BSCPMS

(Balanced Scorecard Perfomance Management System)

By

Muhammad Hakim Bin Saleh

Dissertation submitted in partial fulfillment of
the requirements for the
Bachelor of Technology (Hons)
Information Communication Technology

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Universiti Teknologi PETRONAS
Bandar Seri Iskandar
31750 Tronoh
Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

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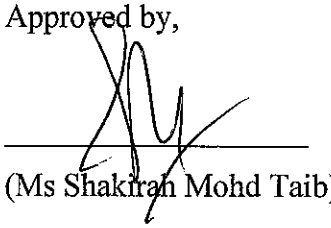
Approved by,



(Ms Shakirah Mohd Taib)

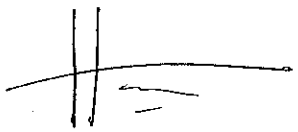
UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

June 2006

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 any person.



MUHAMMAD HAKIM SALEH

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ABSTRACT

Any organisation would surely have their own set of goals and objectives that they want to achieve. However, more often than not, they would not be able to achieve the goals because activities done within the organisation is not inline with their own goal. Another reason behind this failure is there is no proper reporting technique of recording activities done within the organisation. Realising this problem, the author suggest a computer system as the solution that would make used the concept of Balanced Scorecard theory and Reports & Reporting concept. Balance Scorecard is an approach to strategic management that combines measurement and monitoring of financial and non-financial aspects in organization. This approach is developed by Drs. Robert Kaplan (Harvard Business School) and David P. Norton in early 1990s. In this project, the author has developed computer software, **Balanced Scorecard Performance Management System (BSCPMS)** as the final product of this project. This report is prepared to present the overall status and progress of Final Year Project (Part II). This report would be focused on the concept of Balanced Scorecard and how the implementation of the concept can be done with computer software assistant. It includes the details on activities done during the project, system architecture and further discussion about the software.

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CHAPTER 1
INTRODUCTION

Efficiency and effectiveness of programs, processes and peoples in organization need to be properly study to ensure the success for the organization. Every organization, be they public or private, need to measure their performance to stay on the right track to achieve their goal and the process of gathering and analysis of performance data did not stop there. Instead, the performance measurement data can be use to drive improvements and translate strategy into action. In other word, performance measurement can be use to manage the organization.

Measuring the performance is critical in ensuring the success of organization. However, the performance measurement process is not a simple task. It involves many parties in the organization and covers a lot of areas. Every organization, regardless of type needs a clear and cohesive performance measurement framework. For that purpose, it is well agreed by leading organizations that there is need for a structured methodology for using performance measurement information for managing purpose. The *balanced scorecard (BSC)* is a conceptual framework for translating an organization's strategic objectives into a set of performance indicators distributed among four perspectives: *Financial, Customer, Internal Business Processes, and Learning and Growth.*

In the early 1990s, *Drs. Robert Kaplan* (Harvard Business School) and *David P. Norton* have developed the balance scorecard concept after realizing some weaknesses and vagueness of previous management approaches. Since then, The Balanced Scorecard (BSC) has quickly become recognized as an important management tool with the potential to improve organizational performance. A survey conducted in 2003 by Bain & Company on more than 708 companies on five continent shows that 62 per cent of them adopted the balance scorecard approach, amount that much higher than some other well-known management tools such as Total Quality Management, Supply Chain Integration or Activity Based Management.

1.1 BACKGROUND STUDIES

The idea of adopting balance scorecard approach in management of organization itself is an act of rectifying problems in organization. Every organization has their own goals and objectives and they are striving hard to achieve them. The organization mission and vision strategy are divided into four critical areas in the balance scorecard approach. The four perspective pillars of balance scorecard; *Financial perspective, Customer perspective, Internal Business Processes perspective, and Learning and Growth perspective* will provide guidelines for the organization to stay focus on their objectives as well as achieving desired result from each perspective. The act of translating strategy into action based on performance measurement can be achieved by clarifying our goals on the four areas of balance scorecard. The goals are based on these questions:

- *Financial Perspective:* To succeed financially, how we should appear to our shareholders?
- *Customer Perspective:* To achieve our vision, how should we appear to our customers?
- *Internal Business Process Perspective:* To satisfy our shareholders and customers, what business process must we excel at?
- *Learning and Growth Perspective:* To achieve our vision, how will we sustain our ability to change and improve?

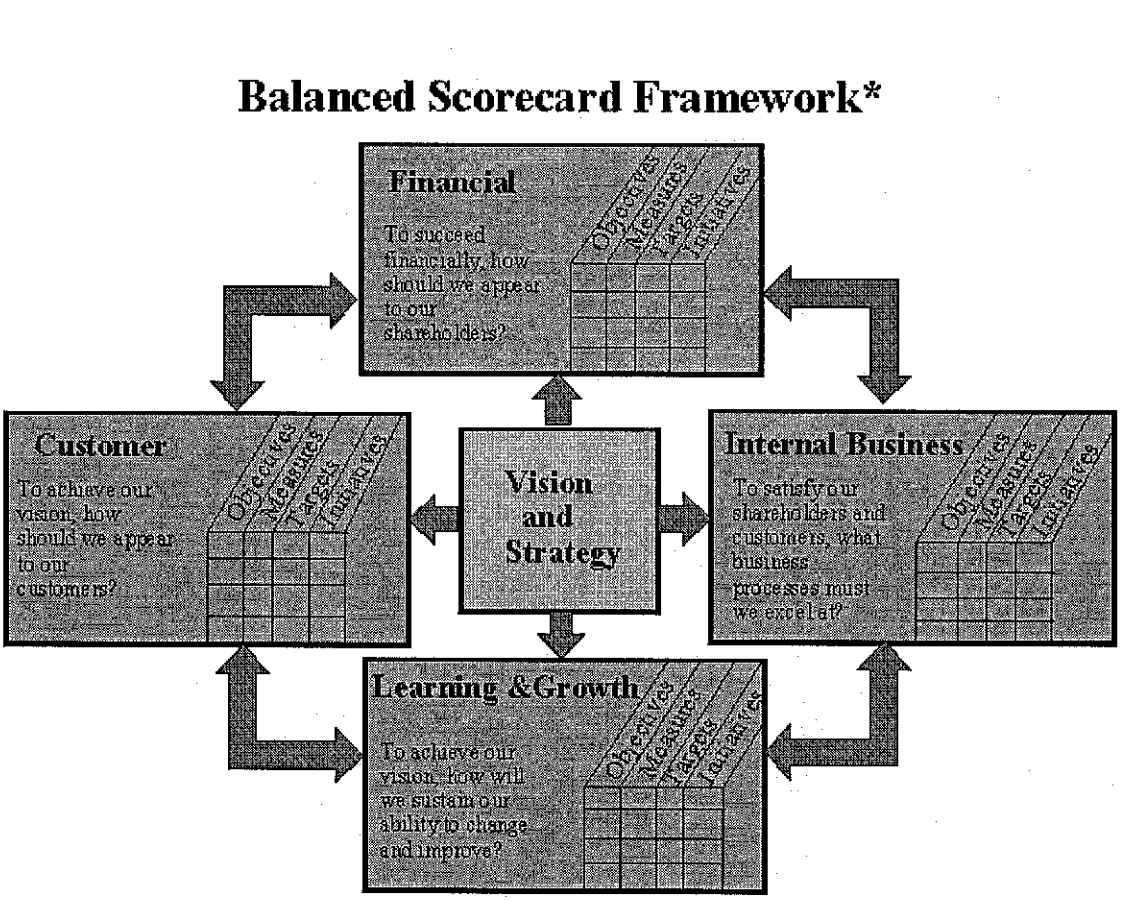


Figure 1 : Balance Scorecard Framework

All four pillars in the balance scorecard should not be treat in literal way. It is actually more abstract concept that flexible and can be use for managing other thing. For example, the financial pillar does not necessarily be in term of finance and money. If the balance scorecard approach is use in school management system, the financial aspect can be represented as the student's examination performance. The flexibility in balance scorecard allows the approach to be use in managing various types of organization.

In balance scorecard methodology, the goals of organization can be achieve with proper assesment and monitoring approach. This can be done by identifying the *objectives, measures, targets* and *initiatives* for every activity in the organization. By identifying all four elements, the activities within the company would then be monitored and reported by the employees for the top management assessment. This would create a systematic approach in tracking activities within the company as well as ensuring everything is being done accordingly to achieve the objectives for the activity.

According to Kaplan and his partner, strategy, the key term in balance scorecard is about hypothesis studies of cause and effect relationship. All four key areas in balance scorecard is inter-related to each others meaning that every activity in the that being done for one of the key areas would give impact to another three pillars in the balance scorecard system. For example, the chain of cause and effect relationships in balance scorecard may start from improvement in the area of learning and growth. As the result from these improvements, the improvement in internal business process can be seen which in turn further improve the customer satisfaction. Improvement in customer satisfaction would in turn cause improvements in sales and the financial measurements of profitability. In short, with proper monitoring, we can ensure everything we done in organization have their very own purpose thus eliminating everything that been done that did not provide the organization any good.

Another important aspect in the balance scorecard is balance. As the name implies, balance scorecard is about balancing organization based on the four critical areas in the scorecard approach. Establishing a balance between four types of measurements is critical in balance scorecard system. These types of measurements include:

- **Short term** and **Long term**
- **External** (for shareholders and customers) and **Internal** (for critical business processes, innovation, and learning and growth)
- **Leading** indicators (outcomes desired and performance drivers) and **Lagging** indicators (outcomes)
- **Objective** measures (e.g., financial) and **Subjective** measures (e.g., many non-financial).

Table 1 below show the sample of balance scorecard and how we measure each perspective using the four measurement approach stated above.

Table 1: Balanced Scorecard Perspectives & Sample Measurements

Perspective	Generic Measurement	Financial vs. Non-financial	Short Term vs. Long Term	Leading vs. Lagging	Internal vs. External
Financial	ROCE,	Financial	Short term	Lagging	External
	EVA,	Financial	Short term	Lagging	External
	Sales growth	Financial	Long term	Lead & Lagging	External
Customer	Profitability,	Financial	Short term	Lead & Lagging	External
	Market Share,	Non-financial	Long term	Lead & Lagging	External
	Retention,	Non-financial	Short term	Lead & Lagging	External
	Loyalty,	Non-financial	Short term	Lead & Lagging	External
	Satisfaction	Non-financial	Short term	Lead & Lagging	External
Business Process	Cost,	Financial	Short term	Lead & Lagging	Internal
	Productivity,	Non-financial	Short term	Lead & Lagging	Internal
	Cycle time,	Non-financial	Short term	Lead & Lagging	Internal
	Quality	Non-financial	Short term	Lead & Lagging	Internal
Organizational Learning	Employee retention,	Non-financial	Long term	Lead & Lagging	Internal
	Technology,	Non-financial	Long term	Leading	Internal
	Climate for action or Culture.	Non-financial	Long term	Leading	Internal

At present, in Malaysia, most company that has adopted the balance scorecard approach did not utilize the full potential lies within it. Balance scorecard is usually being use as reward system to assess employee's performance for their appraisal. This situation is due to the non-existent of computer software in the market to aid the company to fully exercise the potential of balance scorecard approach. Software related issues in balance scorecard would be further discussed in later part of this report.

Performance is a subjective matters and assessing it is not a simple task. Even though the balance scorecard in theory would help the organization in achieving their goals, it is not a simple mathematical value like 1+1=2 equation. It takes a lot of study to understand how to measure something that is discrete like performance and satisfaction. That is why

there is no balance scorecard software available at the mass market. If there such software available, most probably the software is custom made for the specific company.

The author of the balance scorecard system emphasize that "the balanced scorecard should be used as a **communication, informing, and learning system,** not as a controlling system." They identify measurement system into two category, diagnostic measurement and strategic management. **Diagnostic measurements** monitor whether something is in control. A statistical process control chart with upper and lower limits is a good example of a diagnostic type system that can be used for controlling a process. **Strategic measurements** define a strategy for competitive excellence and future success. The balanced scorecard is a strategic measurement system.

To summarize it all, the Balanced Scorecard is an approach to performance measurement that combines traditional financial measures with non-financial measures. This approach provides managers with richer and more relevant information about the activities they are managing, increasing the likelihood of organizational objectives being achieved. It is important to understand that the balance scorecard approach is not only limited to the business organization. We can make use this approach in managing accounting firm, law firm, HRM system and also in managing IT-based development team.

1.2 PROBLEM STATEMENT

In previous section, it stated that one of the reasons behind why balance scorecard approach is not fully utilized in Malaysia is due to non-existent of good Balance Scorecard software available in market. There are a few overseas vendors that provide the balance scorecard solution for business with variation of many additional features but they come along with a sky high price tag. Some of the solution however is less expensive but the features offered are also less sophisticated. It is simply hard to identify which is the best software since the concept is relatively new in Malaysia.

Just like many other management tools or system, well founded theoretical principles does not guarantee success in implementation of Balance Scorecard approach. Balance scorecard software is usually design to facilitate data gathering, data presentation and its subsequent communication within an organization. The aim of Balance Scorecard software is to provide simple, relevant and concise reporting mechanism for the organization. The usage of the software in implementation of balance scorecard however did not ensure the concept is being use effectively.

There are a few issues need to be address when implementing a balance scorecard approach in organization. The issues are:

- **Understanding on the Concept:** Balance scorecard is basically a simple concept in theory. However, despite the simplicity, the understanding of the concept is usually being overlooked resulting poor implementation of the concept.
- **Proper Measurement Approach:** There is a need to ensure that for each goal set within the balance scorecard is something measurable and proper measurement approach is taken.
- **Support from Multilevel Management:** To ensure successfulness of the balance scorecard implementation, the system need support from each level of management within the organization to ensure each department in the organization is actually doing their task properly.
- **Involvement on All Employees/Members:** Everyone in the organization need to get involved in the implementation of balance scorecard to ensure everything in the organization goal can be done together as team.

Many more issues arise in the implementation of the balance scorecard. The challenge now is to create computer software that would handle all those issues in ensuring the execution of balance scorecard implementation a success.

CHAPTER 2
OBJECTIVES

Balance scorecard software falls on information system category. The software will provide aid in information management that enable the management to monitor performance, facilitate decision making as well as driving organization towards proper goals and direction. The business process needs to be design properly so that we have complete balace scorecard software that would facilitate implementation of balance scorecard properly.

The objective of this project is to develop computer software that will make use the concept of balance scorecard in managing organization. The prototype that will be developed should address the issues stated in the previous section. Initially, it is drafted that the prototype of the software should have the following features to support balance scorecard implementation:

- Task tracking and reporting
- Balance scorecard strategic planning
- Performance indicator definition
- HRM support system
- Project Planning
- Reports Printing

The basic flow of the system would be as shown in the figure below. Everything in the software would start from the organizational goals. Then it would be use to develop a balance scorecard sheet. After that the balance scorecard would be use to compare and monitor performance on the key result area.

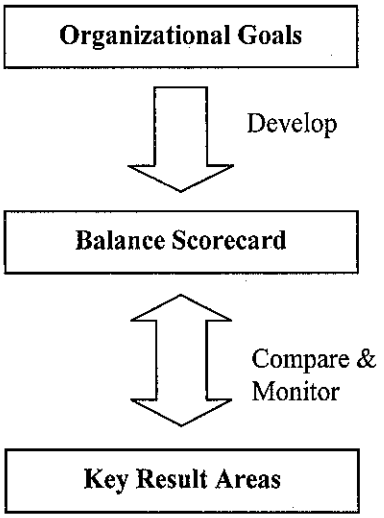
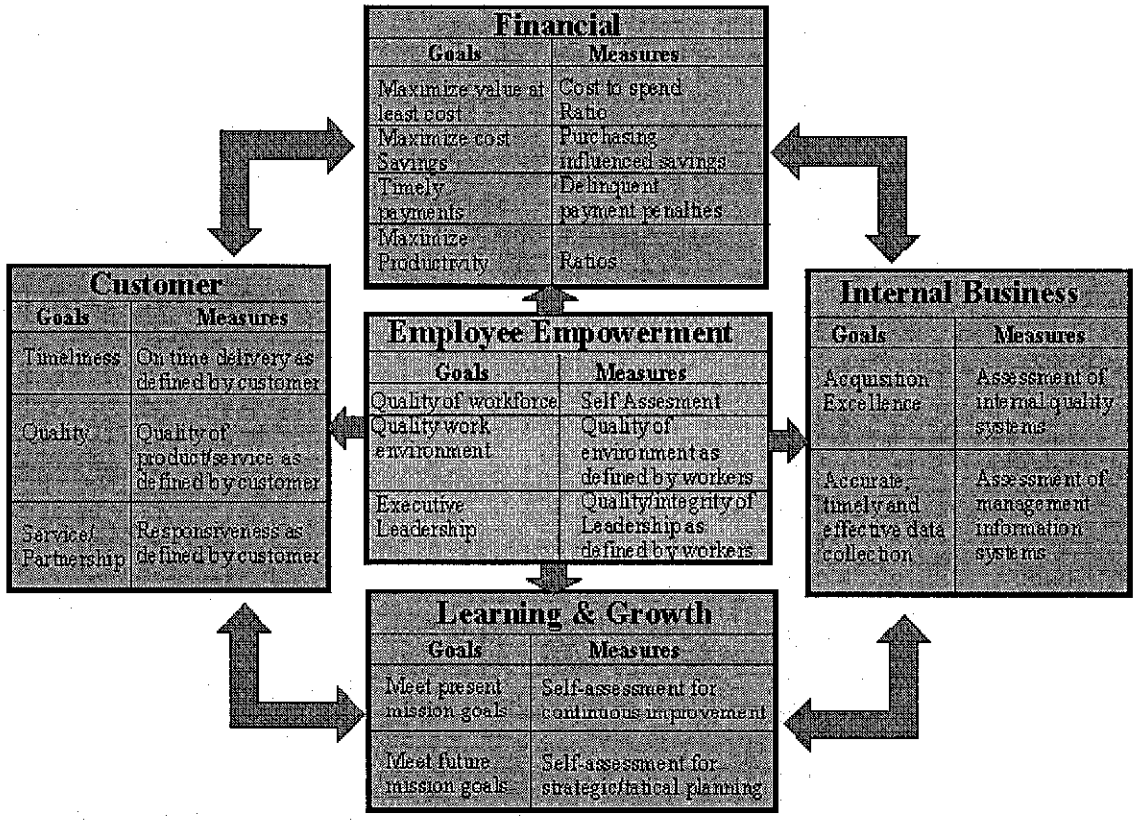


Figure 2 : Basic flow of the system



* Adapted from Kaplan & Norton. 1996. *The Balanced Scorecard*. Harvard Business School Press: 182.

Figure 3 : Sample Balance scorecard

In figure 3, there is an example of the balance scorecard diagram for federal procurement scorecard adapted from an illustration on page 182 of Kaplan & Norton's 1996 book (The Balanced Scorecard). In the diagram there are set of goals and the measure for the goals.

Key result areas in figure 2 derive from the task tracking and reporting function in the system. It would then be compared with the measure that being set with the goals.

2.1 SCOPE

The computer system that will be developed should not be limited to only traditional business organization. The system must be flexible to adapt in different kind of organization environment. The scope of study for this project would be on:

- ***Balance Scorecard Concept***

  The author needs to understand the overall details on what the Balanced Scorecard really is. This is very important because without sound knowledge on this aspect, development of computer software based on it set of theories would be impossible.

- ***Adaptability of Balance Scorecard Theory in Project and Organisation Management.***

  One of the reasons behind selection of Balanced Scorecard as the subject of study for this project is the adaptability of the theory in project and organisation management. The author needs to identify this feature to ensure the prototype developed would have this feature so it can be used in various type of organisation.

- ***Reports & Reporting approach in organizing activities within organisation.***

  There are already several approach used in Balanced Scorecard theory to do data collection for performance analysis. Most of the current system available makes use a spreadsheet style to record data on information about performance. For this project, the author tries to take a different approach for data collection; the Reports & Reporting approach. Reports & Reporting approach allows the system to record all the activities done within organisation as well as updating the data needed for analysis part of the system.

Apart from theories on the Balance Scorecard, the study for the project would also involve on various aspect of computer technology such as:

- ***System architecture of client/server system***

  The computer system to be developed in this project would be a web-based client-server system. Since the system would use web browser as the platform to work, proper study on separation between processes done in client-side machine and server-side machine need to be done to ensure the effectiveness of the system.

- ***Smart Card Technology***

  One of the technologies that have been identified to be use in this system is Smart Card technology. The author intends to include the usage of MyKad for some areas in this system such as user login, employee register and user register.

- ***AJAX***

  AJAX or Asynchronous Javascript and XML are of the modern approach in web programming claimed to have the capability to improve the usability and interactivity of web application. Some component of the prototype developed for this project would use this approach to see how far the claim is true and to see the real effectiveness of this approach.

CHAPTER 3
LITERATURE REVIEW

In completing this project, there are certain concepts that need to be studied. Studies were made based on journals and books to get references on the concepts.

3.1 Balance Scorecard

Balance scorecard is a concept developed by *Drs. Robert Kaplan (Harvard Business School) and David P. Norton.* In their first article on balance scorecard, Kaplan and Norton (1992) begin by saying that "what you measure is what you get." They believed that organization's measurement system affect the driving force behind the organization, the manager and the employee. The balanced scorecard is defined as a set of measurements that give top managers a fast, but comprehensive view of the business including operational measures on customer satisfaction and the organization's innovation and improvement activities, as well as financial measurements. Kaplan and Norton point out that the operational measures drive financial performance. The advantages of the balanced scorecard approach include:

- Integrating seemingly disparate elements such as becoming customer oriented, achieving short response times, improving quality, emphasizing teamwork, reducing product launch times, and managing for the long term.

- Guarding against sub-optimization by showing whether improvements in one area, or perspective, are achieved at the expense of another area.

Their point is later being further supported in their next writing in the article "*Putting the balanced scorecard to work*" (1993) by giving example Rockwater, a global engineering and construction company, used the balanced scorecard to respond to their changing industry.

The concept of Balance Scorecard being undergoes further development afterward. In 1996, Kaplan and Norton suggest the usage of personal scorecard because they believe

that setting goals alone is not sufficient to change employee mindset. The scorecard approach allows manager to introduce four new processes; translating the vision, communicating and linking, business planning, and feedback and learning.

In their newer work, Kaplan and Norton (2001) state that The Balanced Scorecard allows organizations to build a management system that manages strategy; a strategy-focused organization. Strategy means communicating in a way that everyone can understand a plan for success. Focused means navigation in the organization to align strategy, and organization means to mobilize all employees to act in different ways that will link together across the business.

3.2 AJAX

AJAX, or Asynchronous Javascript and XML, is one of those catchphrase of late that will cause much excitement among the web programmer. AJAX is a method of communicating web server at background to allow a website to have much more interaction with the server. Jesse James Garrett of Adaptive Path said AJAX is not a technology. In his article *"Ajax: A New Approach to Web Applications"* (February 18, 2005), he defined AJAX as several technologies, each flourishing in its own right, coming together in powerful new ways. It incorporates standards-based presentation using XHTML and CSS; dynamic display and interaction using the Document Object Model; data interchange and manipulation using XML and XSLT; asynchronous data retrieval using XMLHttpRequest; and JavaScript binding everything together. Based on his writing, we can understand that AJAX is actually an approach that maximise every component that used commonly in web presentation with JavaScript act as the central figure of handling each component to support AJAX.

Even though JavaScript can be considered as the one that hold and orchestrate everything in AJAX, the XMLHttpRequest object is actually the real enabler to this approach. However, since the inclusion of this object in W3C standard for web in 1998, this component remain as dark unexplore region in web technology with very small amount of programmer actually make use of this component. It is a real hidden gem until recently when Google release several of high profile web application such as Google Map and

Gmail that the XMLHttpRequest object become hottest discussion topic in the net. Adaptive Path suggests the name AJAX for the technique of binding XMLHttpRequest with JavaScript and XML. In a few short months, AJAX has moved from relatively unknown and rarely used technology into one of the fastest moving technology to date. The hype for this approach makes every web programmer become excited once again for they knew the job of web designing is no longer become to dead end with introduction of many WYSIWYG editors. Web 1.0 or the classic HTML webpage with fabulous graphic and other third party plugin will soon be not as much interesting without AJAX.

Websites like Google, Amazon.com, Flickr and even Yahoo is rapidly upgrading their sites to include AJAX features. These projects reflects the real value of AJAX that not only it is technically sound, they also practical in real-world applications. Based on current trend, the next generation of web application would be very much rely on AJAX and W3C, the body that control the standards for WWW would surely add more suppport for this approach.

3.3 Smart Card

Smart Card technology is one of the most recent computer revolutions with rapid growing in popularity. A Smart Card come in the size of standard credit card with microprocessor chip embedded to it. The chips can hold various type of information in electronic form with sophisticated security mechanism.

The Smart Card may have the look and feel of normal credit card but it really is a small computer and function as one. Smart Card is nothing similar to magnetic strip card because not only they can store data, it can process them as well. The Smart Card can have many functions such as storing data, make calculations, process data, manage files, and execute encryption algorithms. It makes possible sophisticated and portable data processing applications, and has proven to be more reliable than magnetic strip cards.

In white paper by Smart Card Alliance, "*Privacy and Security Identification Systems: The Role of Smart Cards as a Privacy Enabling Technology*" (2003), it states that Smart cards provide solution that can enhance privacy protection and guard againts identity theft in

different ID system architecture. Unlike other identification technologies, smart cards can provide authenticated and authorized information access, implementing a personal firewall for the individual and releasing only the information required when the card is presented. Smart card technology provides strong privacy enabling features for security of system.

"MyKad PKI White Paper" (2000) explains details about MyKad, a new form identification card for Malaysian that use the Smart Card technology. MyKad is the world's first National Identification Smart Card, also known previously as the Government Multi Purpose Card. MyKad shall be issued by National Registration Department to every Malaysian citizens and any other individuals deemed fit. MyKad functions integrate identity, citizenship, digital thumbprints and other personal details into a credit-card sized piece of plastic. The inclusion of MyKad functionality in any computer system will not only add more value to the system, but also can enhance the security feature of the system.

CHAPTER 4
METHODOLOGY / PROJECT WORK

In completing the project, there are two main task, research and prototyping. The purpose of doing the research is to grab the concept of the balance scorecard and the relevant technologies that would be use in the project. To complete the project, a prototype system would be developed to meet the objective of the project, which is to create balance scorecard software. The prototype developed for this project would be use as the proof of concept for balanced scorecard approach in performanance measurement system.

4.1 RESEARCH / STUDY

Research work for this project would focus on study of balance scorecard and development of expert system. Approach taken in doing the research is studying journals, articles, books from various sources on the balance scorecard implementation and expert system development. For further data gathering, interview session is held to gain the insight on how the balance scorecard implementation by companies in Malaysia.

The project would be developed mostly using a web-based technology. For this project, there would be some study on AJAX approach. AJAX (Asynchronous Javascript and XML) is a method of improving the usability of web application by adding another layer for aiding interaction between client-side and server side of the program. This new layer is called AJAX layer. To understand more about AJAX, a detail study on supporting technology for AJAX must first be done. That includes the study on browser technology, javascript, css as well as XML. The details of the study would further be discussed in the result section of the report.

Apart from performance management, the prototype of this program as any other information system software needs to have a proper data warehouse to store information for the system. The data warehouse would be use to store relevant information to support the performance management system. For this project, an approach in library science cateloging technique called MARC 21 would be use. MARC 21 is the standard in library

material cateloging technique. A detail study on this approach would be done to modify them to suit the function of data warehousing for this system.

4.2 PROTOTYPING

Development of the system would not actually use any standard Software Engineering technique. However the method used for coding is basically the bottom-up approach where components is built in small portion with the used of driver for the upper level that is yet to be developed. The overall process of the prototyping can be seen in the figure below.

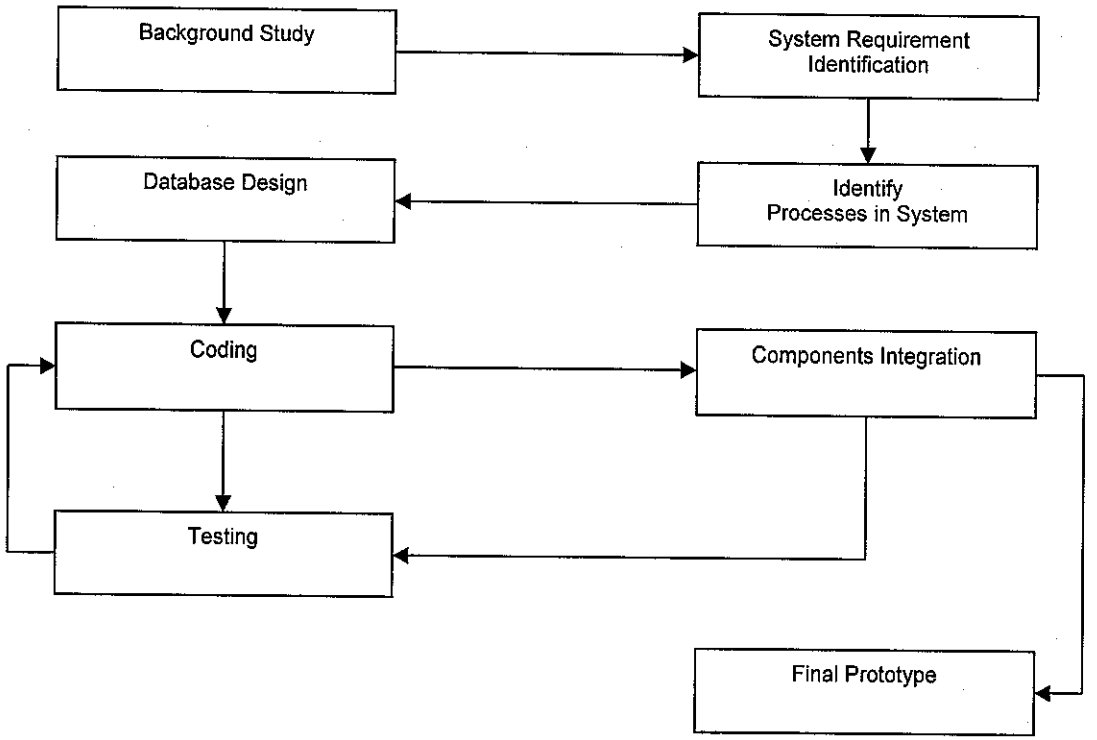


Figure 4 : Prototyping Process

In developing the prototype, the author begins with a background study activity. During this stage, the concepts of Balanced Scorecard are being studied. This stage is important because based on the result from this stage; the system requirement for the prototype is identified.

When the overall system requirement is identified, the next step in development of this prototype is identifying processes that going to be happen in the system. All this is based

on the system requirement that has been identified earlier. Next step is database design. The database is designed to support processes that have been identified earlier.

With completion of database design, the coding process is done. As mentioned previously, a bottom-up approach is taken where components of the system is built from small one and then be integrated until all components is completed. With completion of coding for each component, testing for the component is done. This is to ensure that any bug within the system is detected at early stage. If the test is completed, the coding would continue and the cycle would eventually repeat until several components completed and ready for integration. After the integration, once again the prototype would be put on test. The coding-testing-coding-integration-testing cycle would continue until all the components is completed and being integrated to be final prototype for the project.

The system is planned to be develop using PHP scripting language for the main part of the system. The rationale behind the selection of a web-based approach is because the compatibility between many OS and ease of development as PHP offer a lot of built-in function for programmer. For database of the system, MySQL would be use. The reason behind selection of MySQL database is that it is easy to integrate it with PHP, the main programming language for this project.

For windows user, a custom web-browser would be written using VB 6 to control the usability aspect of the web application. The custom web-browser would ensure incompatibility of client-side scripting between web browsers is properly addressed. The custom web browser would also allow the system to include the usage of hardware such as scanner, smart card reader etc.

CHAPTER 5
RESULTS & DISCUSSION

This section of report would discuss on findings from research or study discussed in previous section. It would also include further discussion about the prototype developed for the project.

5.1 RESULTS FOR RESEARCH AND STUDY

This project span for quite a long time (two semesters), thus enables a thorough study to be done.

5.1.1 Balanced Scorecard

From the study that has been done, the author has managed to grab the essential concepts of balanced scorecard. The challenge is on how to transform the theories and concepts into systematic and organized computer system.

5.1.2 AJAX

AJAX approach is not something that has just emerged recently. It is already around for quite sometime. However, the usage of the technology is not very popular until recently. The term AJAX itself is also relatively new.

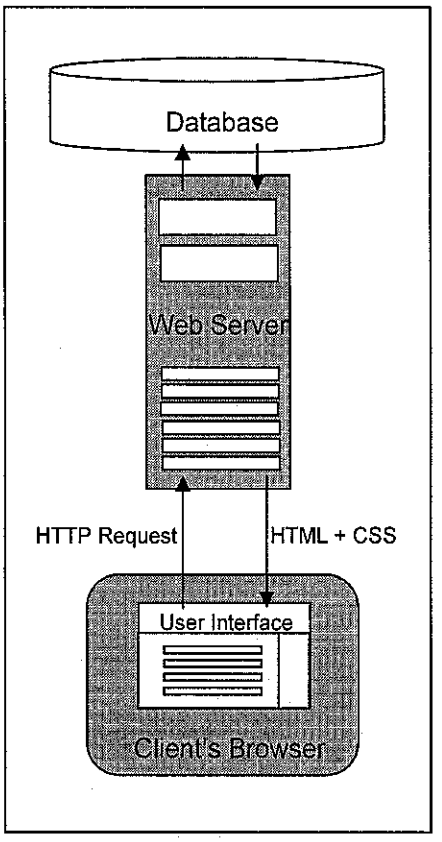


Figure 5 : Traditional web architecture

AJAX opens up a brand new chapter in web programming approach. Traditional web application (some experts called them as Web 1.0) model work like this; the user interface or the web site would have trigger for user to make request to the server. The trigger can be a hyperlink, button or any other HTML element. When user activate trigger, the request to the server is made. The server would do the processing and then would return a HTML code to the browser to display it to user. The architecture for this type of web application model is shown in the figure 5.

To understand the flow of data in traditional web architecture, refer figure 6. From the figure we can see that the back and forth movement of data with user activity need to be stopped during the transmission of data from client to server or from server to client. When the server is doing the processing, what will the user

do? At every step of task, user would need to wait for server processing is done. All this waiting is making the web application seems to be less interactive and less responsive compares to standard desktop application.

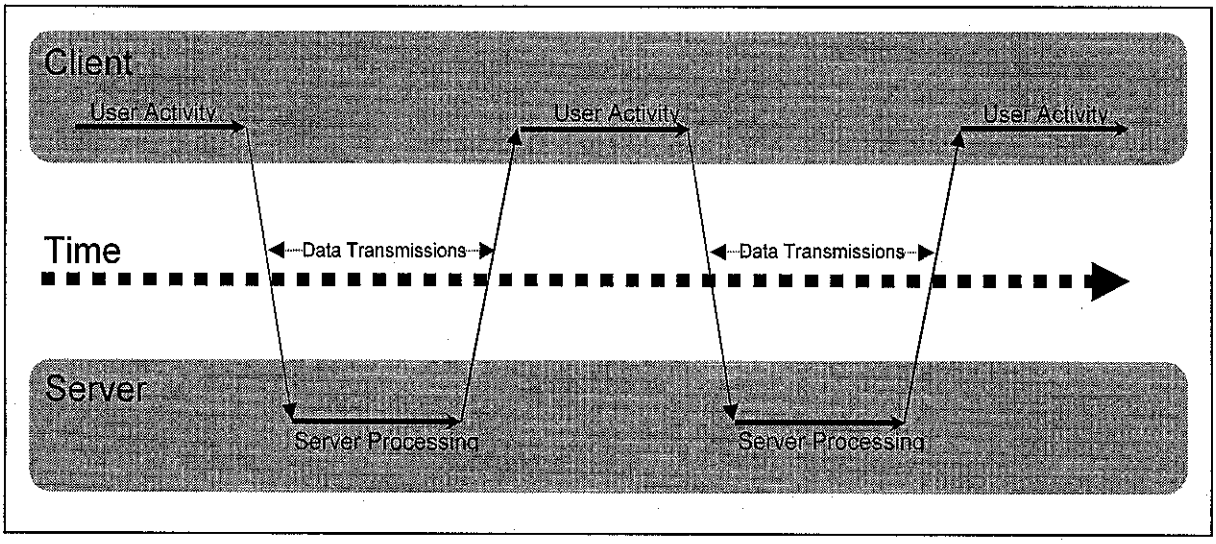


Figure 6 : Client-Server interaction in web 1.0

An AJAX application eliminates the start-stop-start-stop nature of interaction on the web by introducing another level between the web server and client's browser. This intermediary level is called AJAX engine or AJAX agent act as medium in fascilitating data transaction between client and server. The architecture of AJAX system would be further discussed in the next section, the system architecture.

Figure 7 show the AJAX application model. It is almost identical to the traditional web application model with addition of one layer betwee the user interface and the web server. How this engine helps to solve the waiting of server processing in traditional web application model?

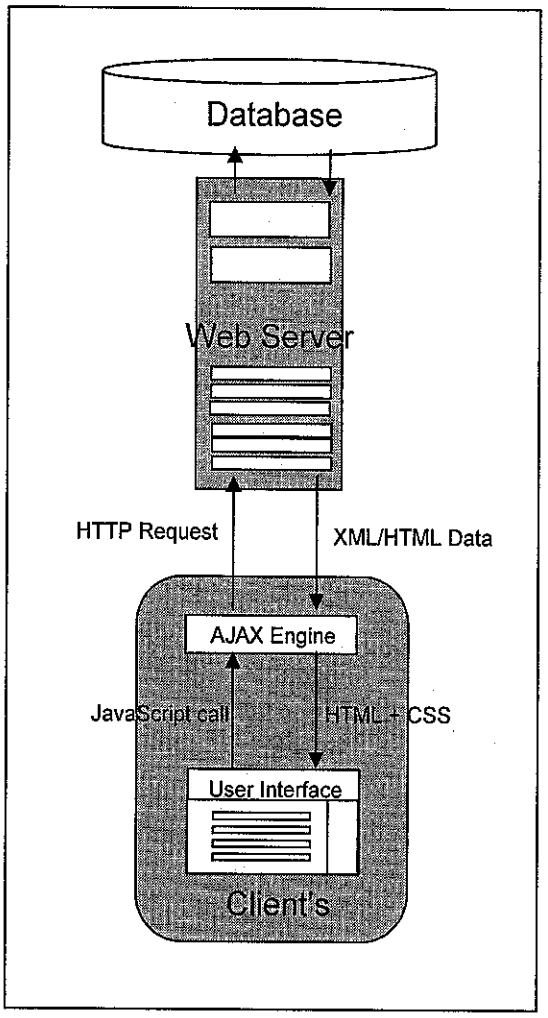


Figure 7 : AJAX Application model

To understand this model better, refer to figure8. In contrast with web 1.0 style, user activity in AJAX application did not stop during data transmission. Thanks to the AJAX engine, the transaction of data can be done in background without user need to stop their work to wait server is processing. The server processing time of AJAX is also usually shorter than the normal processing for standard web application. This is because the request that been made by the AJAX engine to the server is relatively small thus require small processing. Every user interaction that normally trigger the HTTP request in web 1.0 architecture is replaced with called to AJAX engine. The AJAX engine would then make necessary processing and sends the request to server and updates the user interface whenever it is applicable.

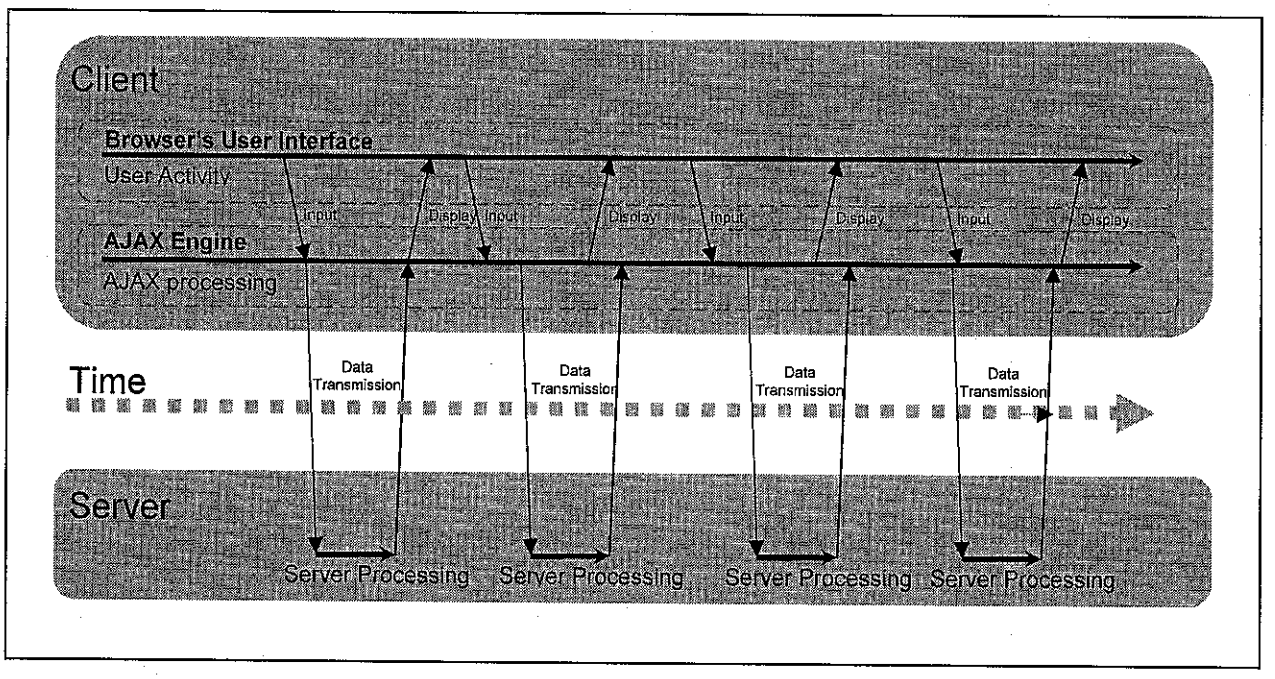


Figure 8 : Client-server interaction in AJAX application model

Even though the AJAX model offer a new breath in web application programming, AJAX still have several down side. For instance, just like any web application that relies on javascript, the effect of implementation may vary from one browser to another. The older browser may not support this technology thus some backward compatibility programming need to be done.

5.2 PROTOTYPE

5.2.1 System Architecture

In previous discussion, AJAX application model and standard web application architecture has been discussed. For this project, the author has decided to combine both approaches for the overall system architecture. The reason behind this decision is simple, for some of the interaction; it is much simpler to use the web 1.0 approach. The example of interaction that would use standard web model is for user to navigate through the menu to use modules included in the program. For interaction that would require communication with database, the AJAX approach would be use for most of them.

5.2.2 Sytem Components

The balance scorecard system would have three primary user, the strategic planner, manager and staff.

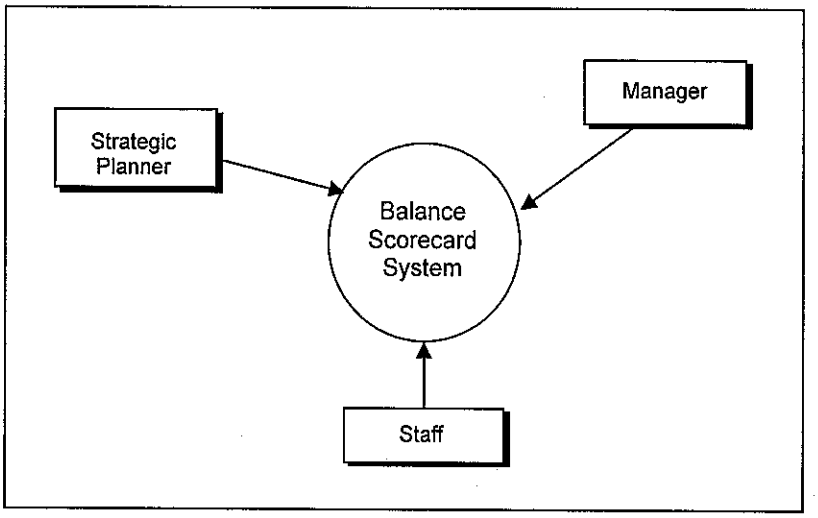


Figure 9 : Context Diagram

Context diagram above show the main user of the balance scorecard system. Strategic planner would responsible in planning the KPI in the organization based on the organizational goals. Strategic planner would involve in process of identifying KPIs, and initial action planning for the organization. The manager would then monitor task that been done by the staff during task monitoring process. They would also responsible to plot any new action plan based on the feedback from the task monitoring process. The staff would responsible in reporting task progress for task monitoring process. The detail flow of the system can be refer on the next figure, the level 1 DFD diagram of the system.

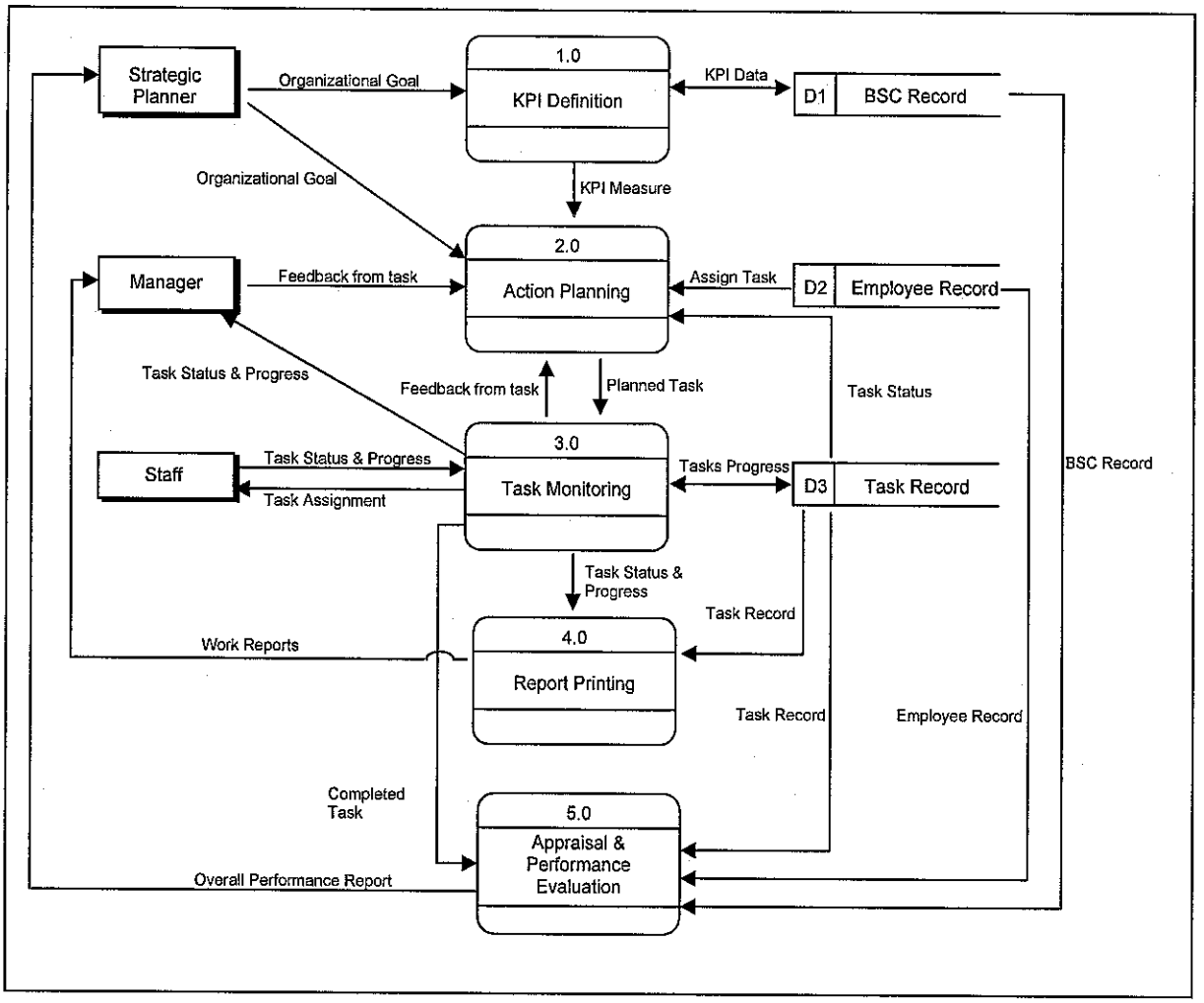


Figure 10 : DFD Diagram of the system

As shown in the figure above, there are five critical processes in the balance scorecard system. The detail of each process is explained in the table 2.

Table 2: Process details

Process	Description
KPI Definition	The system starts with the definition of KPIs (Key Performance Indicator). The KPIs is defined based on the organizational goals. In this process, the measurement and target for each KPIs is identified.
Action Planning	Based on the KPIs, the action plan would be draft. This process would first start with the strategic planner begin the plan for the whole organization before it is narrow down to manager level of the organization.
Task Monitoring	This process would involve the process of

	task assignment, task progress reporting etc.
Report Printing	Report printing is basically the process to be use in preparing reports based on the tasks reported by staff and managerial team.
Appraisal & Performance Evaluation	The final process of the system, the process would evaluate overall performance of staff in the organization as well as preparing appraisal for reward system in the organization.

5.2.3 The Prototype

The prototype for this project has been developed to meet the objective of the project. The system is developed on PHP and use MySQL as the database. Based on the processes identified in the DFD diagram in the previous section, the system has been designed to be divided into 4 main components; Strategic Planning, Reports & Reporting, Scorecard Analysis and System Tools. Function of each component is explained in table 3

Table 3: System Components and their functions

Component / Module	Description / Function
Strategic Planning	This component is use to support process of KPI definition. There are 2 sub-components in this Strategic Planning module; Scorecard Definition, the module we use to set what we want to achieve and Strategic Mapping that help us link our goal effectively.
Reports & Reporting	This module cover up 3 process that identified in previous section, the KPI definition, Action Planning as well as Task Monitoring. These component is divided into two; The Task Register to register new task and Task Tracking to report the status and progress of the tasks.
Scorecard Analysis	The most important part of the whole system, the analysis component. Scorecard analysis is divided into two, the

	Scorecard monitoring where we can monitor the progress of the scorecard and Drill-down Analysis where we can find all the details on each activities that supports our scorecard.
System Tools	This component act as the backbone for the whole system. This component provides the front-end for system administrator to update database reference tables, register user as well as to control the information library for the system.

The system flow starts with the user Sign On to the system. For security reason, users need to register account personally with the system administrator. Figure 10 shows the screenshot for Sign On to the system.

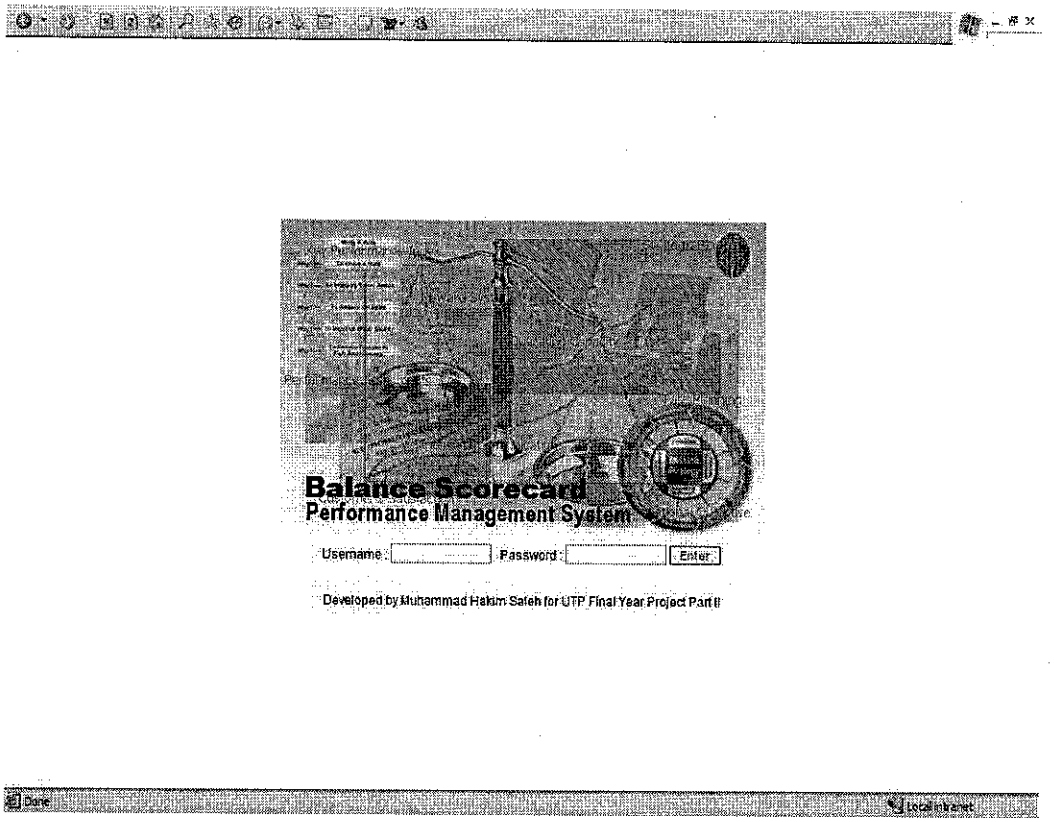


Figure 11: Sign On Screenshot

Figure below show the flow of process before user logging in to the system. As we can see, the system has automatic suspend mechanism to protect the system from unauthorised access. Another key feature in this system is the SSN which stand for Session Serial Number. This system did not use server's session variable or cookies as the verification to each of the page. Instead, the author has design

another method to use encrypted querystring to replace the usage of session and cookies variables.

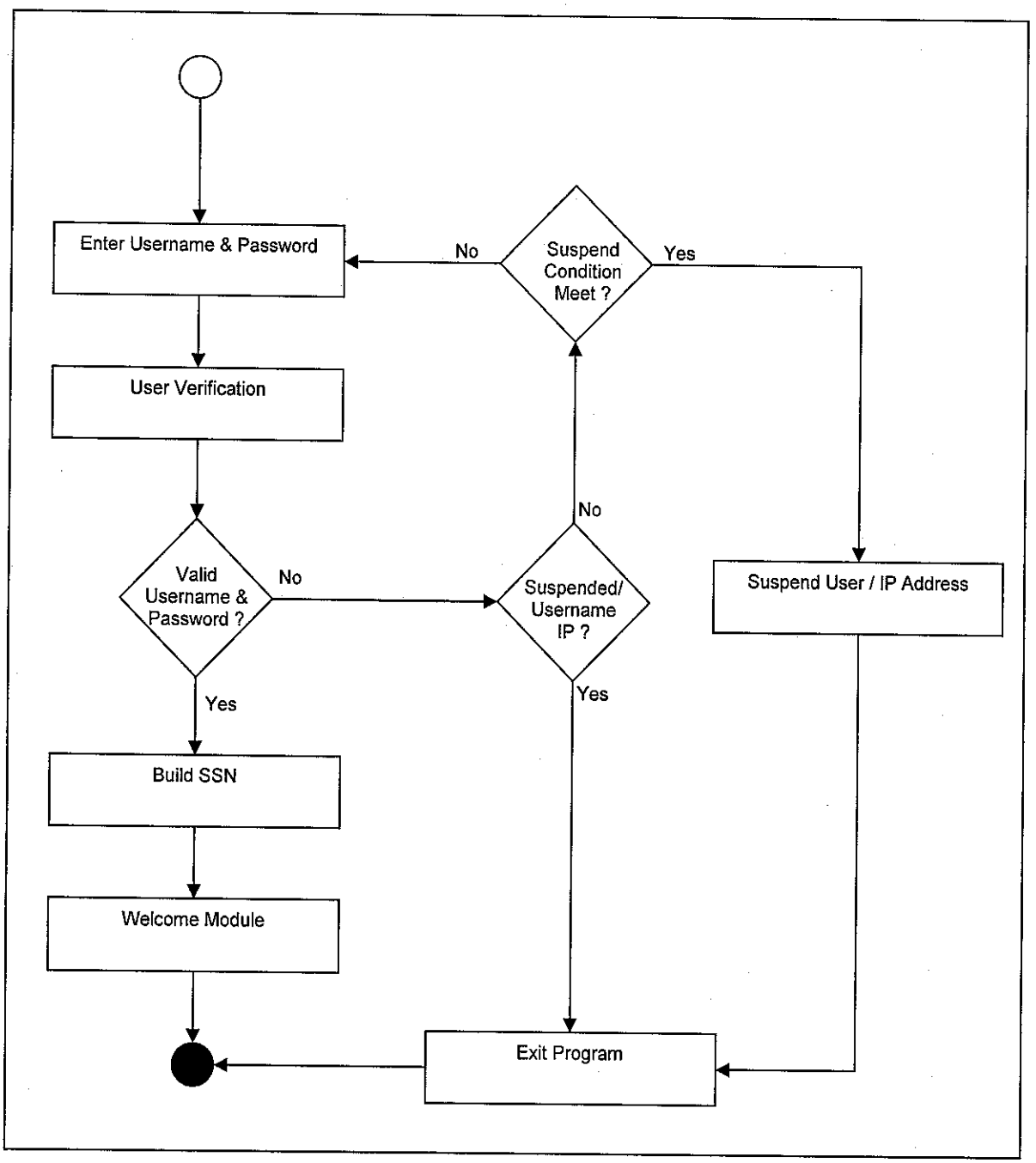


Figure 12: Flow Diagram of Sign On process

When user successfully logged in to the system, the welcome screen informing about the mail messages the user had would be displayed.

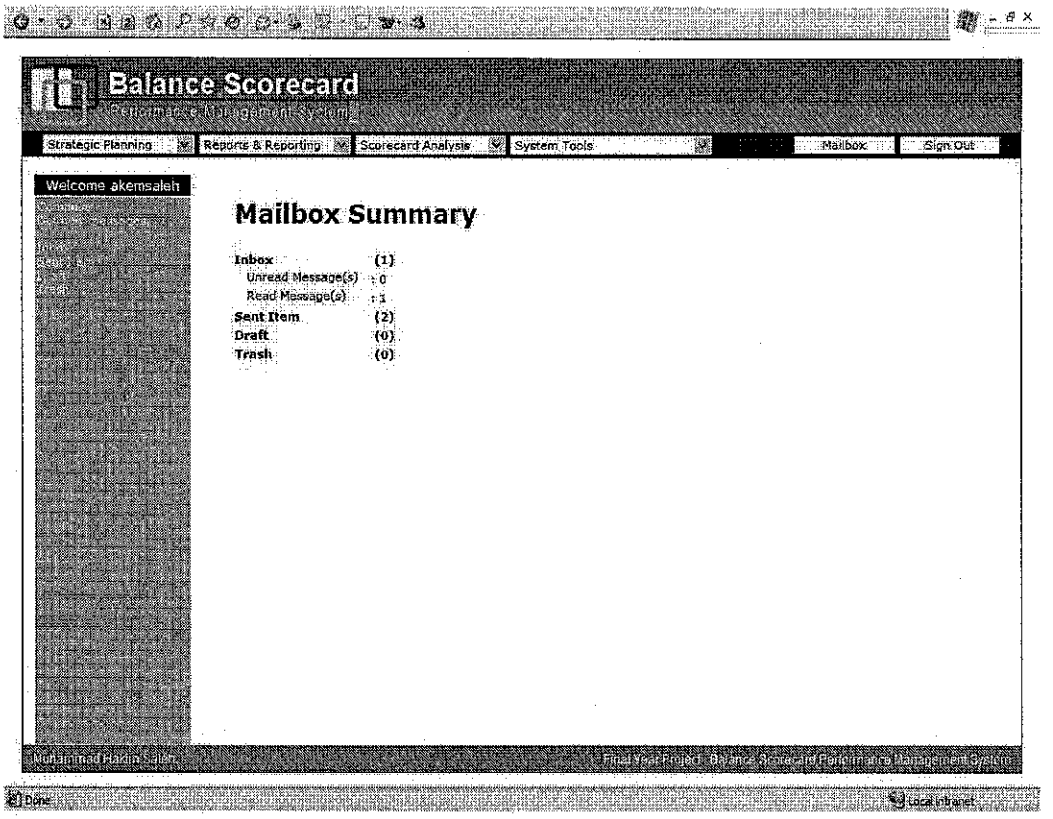


Figure 13: Welcome Screen

One of the author's own primary goal for this project is to create an all in one productivity tools for managing organisation. And for that reason, the author has decided to include the internal messaging system to allow users to interact among themselves without need to use another application. In future, the author plans to modify the code for this messaging function to make it able to be use as web mail client. Figure 13 in the next page shows the screenshot for composing message using this system.

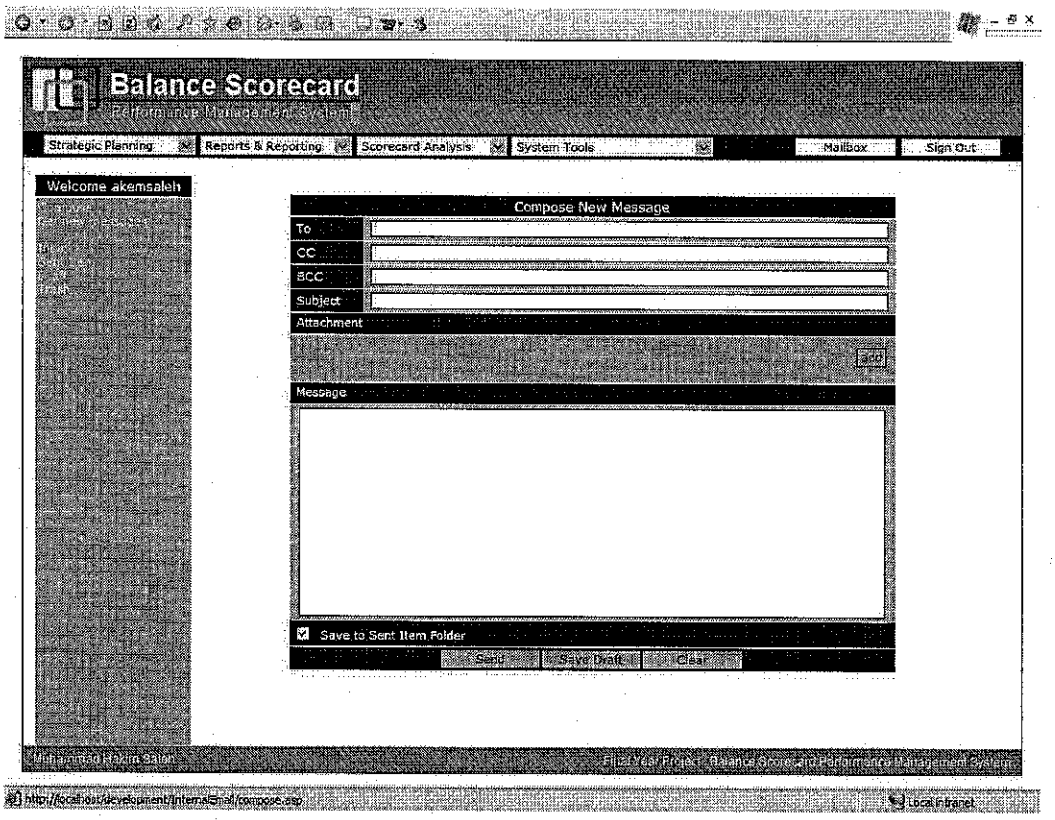


Figure 14: Compose Message Screenshot

Most part of the system work with database updating procedures. The database transaction process is generally explained in the figure 15. First, the editing or creation of new record entry is done. Then user has the choice whether to save or delete the database entry. In the delete branch we can see step called check deletion type. This is because the system can be configured to make destructive deletion that would remove the record from the database or non-destructive deletion that would just mark the database entry as record to be deleted,. Non-destructive delete allow user to restore the entry back before the database clean up is done.

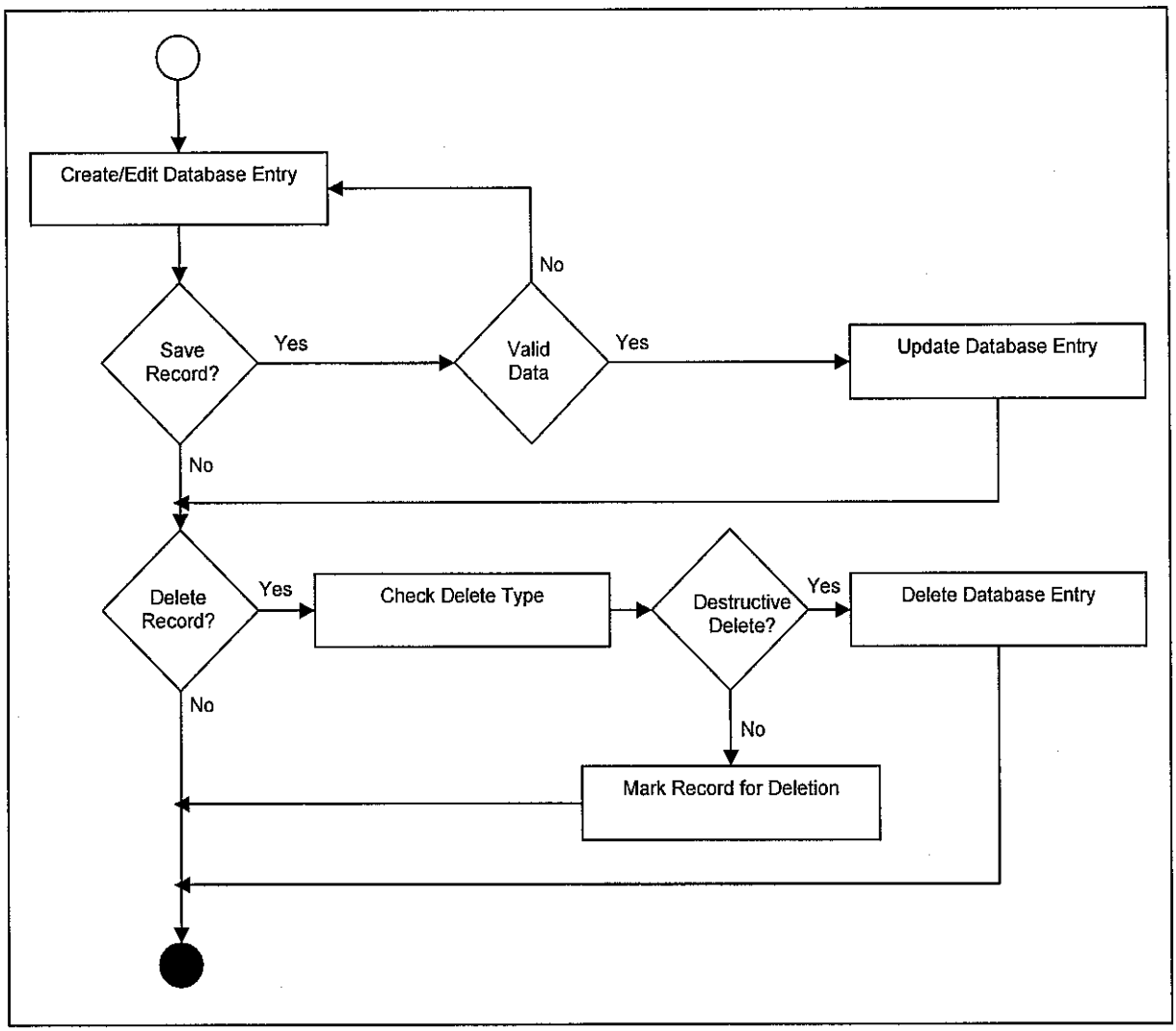


Figure 15: Database updating process

Details of other components of the system would be discussed in next few sub-sections.

5.2.3.1 Strategic Planning Module

The Strategic Planning module can be access by selecting menu from top horizontal bar on the screen under the caption "Strategic Planning". In this module, user would get to choose two sub-modules from the menu, the Scorecard Definition or Strategic Mapping.

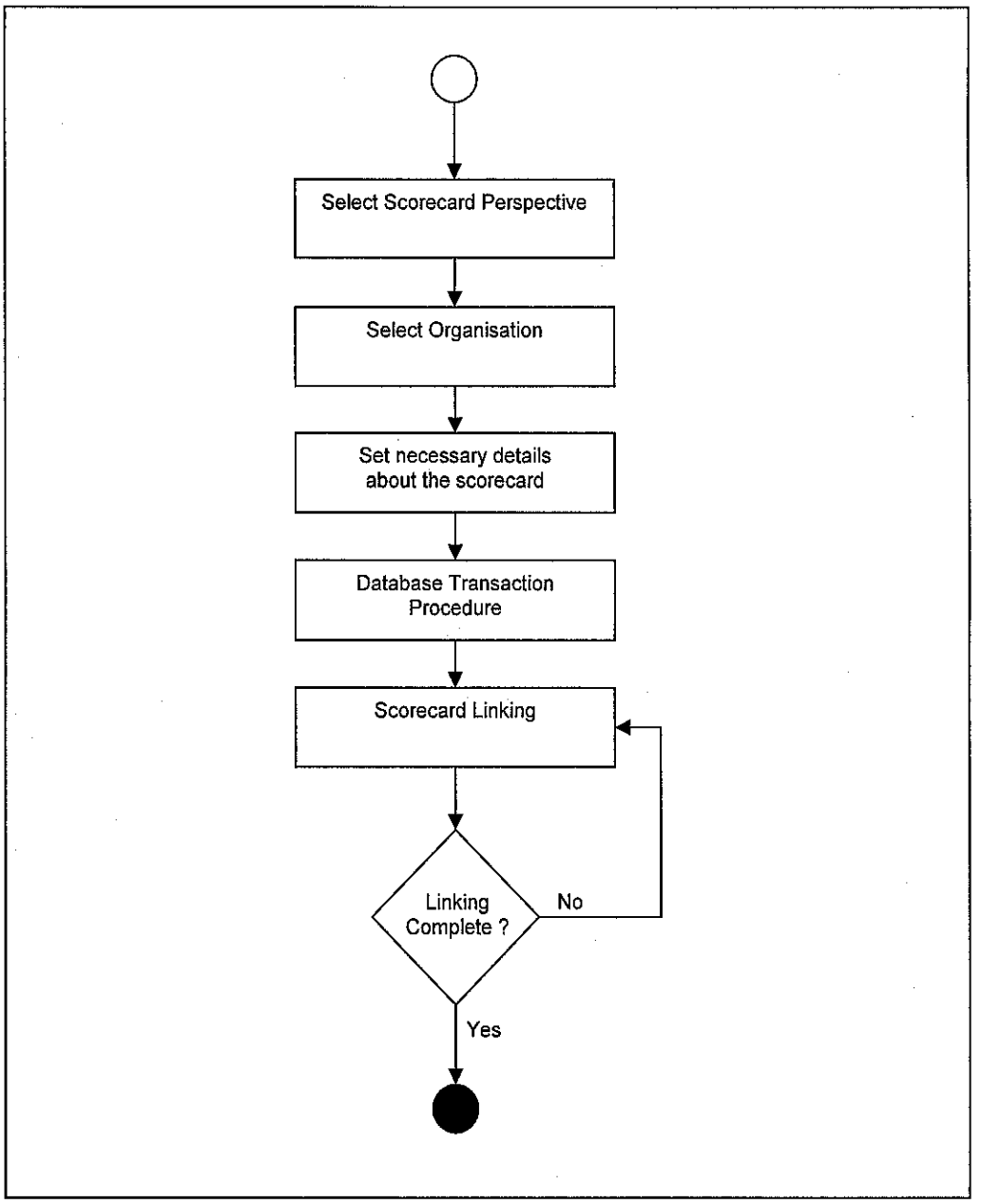


Figure 16: Strategic Planning Process

Figure above summarize the process in Strategic Planning module. It starts with selecting Scorecard's Perspective, assign the organisation for the scorecard and it finish when the scorecard linking is done. The first 3 steps in the process are done in the first sub-module, the Scorecard Definition module.

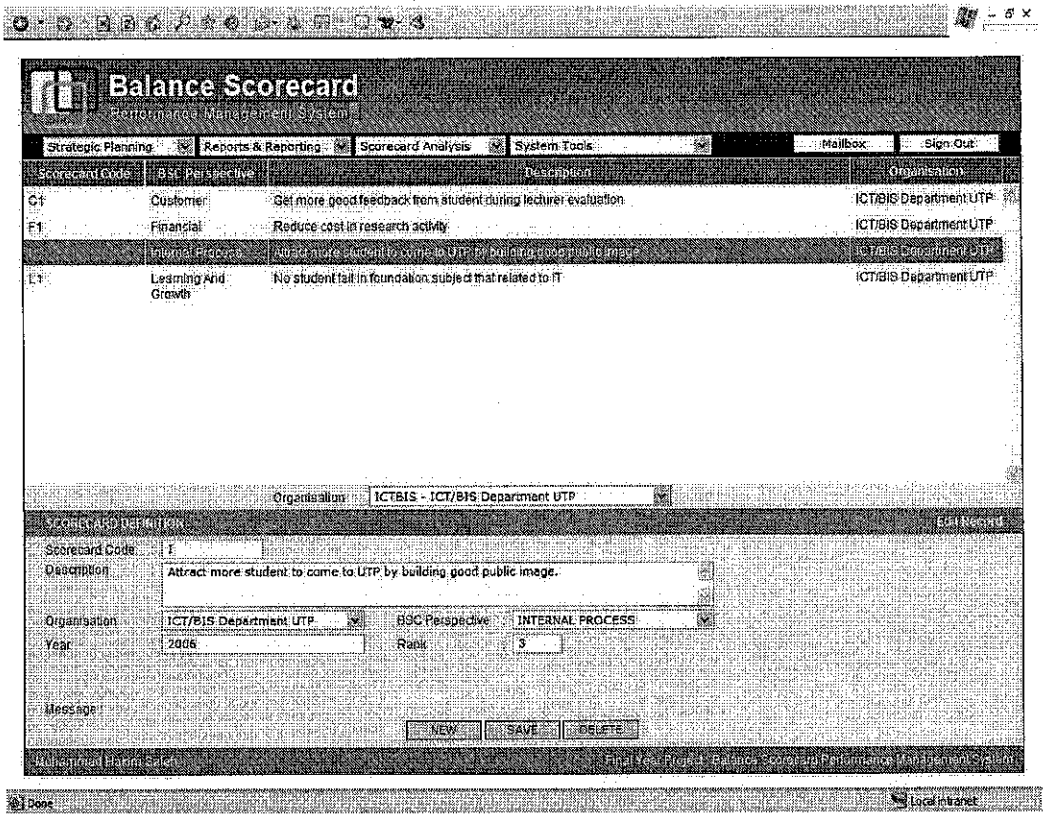


Figure 17: Scorecard Definition Screenshot

Scorecard definition module is where the user would enter what the goal of the organisation wants to achieve. This function is specifically done for the strategic planner and managers within the organisation.

When we are done with the scorecard definition process, we move to the next process; the scorecard linking. This process is done in the second sub-module, the Strategic Mapping module. The summary of the steps in scorecard linking can be found in next page in figure 18.

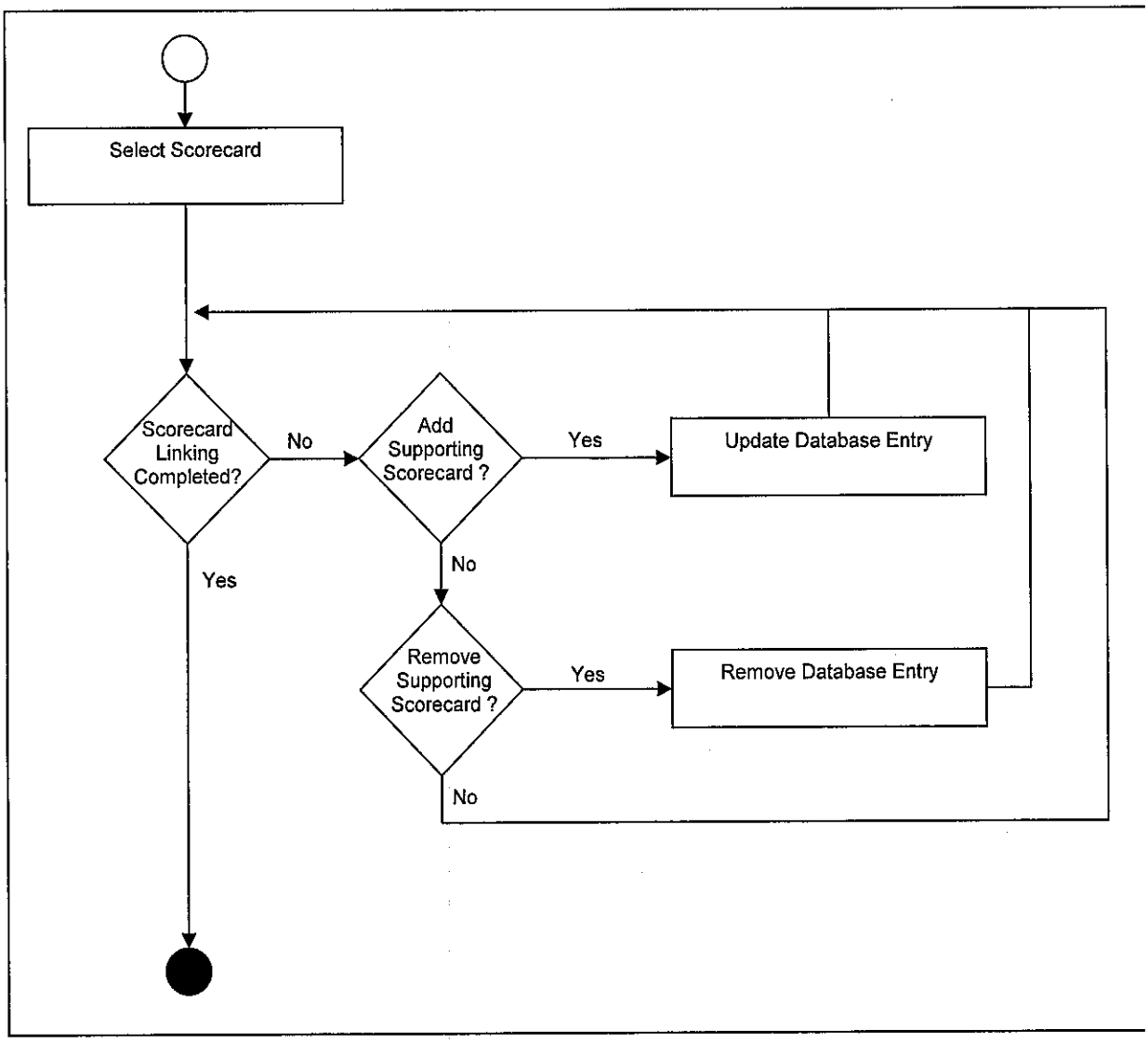


Figure 18: Flow Diagram of Scorecard Linking Process.

The process in scorecard linking is simple; we just loop the process of adding or removing supporting scorecard until we satisfied with the linking that has been done. The screenshot for Strategic Mapping module can be found in figure 19.

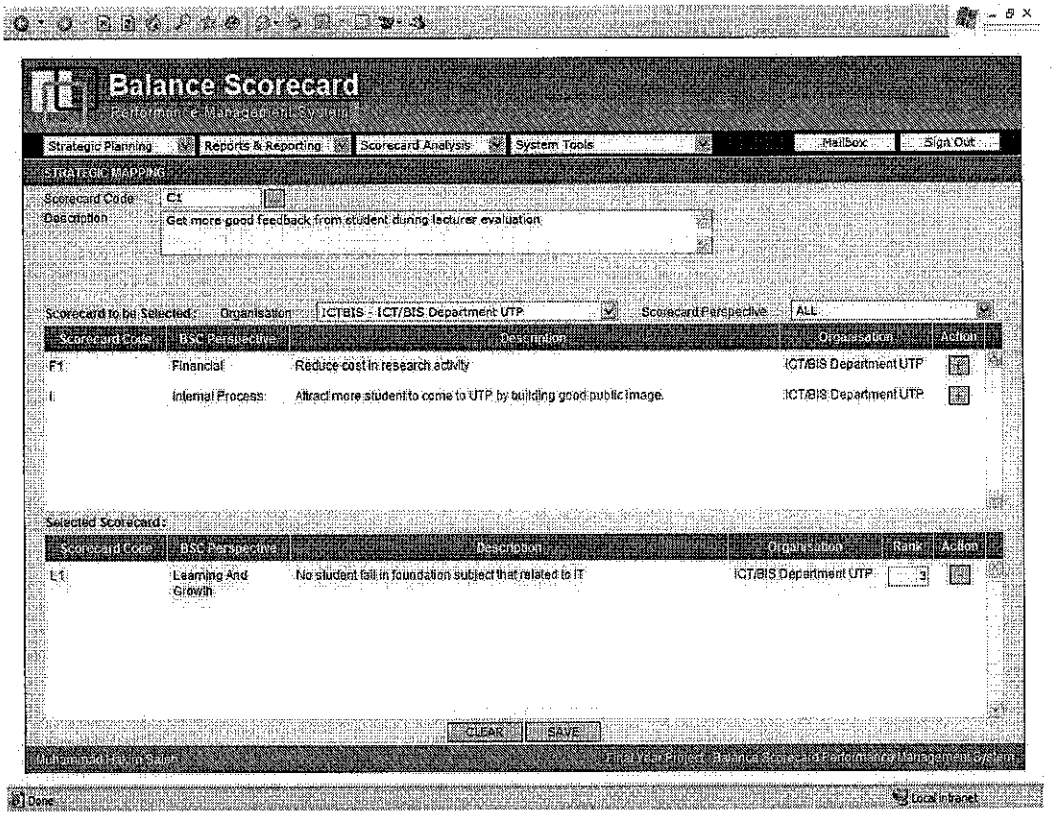


Figure 19: Strategic Mapping Screenshot

5.2.3.2 Reports & Reporting Module

Reports & Reporting module is the module where large part of database transaction is been done. This module responsible in completing 3 important processes identified for the system.

The first sub-module of the Task Register is where the task or initiatives that need to be done within the organisation is registered. The task can be divided into 2 categories, the Strategic Task or Operational Task. The strategic task require the user to enter the KPI section of the form that would be use to measure the performance of the scorecard that we already defined in the Strategic Planning module. Figure 20 show the flow of Task Register process.

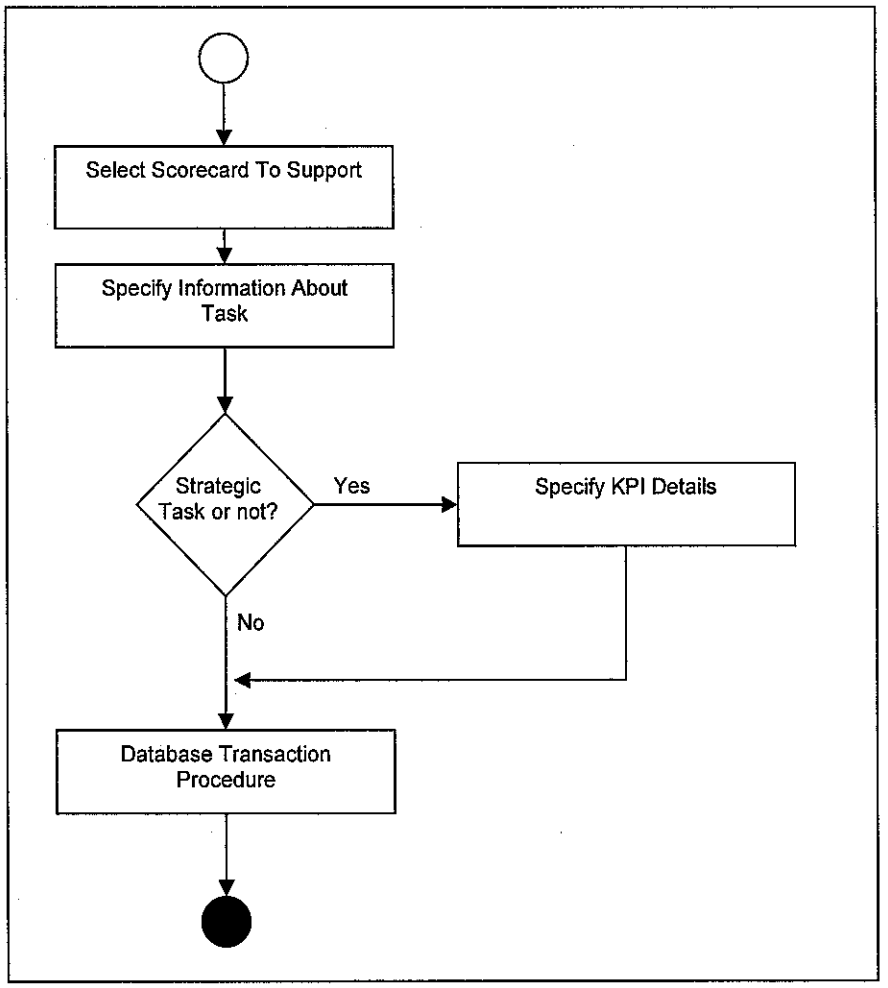


Figure 20: Flow Diagram of Task Register Process

The screenshot for Task Register and Task List can be found in the next page.

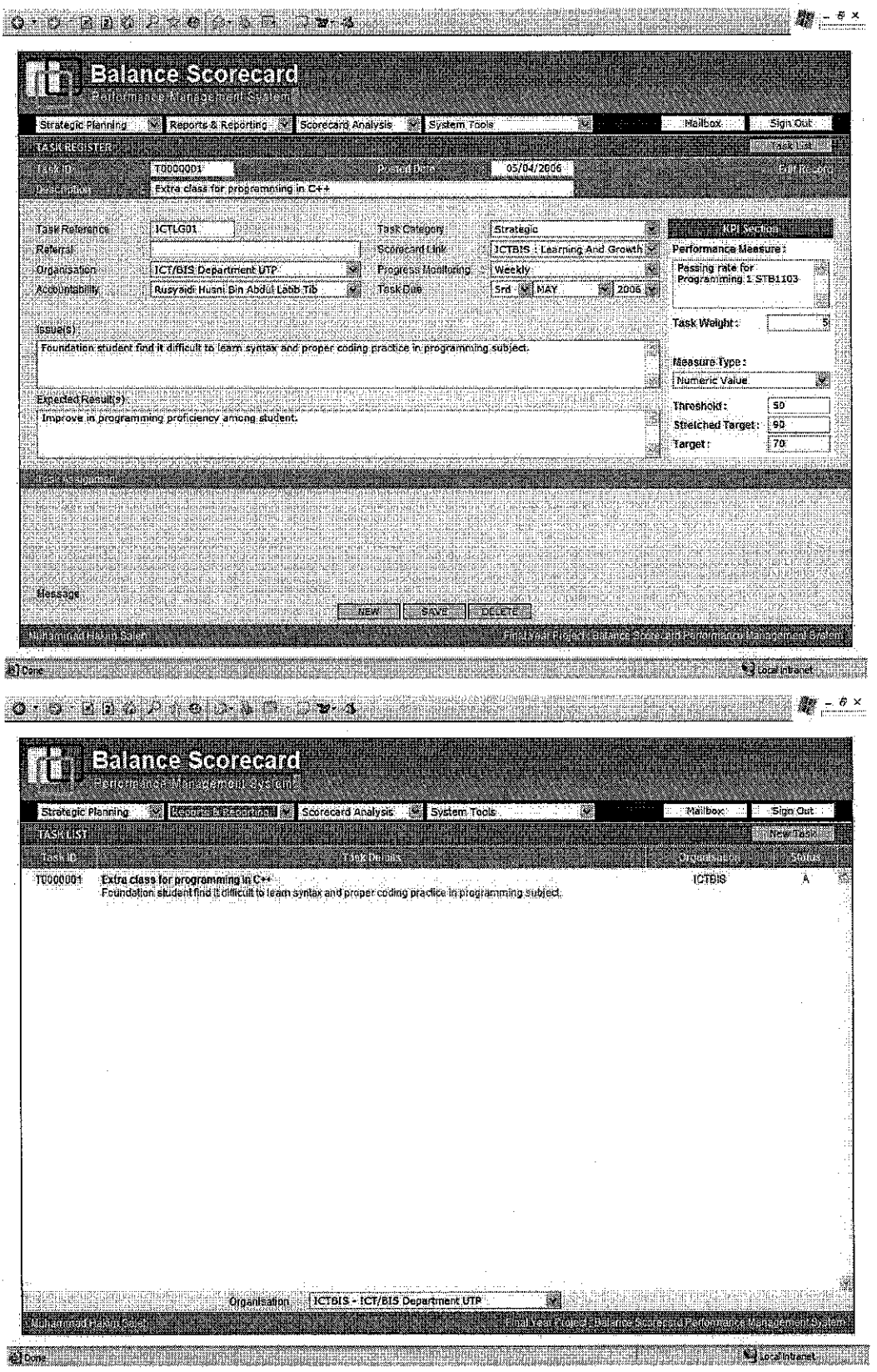


Figure 21: Task Register & Task List Screenshot

Task Tracking module is use to report the progress and the status of the task currently active. The flow diagram of Task Reporting can be found in figure 22.

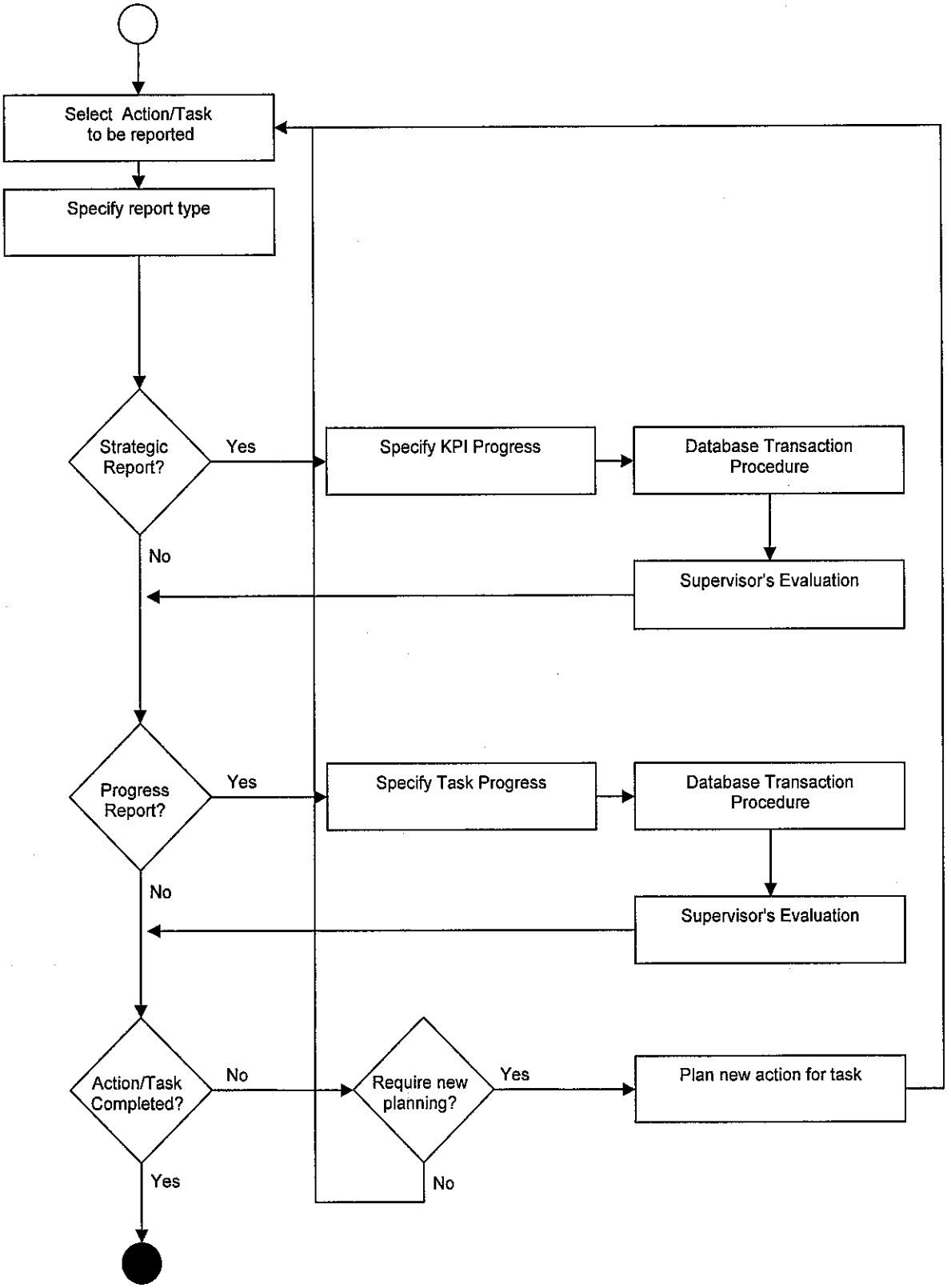


Figure 22: Flow Diagram of Task Tracking Process

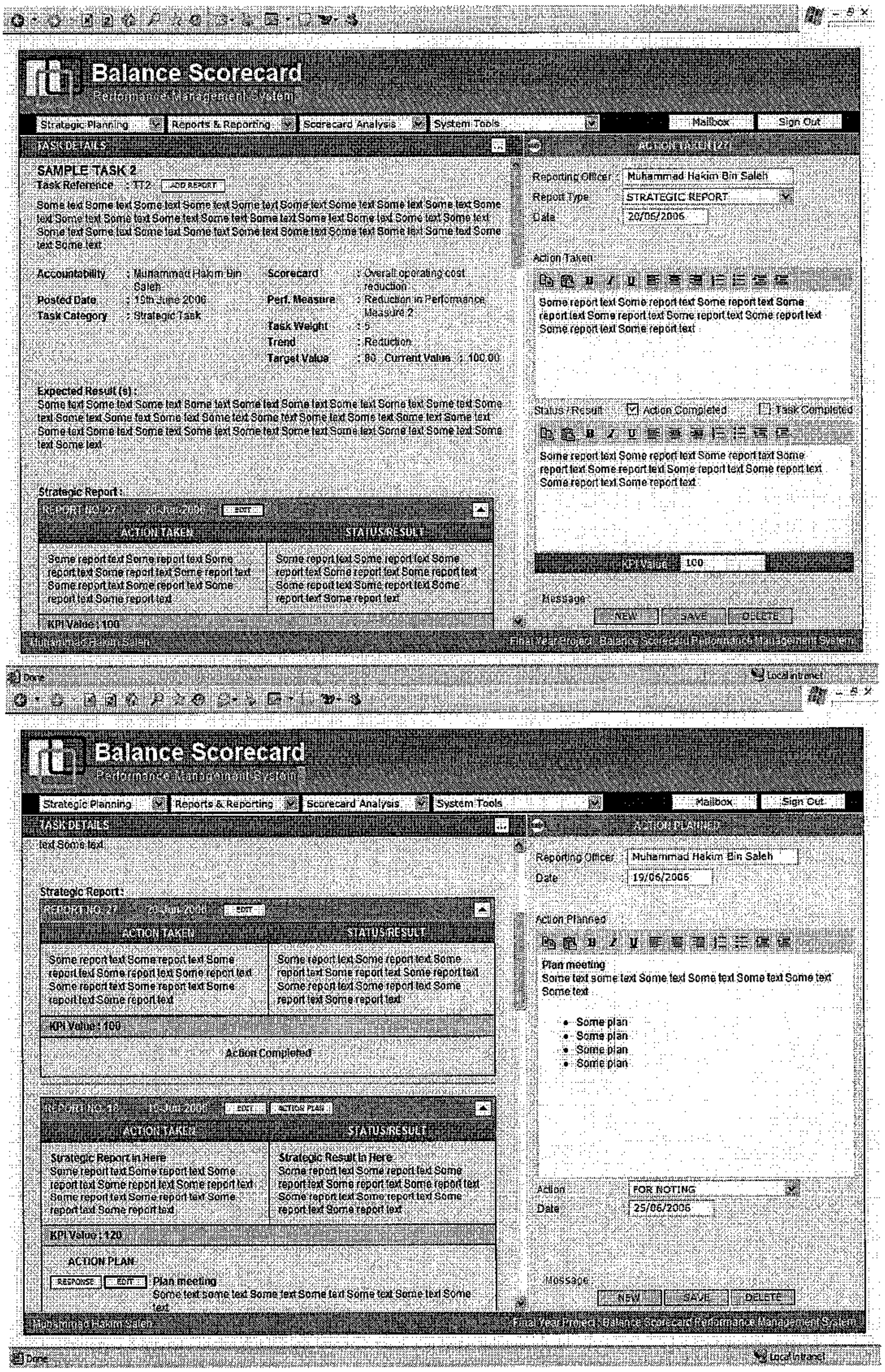


Figure 23: Task Tracking Screenshot

5.3.3.3 Scorecard Analysis Modulue

The Scorecard Analysis module would display user with how well the current the organisation or individual within the organisation that is performing. The Scorecard monitoring module show the overall performance of the company, whether they manage to achieve the goals or not and what tasks is supporting the scorecard. Drill-down analysis in the other hand offer more detail analysis which includes the cause-effect analysis based on the strategic mapping that is done in the Strategic Planning stage.

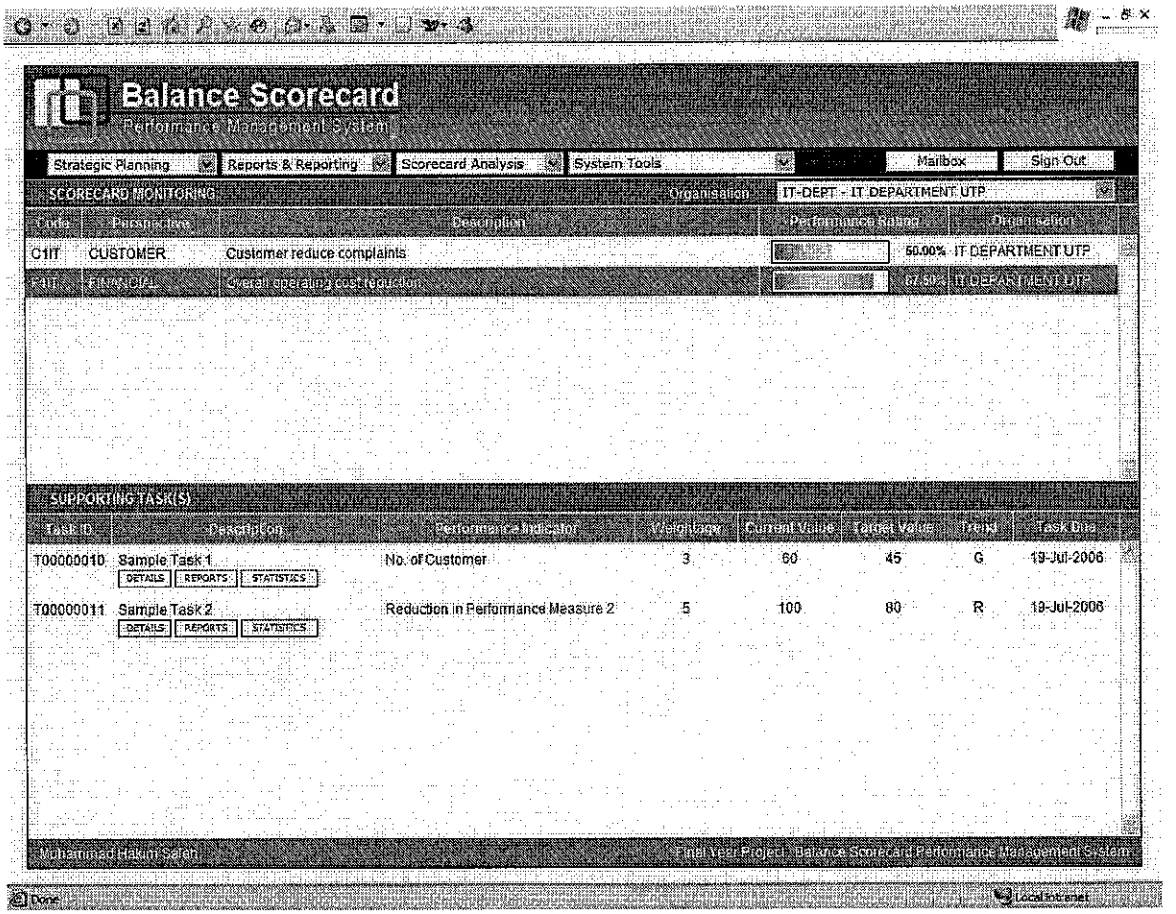


Figure 24: Scorecard Monitoring Screenshot

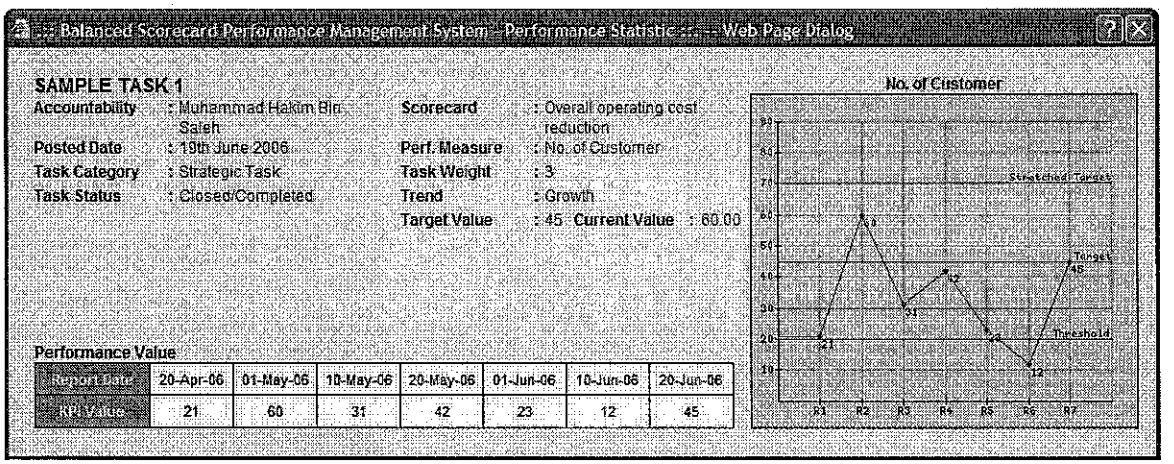


Figure 25: Statistical Information on Task

5.2.3.4 System Tools Module

As mentioned in previous section of the report, the backbone of this system lies on the System Tools module. This is where user is register, provide the front-end to database reference table maintenance as well as the information library is store. The function of this module is straight forward, mainly just about database updating. Here is a few screenshots for sub-modules inSystem Tools menu.

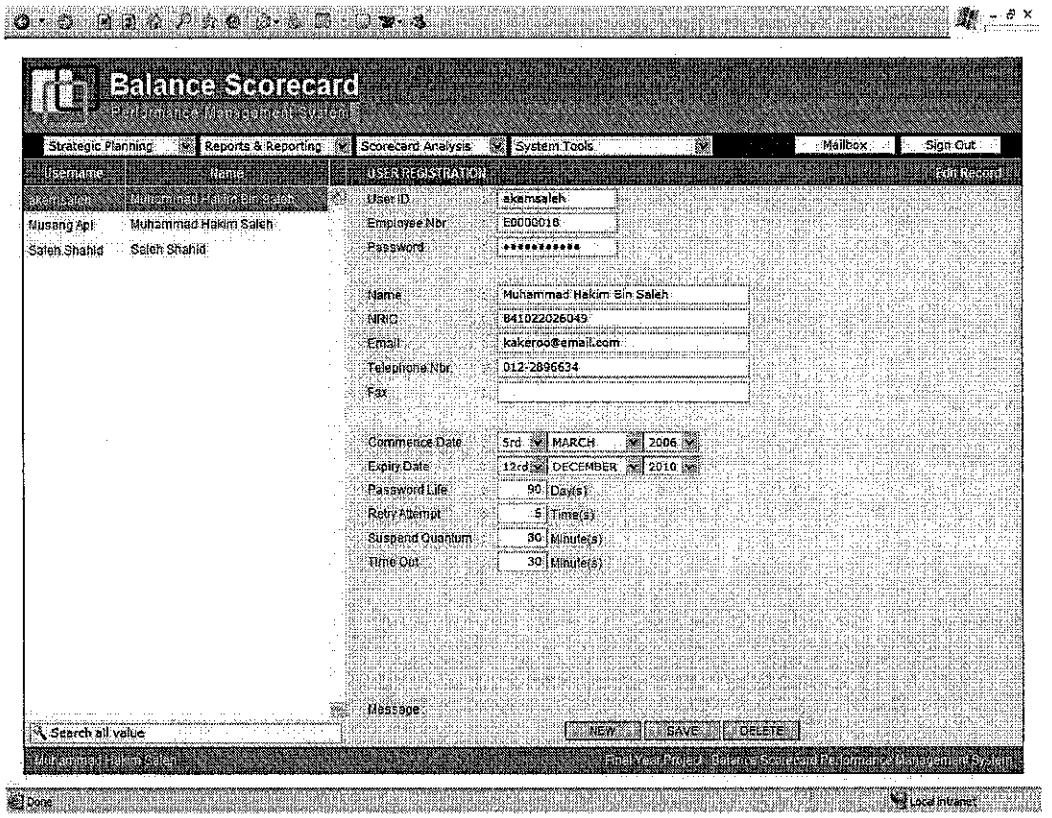


Figure 26: User Register Screenshot

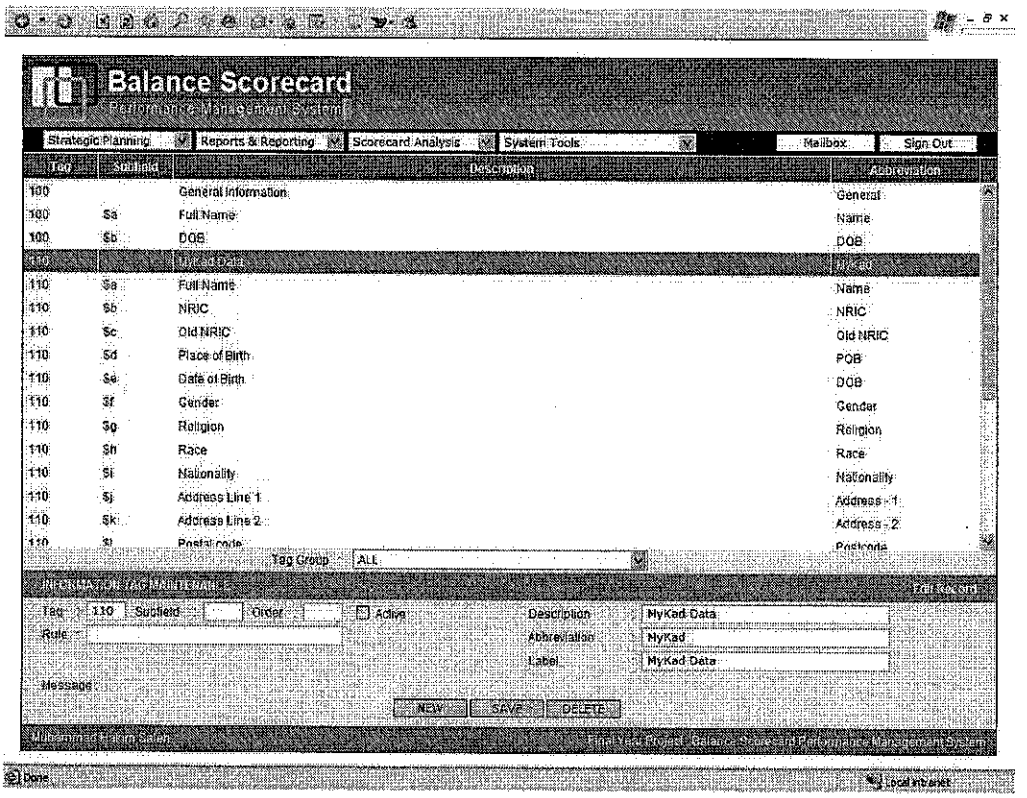


Figure 27: Information Library Tag Entry Maintenance

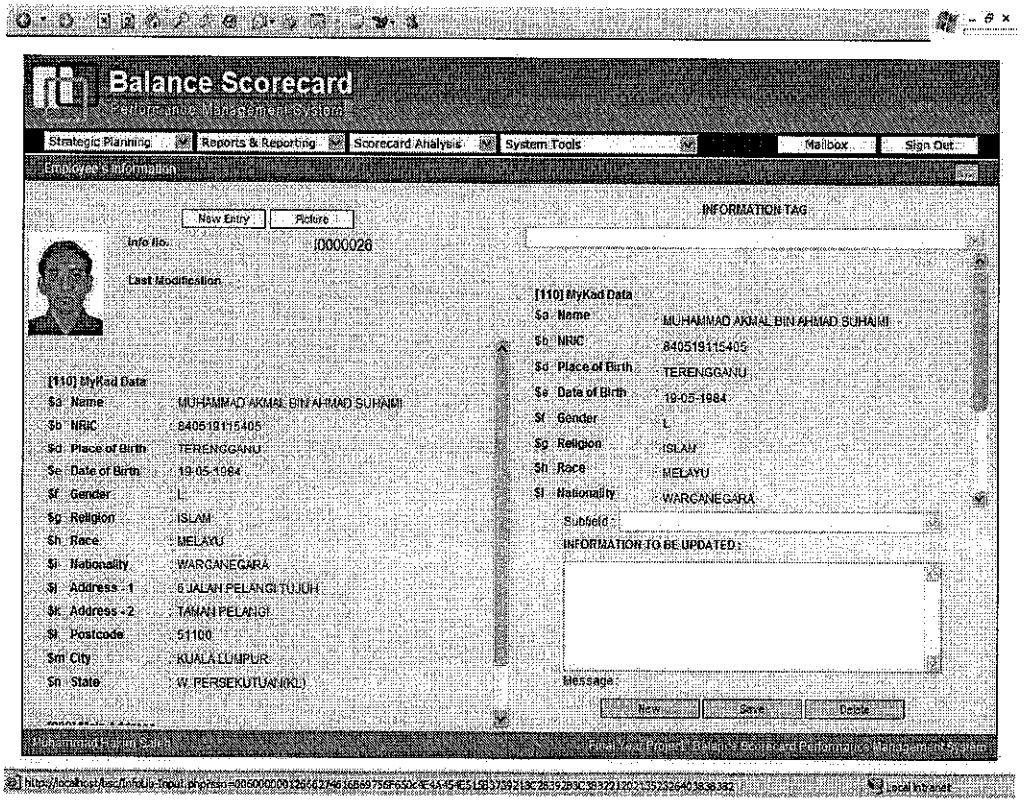


Figure 28: Information Library Record containing employee's records.

5.3 DISCUSSION

5.3.1 System Features

Here is the list of some key features of the prototype that the author think can give the prototype more appeal.

- KPI monitoring concept based on Balanced Scorecard Theory
- Flexible reporting approach.
- MyKad functionality – register employeee and system login (using browser specific developed for this system)
- Tabular data and statistical graph for performance analysis.
- Three selectable colour scheme.
- Dynamic Information Library – currently used storing information for employee.
- Web-based application to allow system to be access easier

5.3.2 System Limitation

There are a few limitation of this prototype. Here is the list of the limitations of the prototype:

- Cross-browser Compatibility
- Lacking in user access to limit activity of user.
- Some of the components did not completely converted to have AJAX feature.

5.3.3 Future Enhancement

The prototype can be expand to offer more management tools for top level decision making. This system can be use as the building block for development of HRM, Financial system.

In future, the prototype can be further enhanced by including more Balaced Scorecard concepts in the system. A further study on AJAX and JavaScripting can solve the limitation of cross-browser compatibility in the prototype.

CHAPTER 6
CONCLUSION

The aim of this project, which is to develop software based on Balanced Scorecard theories and principle, has been succesfully done. However, the effectiveness of the system cannot be determined because the lack of time available to completely test the product. The only testing that has been done so far is usability testing and logic testing to make sure the system function correctly.

For future enhancement, the system can be use as a core to many types of business application suce as accounting system or human resource management system. There are still rooms for improvements and the author intends to fill that room with all that he has.

Reference

Jesse James Garrett(2005). *"Ajax: A New Approach to Web Applications"*

Kaplan, R. and D. Norton.(1992)."*The balanced scorecard - Measures that drive performance.*" *Harvard Business Review* (Jan-Feb): 71-79.

Kaplan, R. and D. Norton, (1993). "*Putting the balanced scorecard to work*". *Harvard Business Review* (September-October): 134-147.

Kaplan, R. and D. Norton, (1996)."*Using the balanced scorecard as a strategic management system.*" *Harvard Business Review* (Jan-Feb): 75-85

Kaplan, R. and D. Norton. (2001). *"The Strategy-Focused Organization: How Balanced Scorecard Companies Thrive in the New Business Environment."* Boston, MA: Harvard Business School Pres[s].

Smart Cards Alliance (2003) ."*Privacy and Security Identification Systems: The Role of Smart Cards as a Privacy Enabling Technology*" –A Smart Cards Alliance White Paper

Malaysia's Governement (2000) *"MyKad PKI White Paper"*