Average (CGPA)**
Sum Total of Credit Points Scored to Date

Sum Total of Credit Hours Attempted to Date
- Grade Point Scale:**
A : High Distinction : 4.00
A- : Distinction : 3.75
B+ : High Credit : 3.50
B : Credit : 3.00
C+ : High Pass : 2.50
C : Pass : 2.00
D+ : Redeemable : 1.50
D : Redeemable : 1.00

6. SUS Questionnaire Questions

	Strongly disagree				Strongly agree
1. I think that I would like to use this system frequently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
2. I found the system unnecessarily complex	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
3. I thought the system was easy to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
4. I think that I would need the support of a technical person to be able to use this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
5. I found the various functions in this system were well integrated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
6. I thought there was too much inconsistency in this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
7. I would imagine that most people would learn to use this system very quickly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
8. I found the system very cumbersome to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
9. I felt very confident using the system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5

7.Raw Data (Coursework mark)

Subject: Distributed Computing

no	subject_id	subject_name	student_id	student_name	tutorialmark	test1	test2	project	totalcoursework
1	IT1	Distributed Computing	9316	ABDUL HAKIM BIN NORDIN	6.5	19	16	8.6	50.10
2	IT1	Distributed Computing	10050	AIDY MUHAMMAD IZZAT B. HANIF	6.8	16	12	7.5	42.30
3	IT1	Distributed Computing	11215	AIZAT B. AZMI	7	17	13	8.7	45.70
4	IT1	Distributed Computing	8853	AUNG CHAN MYAE	6.8	9	15	7.2	38.00
5	IT1	Distributed Computing	9556	BASSEM ESSAM MOHAMED MAHMOUD ELSHAER	7	18	16	7.2	48.20
6	IT1	Distributed Computing	11220	DEVARANI A/P KUMARASAN	9	18	16	8	51.00
7	IT1	Distributed Computing	8925	EE HAN SEONG JARED	5.2	16	15	8.8	45.00
8	IT1	Distributed Computing	8808	EMEELA WAE-ESOR	8.8	14.5	13	7.1	43.40
9	IT1	Distributed Computing	11222	HAFIF HALMI B. HAPSAMI	7.2	13.5	12	7.5	40.20
10	IT1	Distributed Computing	10398	INTAN SURIANY BINTI SOHAIMI	5.2	15	13	8.7	41.90
11	IT1	Distributed Computing	11375	JENANI A/P JAYAVALAN	7.2	18	19	7.2	51.40
12	IT1	Distributed Computing	9244	M NAZMI IZUDDIN B. MOHAMAD NASIR	5.4	16	0	7.2	28.60
13	IT1	Distributed Computing	8811	MASWIN NARATHICHAT	6.8	14.5	14	8.7	44.00
14	IT1	Distributed Computing	11226	MOHAMMAD FATHI ISLAM B. NOR AFFENDI	7	17	13	7.2	44.20
15	IT1	Distributed Computing	9229	MOHD FIRDAUS BIN MAMAT	5.2	19.5	18	7.2	49.90
16	IT1	Distributed Computing	11229	MOHD ZUHAIRI B. MOHD ZUBIR	8.8	17.5	17	8	51.30
17	IT1	Distributed Computing	11230	MUHAMAD AKIRI B. MD NAWI	8.8	16	13	8.7	46.50
18	IT1	Distributed Computing	8296	MUHAMMAD HAFIZ BIN AZMAN	7	12	11	7.2	37.20
19	IT1	Distributed Computing	12395	MUHAMMAD SAFWAN B. SETH	8.8	16.5	14	7.2	46.50
20	IT1	Distributed Computing	11232	MUHAMMAD ZAINURIN AKMAL B. AHMAD ZAINI	7	11	15	8	41.00
21	IT1	Distributed Computing	8807	MUYAHIDEEN HASAMOH	6.6	16.5	13	8.8	44.90
22	IT1	Distributed Computing	7823	NUR NABBIHA BINTI RIZA	7	18	18	7.1	50.10

8.Subject: Network Security

no	subject_id	subject_name	student_id	student_name	assignment1	assignment2_mark	tutorial	test1	test2	project	totalcoursework_mark
1	TCB2063	Network Security	9316	ABDUL HAKIM BIN NORDIN	8	8	6.5	6.5	6.5	8.6	44.10
2	TCB2063	Network Security	10050	AIDY MUHAMMAD IZZAT B. HANIF	8	8	6.8	6.8	6.8	7.5	43.90
3	TCB2063	Network Security	11215	AIZAT B. AZMI	8	8	7	6.5	6.5	8.7	44.70
4	TCB2063	Network Security	8853	AUNG CHAN MYAE	8	8	6.8	6.8	6.8	7.2	43.60
5	TCB2063	Network Security	9556	BASSEM ESSAM MOHAMED MAHMOUD ELSHAER	8	8	7	7	7	7.2	44.20
6	TCB2063	Network Security	11220	DEVARANI A/P KUMARASAN	8	8	9	6.8	6.8	8	46.60
7	TCB2063	Network Security	8925	EE HAN SEONG JARED	5	8	5.2	7	7	8.6	40.80
8	TCB2063	Network Security	8808	EMEELA WAE-ESOR	6.5	8	8.8	6.8	6.8	7.5	44.40
9	TCB2063	Network Security	11222	HAFIF HALMI B. HAPSAMI	8.8	7	7.2	6.5	6.5	8.7	44.70
10	TCB2063	Network Security	10398	INTAN SURIANY BINTI SOHAIMI	8	7.5	5.2	6.8	6.8	8.6	42.90
11	TCB2063	Network Security	11375	JENANI A/P JAYAVALAN	7	7	7.2	6.5	6.5	7.5	41.70
12	TCB2063	Network Security	9244	M NAZMI IZUDDIN B. MOHAMAD NASIR	7.5	5	5.4	6.8	6.8	8.7	40.20
13	TCB2063	Network Security	8811	MASWIN NARATHICHAT	7	6.5	6.8	7	6.8	8.6	42.70
14	TCB2063	Network Security	11226	MOHAMMAD FATHI ISLAM B. NOR AFFENDI	5	8.8	7	6.8	6.5	7.5	41.60
15	TCB2063	Network Security	9229	MOHD FIRDAUS BIN MAMAT	6.5	7.5	5.2	9	6.8	8.7	43.70
16	TCB2063	Network Security	11229	MOHD ZUHAIRI B. MOHD ZUBIR	8.8	8.8	8.8	8.8	6.8	7.2	49.20
17	TCB2063	Network Security	11230	MUHAMAD AKIRI B. MD NAWI	8	8	8.8	8.8	8.8	8.6	51.00
18	TCB2063	Network Security	8296	MUHAMMAD HAFIZ BIN AZMAN	7	7	7	7	8.8	7.5	44.30
19	TCB2063	Network Security	12395	MUHAMMAD SAFWAN B. SETH	7.5	7.5	8.8	8.8	8.8	8.7	50.10
20	TCB2063	Network Security	11232	MUHAMMAD ZAINURIN AKMAL B. AHMAD ZAINI	7	7	7	8.8	7	7.2	44.00
21	TCB2063	Network Security	8807	MUYAHIDEEN HASAMOH	5	5	6.6	7	8.8	7.2	39.60
22	TCB2063	Network Security	7823	NUR NABBIHA BINTI RIZA	6.5	6.5	7	8.8	8.8	8	45.60

9. Subject: Software Engineering

no	subject_id	subject_name	student_id	student_name	labtest_1	labtest_2	test1	test2_mark	project	totalcoursework
1	TCB2043	Software Engineering	9316	ABDUL HAKIM BIN NORDIN	6.5	7.2	7.2	8.6	17	46.50
2	TCB2043	Software Engineering	10050	AIDY MUHAMMAD IZZAT B. HANIF	6.8	5.2	5.2	7.5	13	37.70
3	TCB2043	Software Engineering	11215	AIZAT B. AZMI	7	7.2	7.2	8.6	11	41.00
4	TCB2043	Software Engineering	8853	AUNG CHAN MYAE	6.8	5.4	5.4	7.5	14	39.10
5	TCB2043	Software Engineering	9556	BASSEM ESSAM MOHAMED MAHMOUD ELSHAER	7	6.8	6.8	8.7	15	44.30
6	TCB2043	Software Engineering	11220	DEVARANI A/P KUMARASAN	9	7	7	7.2	13	43.20
7	TCB2043	Software Engineering	8925	EE HAN SEONG JARED	5.2	5.2	5.2	7.2	18	40.80
8	TCB2043	Software Engineering	8808	EMEELA WAE-ESOR	8.8	8.8	7.2	8	17	49.80
9	TCB2043	Software Engineering	11222	HAFIF HALMI B. HAPSAMI	7.2	7.2	5.2	8.8	13	41.40
10	TCB2043	Software Engineering	10398	INTAN SURIANY BINTI SOHAIMI	5.2	5.2	7.2	8.6	11	37.20
11	TCB2043	Software Engineering	11375	JENANI A/P JAYAVALAN	7.2	7.2	7.2	7.5	14	43.10
12	TCB2043	Software Engineering	9244	M NAZMI IZUDDIN B. MOHAMAD NASIR	5.4	5.4	5.2	8.7	15	39.70
13	TCB2043	Software Engineering	8811	MASWIN NARATHICHAT	6.8	6.8	7.2	7.2	17	45.00
14	TCB2043	Software Engineering	11226	MOHAMMAD FATHI ISLAM B. NOR AFFENDI	7	7	5.2	7.2	13	39.40
15	TCB2043	Software Engineering	9229	MOHD FIRDAUS BIN MAMAT	5.2	5.2	7.2	8	11	36.60
16	TCB2043	Software Engineering	11229	MOHD ZUHAIRI B. MOHD ZUBIR	7.2	7.2	5.4	8.8	14	42.60
17	TCB2043	Software Engineering	11230	MUHAMAD AKIRI B. MD NAWI	5.2	5.4	6.8	8.6	15	41.00
18	TCB2043	Software Engineering	8296	MUHAMMAD HAFIZ BIN AZMAN	7.2	6.8	7	7.5	13	41.50
19	TCB2043	Software Engineering	12395	MUHAMMAD SAFWAN B. SETH	5.4	7	5.2	8.7	17	43.30
20	TCB2043	Software Engineering	11232	MUHAMMAD ZAINURIN AKMAL B. AHMAD ZAINI	6.8	5.2	7.2	7.2	13	39.40
21	TCB2043	Software Engineering	8807	MUYAHIDEEN HASAMOH	7	8.8	5.2	7.2	11	39.20
22	TCB2043	Software Engineering	7823	NUR NABBIHA BINTI RIZA	5.2	8.8	7.2	8	14	43.20
23	TCB2043	Software Engineering	10860	Muhamad Shafiq Bin Roslan	8.8	7.2	5.4	8.8	15	45.20
24	TCB2043	Software Engineering	10863	Muhammad Syahmi Bin Hamizul	8.8	5.2	6.8	8.6	13	42.40
25	TCB2043	Software Engineering	10894	Nik Akmal Afif Bin Nik Othman	7.2	5.2	7	7.5	18	44.90
26	TCB2043	Software Engineering	10963	Nurul Najat bt. Ahmad	5.2	7.2	5.2	8.7	11	37.30
27	TCB2043	Software Engineering	11001	Syakir Saniy Johani	7.2	5.2	8.8	7.2	14	42.40
28	TCB2043	Software Engineering	11009	Tg Ibrahim Tg Muhammad	5.4	7.2	8.8	7.2	15	43.60
29	TCB2043	Software Engineering	11010	TG Norhanisah TG Kamarudin	6.8	5.4	7.2	8	13	40.40
30	TCB2043	Software Engineering	11832	Du Hoang Long	7	6.8	5.2	8.8	18	45.80

