Proposing a New Method for Procurement System in Universiti Teknologi PETRONAS

By

Nur Dalila binti Radzali @ Razali

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

JANUARY 2012

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CERTIFICATION OF APPROVAL

Proposing and Developing a New Method for Procurement System

in

Universiti Teknologi PETRONAS (eIMIS)

by

Nur Dalila binti Radzali @ Razali

A project dissertation submitted to the

Business Information System Programme

Universiti Teknologi PETRONAS

in partial fulfillment of the requirement for the

BACHELOR OF TECHNOLOGY (Hons)

(BUSINESS INFORMATION SYSTEM)

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January 2012

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.

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ABSTRACT

The main objective of this research is to find new method to enhance the procurement system in Universiti Teknologi PETRONAS (UTP) by using tools that can assist in enhancing the procurement system. The problem with current conduct is that, there is no computerized system that can help in decision making to raise a Purchase Requisition (PR) and can help track and manage inventory movement, which cost in time and effort due to physical counting and leads to high human error and operational tasks inefficiency.

This research encompasses the Inventory Management relation to Procurement process, which utilizes the web application e-Inventory Management Information System (eIMIS). The project looks at the related works by researchers from various scope of study, which includes inventory management concepts, the importance of tracking the stock age of an inventory and tracking the inventory level and how inventory helps in managing procurement. It focus more on the consumables inventory in Universiti Teknologi PETRONAS labs, developed using ASP.Net language and having Microsoft Access 2007 as the database. This paper also touches on the system flow, mechanism and tools used to develop and use the web application. Two surveys were conducted to gather information on the user acceptance towards the system and on the web application general look and feel, which uses the System Usability Scale standards to know the level of the usability of the eIMIS. The result shows that the system is perceived as convenience and useful in completing daily tasks of the users and the SUS is 82.25%, which is high in usability.

ACKNOWLEDGEMENTS

Alhamdulillah, praise be to Allah S.W.T, the most gracious and most merciful for giving me the strength and wisdom in completing this project. I would like to reach out my greatest appreciation to my supervisor, Dr. P.D.D. Dominic for his understanding and professional ways in guiding, commenting and motivates me in order to complete the development of this project.

I would also like to thank Mr. Elyas and Mr. Fadhullah, as the representatives of Purchase Department, and the faculty side, Chemical Engineering Department of Universiti Teknologi PETRONAS who has been of great assistance with regards to this project requirements and specifications.

Furthermore, I would like to extend my gratitude to En. Johan Ariff from Civil Department and En. Ruslan from CIS Department for giving their assistance in providing me the information that I needed in order to carry on with the development of eIMIS.

Last but not least, I would like to thank my family and friends for their supports and understandings.

Thank you.

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CHAPTER 1

PROJECT BACKGROUND

1 Background Study

Procurement and inventory are interrelated with each other. Inventory management manages the inventory in a manner that the company can provide the inventory for sale based on customer's demand yet strive to achieve low inventory level, while procurement process assists in getting the best deal for the inventory should it need to be restocked.

Having too much inventory at hand can be troublesome as it ties up to the company's capital and other costs. Therefore, this research is conducted to see how stock aging and quantity checking tool can help in managing the inventory and how the tools can help in procurement decision-making,

The researcher has taken Universiti Teknologi PETRONAS (UTP) as a case study to clearly see if the existing practice in procurement system can be enhanced with the proposed new method, which will make use of stock aging and quantity checking especially on their lab facilities.

1.1 Problem Statement

In order to have an efficient procurement system at a minimal cost, UTP needs procurement procedures that are prompt, convenient and accurate. In addition, the procedures should be able to help in decision-making processes.

Currently, UTP's procurement flow needs to go through the approval stages of at least two different departments, which are the faculties, and the UTP's Purchasing

Department. Not only that, the inventory tracking practice, which is done at the faculty level, is different from one lab technician to the other.

Although the system is fairly effective, it lacks in terms of practicality as the inventory tracking practice is decentralized and might cause confusion should there be any new lab technician in charge of raising Purchase Requisition.

Since the faculty is in charge in making the purchase requisition and keeping track on the inventory, it is plausible for the purposed system to assist the faculty in making the decision to re-order new stocks by having the quantity checking system, as well as stock aging report to determine which item/stock that needs repurchasing and which stocks that need to be disposed. This will result in a speedy and relatively accurate decision-making as well as making the purchase requisition process more efficient with the supporting reports and make it easier for the Purchase Requisition approval process.

Without a proper material planning or inventory control system, UTP will not only be wasting their time and money that will jeopardized their overall efficiency, but also undue purchasing decision could lead to a delay in delivering optimum operational needs.

1.2 Significant of the Project

The objective of the proposed new method in procurement project is basically to provide the person in charge with tools that can help them in making decision to procure and restock inventory. The significance of this project is to give assistance to the person in charge to in terms of decision support for decision making to procure and restock inventory. The project also gives the person in charge the bird eye's view on inventory quantity level which is the determinant of re-order point as well as give

the information which inventory is a fast or slow moving in order to avoid obsolete stock and too much stock on hand.

1.3 Scope of Study

The aim of this project is to explore options for a new procurement system that would focus on the inventory re-order supports such as stock aging report and quantity checking system as well as to explore the alternatives to enhance the Purchase Requisition notification system. To do this, a consultation session with representatives from UTP's faculties and Purchasing Department will ensue to look at the procurement flow, how inventory are tracked and how the decisions are made. Research area of this project consist of identifying the most suitable design principle that can be applied in developing the system logic and the interface, as well as integrating the proposed system with the real world business process. UAT (User Acceptance Test) will also be conducted in order to test the usability of this system.

1.4 Objectives

The objectives of the research are as follows:

- To research on the information needed to build the system logic
- To research on suitable principle that needs to be applied in designing suitable interface for application.
- To develop a system that can:
    - Provide stock age tracking and quantity checking tool
    - Act as an online platform for request for consumables to be made and tracked
- To test on usability of the application.

1.5 Feasibility Studies

1.5.1 Economic Feasibility

Economic feasibility covers the development costs, operating costs, and intangible costs and benefits. For the development and operating costs which consist of labor, hardware, software, licensing and user trainings, the figure can be roughly projected as below:

Development costs	Estimated Price (RM)
Hardware	2500
Printer	110
Software	
Microsoft 2010 Professional	1258
Microsoft Visio 2010 Standard	782
Microsoft Visual Basic	2495
Development labor	2000
Total Development costs	9145
Operational Costs	
Hardware	8300
Software	3211
Operational labor	1800
Total operational costs	13311
Total costs	22456

Table 1.5-1: Estimated Cost Incurred for Development and Operational Side

According to a report by Yankee Group (2005), product information management (PIM) increases inventory management process by 25%. This is a part of intangible benefits that the proposed system provides. Other than that, with the development of the proposed system, higher quality products can be provided and reduction in inventory that can cut down costs of forward ordering due to better decision-making based on the proposed system outcomes - the Stock Aging report and the Quantity checking system.

1.5.2 Technical Feasibility

The technical feasibility focus around the big question: *Can we build it?* which governs the familiarity of the functional area, the technology area, project size and the compatibility of the proposed system (Dennis et al, 2010, p. 46).

(i) Minimum risks on Technology area

Based on the general observation made in UTP's Purchasing Department, it can be said that the personnel is familiar with the functional side of the proposed system and IT literate, seeing the department is using the SAP ERP system to assist in procurement processes. Thus, the risks of developing the proposed system are at minimum.

(ii) Medium risks on familiarity of the functional area

Although the Purchasing Department are clear of the other departments' functions and roles in providing them the information that they need to continue with the procurement process (i.e Purchase Requisition), the departments or faculties work in a decentralized form which means different practice for different person. Therefore, the risks of the developing the proposed system in this context are medium.

(iii) Medium risks on Project Size

The project size of the proposed system is in a small to medium scale due to it being developed individually and it caters the small portion of the whole procurement processes, which also minimize the development risks. Furthermore, the proposed system will be developed in Visual Basic environment and uses the Microsoft Access as the database that is easier to maintain compared to other platform.

1.5.3 Operational Feasibility

Operational feasibility is a measurement tool on how well the proposed system addresses the problems, takes advantages of the opportunities identified in the system scope definition and how well it satisfies the requirement identified in the requirement analysis phase in the development (Bentley et al, 2007, p. 417).

The proposed system helps in introducing new method of decision making in making purchases, which indirectly gives benefits in terms of cost reduction in purchasing inventory (i.e lab facilities). The proposed system also addresses the communication issues between the Purchasing Department and the lab technicians by providing the notification system once the Purchase Requisition has been approved by the Head of Department.

In order to cater the adaptability challenges that the proposed system will issue, internal training will be provided to the users, mainly the lab technicians on how to use the system and how to incorporate the proposed system in their job scope to enhance their productivity and job efficiency.

1.5.4 Schedule Feasibility

The time frame that is desirable for the system is 8 months. The development process will involve 5 different phases which are based on the System Development Life Cycle (SDLC) methodology; Planning, Analysis, Design, Implementation and Maintenance. The planning, analysis and part of the design phase will be conducted in the first 4 months, while the rest will be conducted in the remaining 4 months. Each phases involve are turned into milestone in order to avoid delay and saves on the development costs.

1.6 Gantt Chart

No	Detail/Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Conducting Research														
2	Preparing project proposal														
3	Gathering Sources														
4	Initiating Extended Proposal														
	Problem Background														
	Literature Review														
	Methodology														
5	Extended Proposal Submission						◆								
6	Proposal defence								◆						
7	Gathering requirements from expected user through							Mid Semester Break							
	Interview														
	Questionnaire														
	Etc														
8	Analyzing Findings														
9	Drafting System Diagram Design														
10	Compiling Diagrams													◆	
11	Interim Report Submission														◆
12	Amendments														
13	Full Report Submission														◆

Figure 1-1: Gantt Chart

CHAPTER 2

LITERATURE REVIEW

2 Inventory Management: Definitions and Concepts

Procurement process, which starts with creation of purchase requisition, happens when inventory is low on stock and need to be re-ordered or purely because new stock is needed. It is closely related with the inventory management processes in terms of tracking the consumption quantity and identifies re-order level. Therefore, maintaining the right inventory levels is crucial for businesses because if it is not properly managed, the inventory can be liability to a company.

According to Chary (2000, p. 137) and Mercado (2008, p. 1), inventory management deals with the continuous need to ensure how much to keep on hand, how frequent and when the inventory need to be replenished. Inventory is running capital thus; the inventory control is an important aspect of operation management.

Inman (n.d.) state that inventory management, or inventory control is a way to balance inventory needs and requirements with the need to minimize costs that resulted from obtaining and holding inventory. Based on this context, Chisholm (2000) agrees by noting that the inventory is a potential source of cost reduction and for efficiency's sake, public sector organizations are also focusing on inventory management improvements.

Reimer et al. (n.d.) as discussed in the article *The Benefits of Inventory Control,* industry averages suggest that a 20 percent reduction in inventory is obtainable with an inventory control system which also given an example where, for a company with

a yearly sales volume of $1 million, such a decrease would result in savings of $14,400 per year and would make $48,000 of new liquidity available for reinvestment purposes. In a brief, controlling the inventories of the company can help cut major costs and have a remarkable impact on the financial bottom line of the company. To quote Reimer et al., "*The benefits of inventory control far outweigh the costs*". This view goes hand in hand with the holding costs (Beasley, n.d.) disadvantages, one of which leads to money tied up and decrease the opportunity cost, labor, obsolescence costs and storage costs all of which resulted from holding unnecessary amount of inventory on hand.

2.1 The Importance of Identifying Quantity Level and Having Stock Aging Record

It is suffice to say that reducing inventory is the desirable outcome. Black (2008, p. 112) suggests that one of the first steps one can take is by classifying parts inventories as one of three types, which are:

- X - Dead Stock. This inventory is not needed, as it might be obsolete, outdated, or damaged. Action should be taken to diminished them.
- Y - Parts out of balance, which refer to too many stock on hand.
- Z - Part whose inventories may be considered under control.

High urgency of action needs to be taken to both Category X and Category Y inventories to eliminate bad inventory and holding costs.

Craig (2011) stated that inventory has a "limited shelf-life", which in retailing world, means that there is an opportunity period for that inventory to be sold. Once the period ends, the sales value of it decreases and the profitability and inventory turnover are not maximized. In addition to this issue, excess inventory may also influence service and operations such as incurring unnecessary freight costs, and should the company does cycle counting, then such (dead) inventory that is counted too often may lead to wasted time and effort.

This is where implementing an inventory management tool can be beneficial. Category X, which is the dead stock, can be identified with the use of the proposed system's outcome, which is the Stock Aging record. As the name suggests, it contains information on the age of the stock and the shelf-life information. From this, not only the management can identify which stock is reaching its maximum shelf-life, but also able to know which ones are the fast or slow moving inventories so that they can make decision whether to keep purchasing the inventory or looking for an alternative.

Another proposed system's outcome, which is the quantity checking tool can help in determining what and how much inventory is needed as discussed in the earlier section. As mentioned by Black (2008, p. 112), those inventories in Category Y need a strong attention in order to lessen quantity, which can be beneficial by using the tool. Another usage of this tool can also be seen in determining the re-order point. A re-order point is basically a level of inventory that is chosen as the signal to replenish (Mercado, 2008, p. 64).

2.2 The Importance Practicing Inventory Control Management with Procurement Processes

In many large organizations such as UTP inventory purchasing are separate units that may reside in the same department or in different departments that can be depicted with a real life situation, where~~by~~ inventory management and tracking is done at the Faculty level while purchasing processes are done by the Purchasing Department. When inventory departments work closely with purchasing departments (Chisholm, 2000) such advantages could be obtained:

- Increase in Vendor performance and on-time delivery
- Decrease stock outs
- Increase savings potential

Chisholm (2000) also suggests that inventory management departments must work with purchasing departments and customers to bring together the two conflicting objectives. - (1) maximize customer service (which is to provide material when the customer needs it) and (2) minimize inventory dollars (which is to control the number of cash invested in parts and material). Ways to meet these two conflicting objectives include the following:

- Clear and regular communication among maintenance, inventory management, and purchasing departments;
- Dynamic material planning by maintenance, inventory management, and purchasing departments;
- Effective physical control of parts

In relation to that, Schreibfeder (2004) stated that an early warning system or simply a notification system is a good practice to have due to its usefulness in alerting a buyer of an approaching crisis.

One of the ways to acquire/have the early warning system is to notify the available quantity of stock on-hand whether it is below the safety stock level or not. The safety stock acts as insurance inventory, which is designed to compensate for delays in receiving replenishment shipments. Requester (in our case, the faculty staff, say a lab technician) should be informed if reserved inventory is being used so that they can advance existing incoming shipments or obtain the product from an alternate source (Schreibfeder, 2004). The early warning system in a way helps in meeting the two conflicting objectives described by Chisholm above. To quote Schreibfeder (2004), "*They won't receive a multitude of alerts, but every one they do get will require their attention*".

Chisholm (2000) also states that determining the quantity of inventory to be purchased can be based on a variety of factors such as material forecasts, inventory target levels, or simply the current amount of inventory on hand.

In a nutshell, a proper inventory management would help in terms of projecting inventory requirements both for the short term and long term and plan for the increase or decrease in inventory stock accordingly (Chisholm, 2000).

CHAPTER 3
METHODOLOGY

3 Research Methodology

The research methodology section represents the strategies that consist of collecting and analyzing data collected in order for meaningful analysis and interpretations of the research findings to be present. This section focuses on giving the insights on how the research is carried out. This includes the mode of data collection, how the data is analyzed and the research tool design.

Vital information for this research work are collected through primary and secondary sources with the combination of:

(1) Interview with the key personnel in the purchasing department and the faculties of UTP. *(See Appendix 1. Interview Outline)*

(2) Observation of the inventory management and procurement processes in order to have more understanding on the procurement and the inventory management flow

(3) Document reviews which consists of records of any relevance document involved during the inventory and procurement processes

(4) Acceptance survey will be conducted on the selected population, which consist of UTP's lab technicians. *(See Appendix 2. Acceptance Survey)*

(5) eIMIS Web Application Usability Test will be conducted on selected population, which consist of the system's related users (*See Appendix 3. eIMIS Web Application Usability Test*)

3.1 Sample Design

3.1.1 Defining the population

An acceptance survey has been conducted in the campus on relevant personnel such as lab technicians because they are responsible in raising a Purchase Requisition, on all relevant departments which are the: (1) Department of Chemical Engineering, (2) Department of Civil Engineering, (3) Department of Geosciences & Petroleum Engineering, (4) Department of Engineering & Electronic Engineering, (5) Department of Computer and Information Sciences and last but not least, (6) Department of Fundamental & Applied Sciences.

Not only that, the eIMIS web application usability test also took place in the campus on selected personnel such as students (for the requester role, as well as other roles), lab technician and lab executive in order to gather information on the level or scale of the application usability to a real world implementation.

3.1.2 Sample Size

The total number of lab technicians from the departments mentioned is 106. From this number, 25 respondents have desired to represent the overall population. This is due to the limitation of costs and time constraint to reach out to above 25 respondents.

The usability test was conducted on 15 respondents which 10 of them being students that act as a requester as well as represent as the general respondents that gives general outlook on the look and the feel of the web application, where as another 5 consists of lab technician and lab executive to test the usability of each role's module functions and flow. This is due to the limitation of costs and time constraint to conduct a full application usability test to the users.

3.2 Research Hypothesis

The following hypothesis was tested in this research work:

Implementation Hypothesis

- **H0:** UTP does not make use the inventory management approach in making decision to procure inventory
- **H1:** UTP make use the inventory management approach in making decision to procure inventory

Usability Hypothesis

- **H0:** eIMIS web application is hard to use in terms of the whole look and feel of the application and users are less likely to use the web application once implemented
- **H1:** eIMIS web application easy to use in terms of the whole look and feel of the application and users are most likely to use the web application once implemented

3.3 Method for data presentation and interpretation

The data collected will then be mainly presented in graphic forms, which are the combinations of:

(i) Qualitative data such as the existing procurement flow which is hoped to be gathered via the interview session will be presented in a well thought out flowchart in order to give depiction on how the procedure flow from one to another.

(ii) Quantitative data that are derived from the acceptance survey and application usability test will be utilizing the use of bar charts and pie charts to identify and differentiate the percentage or value obtained from different group of respondents.

A standard font is used to accompany the graphic in terms of its axis descriptions and title. Not only that, filled patterns will also be utilized depending on its relevance to present the data more distinctively from one another. According to

Egger et al. (n.d.) data collection is the systematic copy of information while the data analysis consist of identifying patterns and trends in data sets collected and the data interpretation in explaining the identified patterns and trends.

Upon collecting the qualitative data from both the interview and the observations, careful analysis has been done to prepare a SWOT analysis to analyze how to best cater both parties. The results of the survey are processed using the (1) SPSS software and (2) the word processing software, Microsoft Word 2008.

3.4 System Methodology

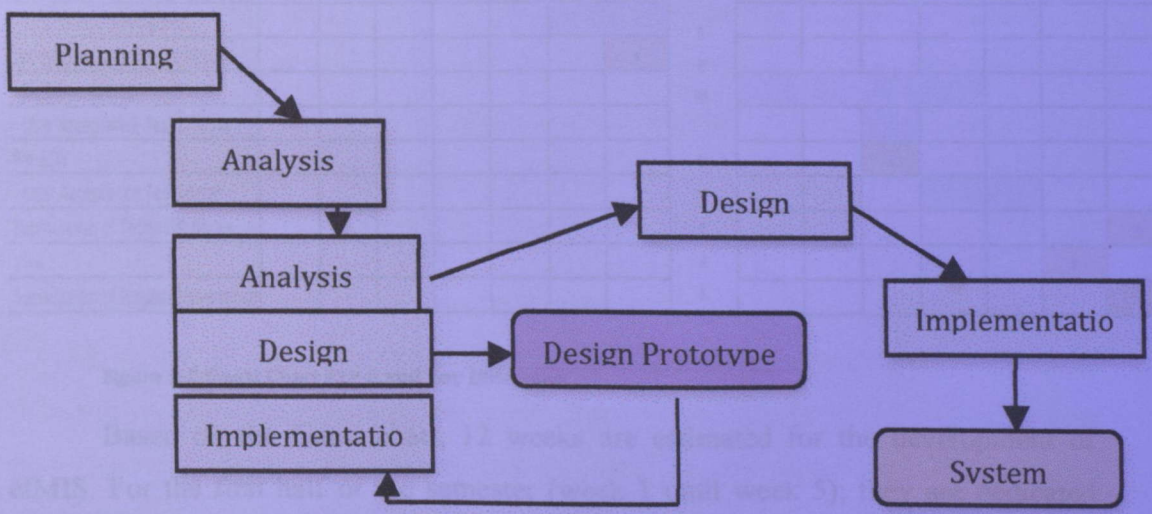


Figure 3-1: Throwaway Prototype

Based on the fact-finding activities findings, it can be said that the proposed system should be developed in a throwaway prototype environment, which requires the developer to always analyze and design the current prototype state with the user to

ensure the developer meet the user requirements, as user requirements tend to change from time to time.

3.5 Project Activities

This project consists of four main activities, which are (1) the Planning Phase (2) the Analysis Phase (3) the Design & Development Phase and (4) the Implementation Phase. The section will elaborate more on each phase of the project in details.

3.5.1 Gantt chart and Key Milestone

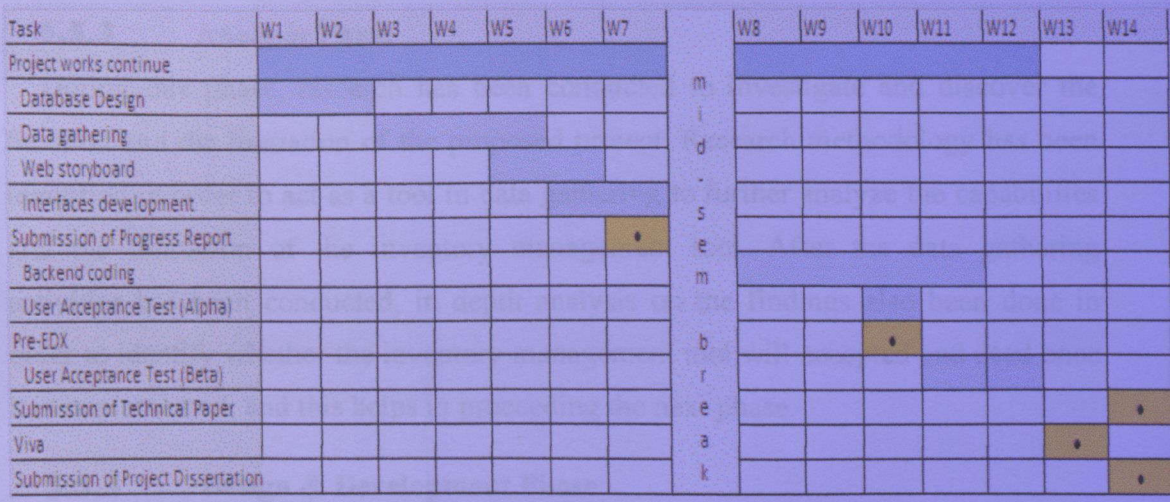


Figure 3-2:Gantt Chart FYP II and Key Milestone

Based on the Gantt chart, 12 weeks are estimated for the development of eIMIS. For the first half of the semester (week 1 until week 5); they are dedicated solely for data gathering for database development purposes, drafting and designing the web interfaces. By week 6 onwards, the backend coding for the website which consists of full development phase will be executed.

A user acceptance test (UAT) alpha level will be conducted on week 10, which the system will operate in 90% completion with dummy data for the developer to do testing and do quick bug fixing. After the pre-EDX which is week 11 onwards, eIMIS

will be given a test run using UAT beta for the real-world user(s) and final tweaks will be completed by week 12.

3.5.2 Planning Phase

During planning phase, the business concept and value of the project is determined and identified. A preliminary studies has been conducted in order to identify feasible aspects of the project and based on this, a project plan has been produced. The deliverables for this phase is the feasibility studies and the project execution plan.

3.5.3 Analysis Phase

During this phase, research has been conducted to investigate and discover the function and the limitation of the proposed project. Research methodology has been identified in order to act as a tool in data gathering to further analyze the capabilities and the limitation of the inventory management tool. After the data gathering activities has been conducted, in depth analysis on the findings also been done in order to identify whether the inventory management tool will accepted and used once it is implemented, and this helps in proceeding the next phase.

3.5.4 Design & Development Phase

All the actions taken along the development of the system are documented under this section. The actions include the development of the interfaces storyboard on how they interconnected with each other as well as the functions available, the development of the database, and how the user interfaces will look like. The outline or draft of the whole outlook on the system has to be developed first before executing the actual implementation. Also, during this stage, the proposed system's name was identified which is called ***e-Inventory Management Information System*** (eIMIS). Below are some of the activities conducted throughout the design phase for the system:

3.5.4.1.1 Database Design

The database is the backbone of any system; therefore it took longer time in identifying the entities involved together with its attributes and relationships to one another. The relationships between the tables in the database are in this order

3.5.4.1.2 Storyboard

A website storyboard is an illustration of the relationships between the web pages that constitutes the site. For eIMIS, a storyboard has been developed in order to assist in interfaces design in the future and to ensure that the flow is as intended. There are basically three basic flows in eIMIS that can be depicted in a storyboard below:

1. ***Request flow:*** User have to log in → make a request under New Request → Lab Exec review, approves and allocate → Lab Technician do the allocation (under the Monitor Request)→Requester can view Request Status and allocation
2. ***Stock Age Report flow:*** Lab Technician or Lab Executive filled in the criteria → eIMIS populate the data based on criteria selected
3. ***Quantity Checking flow:***Lab Technician or Lab Executive filled in the criteria → eIMIS populate the data based on criteria selected

3.5.4.1.3 Sitemap

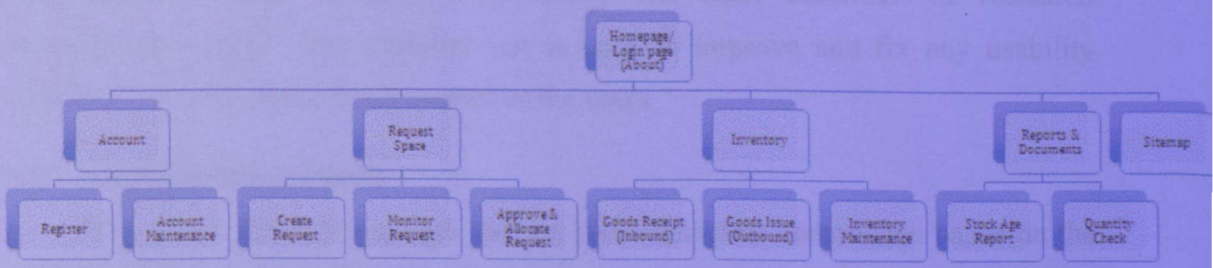


Figure 3-3: eIMIS Sitemap

3.5.4.2 Development Phase

3.5.4.2.1 Database Development

After the entities, attributes and relationships between the entities have been identified and draft out, the next step is to develop the eIMIS database together with the tables.

3.5.4.2.2 Website Interfaces Development

The development of the pages started parallel with the development of the storyboard. The priority of pages creations are given based on its functions and for the time being, only pages that contain critical forms are created in order to ensure all the basic functions related to the system can be connected smoothly.

3.5.5 Tools

The development of eIMIS involve using Adobe Macromedia and Adobe Photoshop CS4 for the interfaces, a developer tool that supports web based application due to its multi-user client/server architecture nature which is the Microsoft Visual Studio 2010 Ultimate that supports Visual Basic and ASP.net programming language. For the database, Microsoft Access 2010 is used for the database design and development

After the prototype has been completed, application usability test has been conducted which the research methodology has been described in Research Methodology section. The usability test is used to improve and fix any usability problems before it can be implemented to the users.

3.6 Implementation Phase

During this phase, the system will be 100% complete constructed based on the prototype developed and it undergoes several testing in order to ensure it is bug free in order to run properly and produced the desired result.

CHAPTER 4
RESULTS AND DISCUSSION

This chapter will discuss the results and findings from the research methodology tools discussed in Chapter 3. It will cover the qualitative findings from the interview, document review and observation, as well as the quantitative findings from the acceptance survey and eIMIS web application conducted.

4 Findings

4.1 Qualitative Data

4.1.1 Interview & Observation

Interview is the most common and direct method to gather information. The session has been conducted thrice, which the initial interview was conducted with the Purchasing Department, once through phone since the location of the interviewer at that particular time was not in campus, while the second interview conducted through personal meeting both with the Chemical Engineering Department. The Chemical Engineering Department is the representative of the faculty level since it is relevant to implement both Quantity Checking tool and Stock Aging report as the department's procurement tool. Below is the interview summary based on the interviews conducted:

Person Interviewed:

- Mr Elias, Purchasing Department personnel, Purchasing Department, Universiti Teknologi PETRONAS.

- Mr Fadhullah, Lab Executive, Chemical Engineering Department, Universiti Teknologi PETRONAS.

Interviewer: Nur Dalila Radzali @ Razali.

Purpose: to obtain better understanding on the current system and the requirements for new system to be developed.

Summary of Interview:

- Interview with Purchasing Department
    - The interview conducted with Mr Elias exposed the procurement flow in UTP as a whole, which consist of the current existing system used in Purchasing Department, the role and responsibilities of Purchasing Department, which is to process all the purchase request and finding the right vendor to match the request and get the best deal. Based on the interview, it is found that the UTP is using SAP ERP to handle its procurement flow as a whole, which starts from the purchase requisition (PR) up until the purchase order and invoicing. In order to raise a PR, user needs to log on PINTAS, which is a customized SAP system for UTP's Purchasing Department.
    - Due to this information, it is found that the faculty staff such as lab technicians and lab executives raises most PR.
    - The cost of using PINTAS in terms of only obtaining password and username consumed a large sum of money, which is RM 5,000.
    - In order to complete a procurement process, one need to undergo several approval level such as getting endorsement from the Head of Department, and then another endorsement from Financial Department.

- It is also found that the communication between Purchasing Department and faculties level are inefficient because there is no notification system that can notify Purchasing Department of an approved PR from the faculty.

- Interview with Chemical Engineering Department
  - It is found that there is no computerized system that monitors the inventory, which caused in manual counting and tracking. The current manual system flow can be illustrated as below:

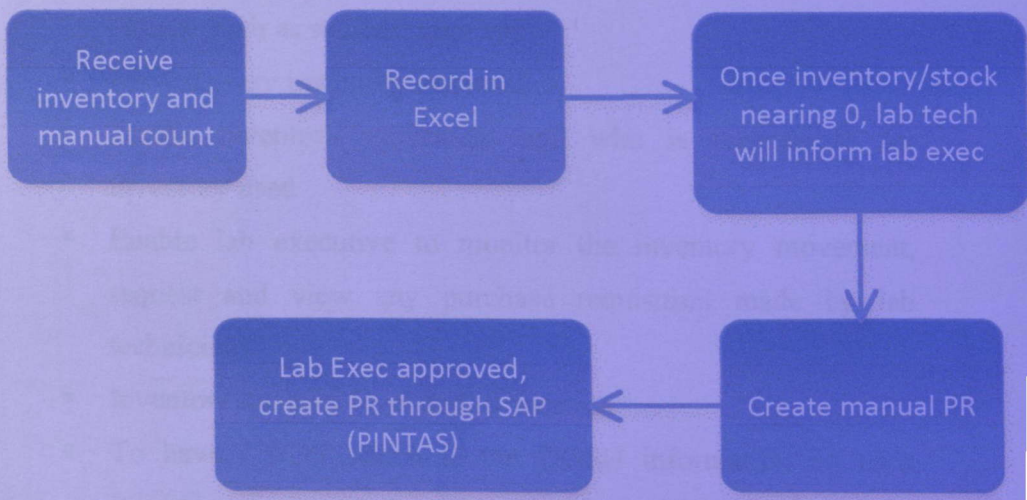


Figure 4-1:Current Manual System Flow for Inventory Tracking

  - The manual inventory tracking which is the physical count is the only tool used to raise a PR to procure stock that falls under the safety level. Sometimes the lab technicians gave the wrong information on the material's name, which results in high human error and cost a lot of time to correct.
  - The Excel files used to store material information lacks security measures to it, which makes it prone to unreliable data and information.

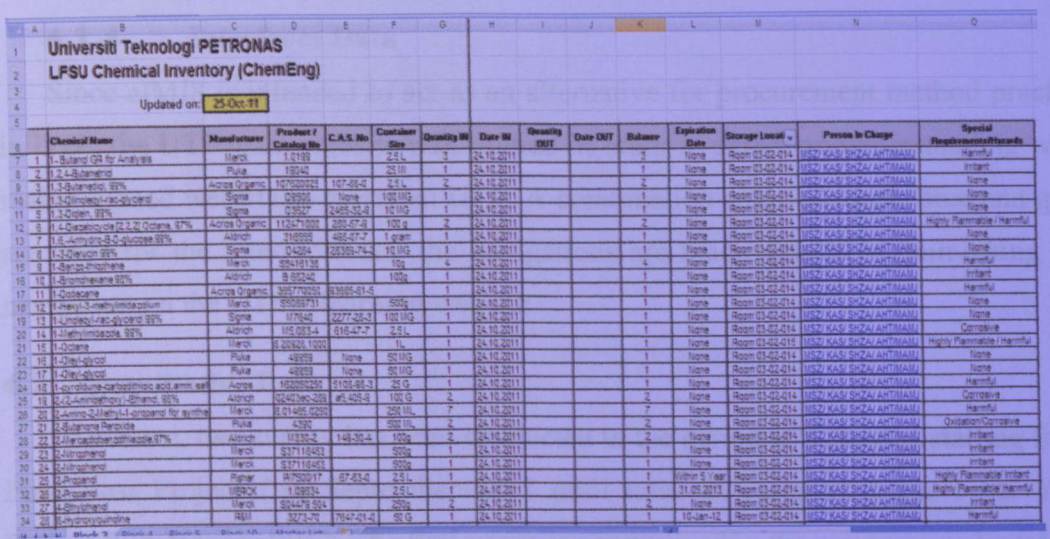
- From the interview, its is costly to purchase an inventory system which for only for licensing might cost around RM 80,000 per year and it is also found that there are several other category of inventory which are:
  - Consumable (below RM 5,000)
  - Asset (Below RM 50,000),
  - Asset (Above RM 50,000)
- The proposed system is desired to have these capabilities:
  - Multi user environment that can caters to material usage request such as student, tutor etc.
  - Record every inventory information
  - Tracks inventory movement and who is responsible for inventory used
  - Enable lab executive to monitor the inventory movement, request and view any purchase requisition made by lab technicians
  - Inventory quantity level and its location
  - To have CS/DS which is the DOSH information on each inventory (optional)

- Observation
  - Based on the informal observation made during the interview, it can be said that the user (lab executive) is keen on having the proposed system and having it implemented for the department usage.
  - In addition to that, they are planning to request for an inventory management system similar to the proposed system

4.1.2 Document Reviews

There are two documents reviewed during the interview which 1) consist of procurement process flowchart issued by Purchasing Department and 2) Excel file of

inventory information issued by Chemical Engineering Department which can be seen below:



Universiti Teknologi PETRONAS
LFSU Chemical Inventory (ChemEng)

Updated on: 25-Oct-11

	Chemical Name	Manufacturer	Product / Catalog No	C.A.S. No	Container Size	Quantity IN	Date IN	Quantity OUT	Date OUT	Balance	Expiration Date	Storage Locati	Person In Charge	Special Requirements/Hazards
1	1-Butanol GR for Analysis	Merck	1.01199		2.5 L	3	24.10.2011			3	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	Harmful
2	2,4-Butanediol	Fluka	19042		25 lit	1	24.10.2011			1	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	Irritant
3	1,3-Butanediol, 99%	Acros Organics	107329955	107-88-0	2.5 L	2	24.10.2011			2	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	None
4	1,3-Dioxepan-(+/-)-glycerol	Sigma	D3855	None	100 MG	1	24.10.2011			1	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	None
5	1,3-Octen, 99%	Sigma	D3527	2408-37-9	10 MG	1	24.10.2011			1	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	None
6	1,4-Dioxaspiro[4.5]decane-2,3-diol, 97%	Acros Organics	112471000	2980-67-9	100 g	2	24.10.2011			2	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	Highly Flammable / Harmful
7	1,6-Anhydro-β-D-glucose 99%	Aldrich	316997	498-07-7	1 gram	1	24.10.2011			1	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	None
8	1,6-Hexanediol	Sigma	H4254	25339-17-5	10 MG	1	24.10.2011			1	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	None
9	1,8-Cineol 99%	Merck	S5431135		10g	4	24.10.2011			4	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	Harmful
10	1,8-Dibromooctane 98%	Aldrich	B 88240		100g	1	24.10.2011			1	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	Irritant
11	1,9-Decadiene	Acros Organics	395770050	13665-81-5		1	24.10.2011			1	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	Harmful
12	1-Hexyl-3-methylimidazolium	Merck	S6088731		500g	1	24.10.2011			1	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	None
13	1-Linoleyl-(+/-)-rac-glycerol, 99%	Sigma	M7640	2277-28-3	100 MG	1	24.10.2011			1	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	None
14	1-Methylimidazole, 99%	Aldrich	MS 083-4	616-47-7	2.5 L	1	24.10.2011			1	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	Corrosive
15	1-Octene	Merck	S 28328 1000		1L	1	24.10.2011			1	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	Highly Flammable / Harmful
16	1-Oleyl-glycol	Fluka	48859	None	50 MG	1	24.10.2011			1	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	None
17	1-Oleyl-glycol	Fluka	48859	None	50 MG	1	24.10.2011			1	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	None
18	1-pyrrolidine-carbodithioic acid,amm. salt	Acros	162662500	5108-96-3	25 G	1	24.10.2011			1	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	Harmful
19	2-(2-Aminoethoxy)-Ethanol, 98%	Aldrich	03467-bec-289	#6.405-8	100 G	2	24.10.2011			2	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	Corrosive
20	2-Amino-2-Methyl-1-propanol for synthesis	Merck	8.014.65.2293		250 ML	7	24.10.2011			7	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	Harmful
21	2-Butanone Peroxide	Fluka	4320		500 ML	2	24.10.2011			2	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	Oxidation/Corrosive
22	2-Mercaptoethanolthiazole,97%	Aldrich	M330-2	149-30-4	100g	2	24.10.2011			2	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	Irritant
23	2-Nitrophenol	Merck	S3711645 3		500g	1	24.10.2011			1	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	Irritant
24	2-Nitrophenol	Merck	S3711645 3		500g	1	24.10.2011			1	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	Irritant
25	2-Propanol	Reher	R7500017	67-63-0	2.5 L	1	24.10.2011			1	Within 5 Year	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	Highly Flammable Irritant
26	2-Propanol	MERCK	1.09634		2.5 L	1	24.10.2011			1	31.05.2013	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	Highly Flammable Harmful
27	4-Bromophenol	Merck	S5447 9 594		250g	2	24.10.2011			2	None	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	Irritant
28	8-Hydroxyquinoline	BDH	3273-70	7647-01-0	50 G	1	24.10.2011			1	10-Jan-12	Room 03-02-014	MSZI KASI SHZAI AHTMAMU	Harmful

Figure 4-2:Excel Sheet containing Material Master Data

4.1.3 Database Data

As mentioned, in the first few weeks, data from UTP technologists from five faculties which are 1) ITMS (CIS Department) 2) Chemical Engineering Department 3) Petroleum & Geoscience Department 4) Civil Engineering Department and 5) Electrical & Electronic Department were gathered in order to have an overview on how the database would look like.

From the data gathered, it can be concluded that the eIMIS is well suited for the consumables asset and not appropriate for tracking small inventory such as nails in Civil Engineering Department and lab equipment such as given by the Electrical & Electronic Department. It is also found that, ITMS could benefit from the periodical notification on nearing expiration for software licensing.

Due to some irrelevant data gathered, it is decided that only data from ITMS and Chemical Engineering Department will be used as the dummy data for the system to enable clear concept testing on inventory tracking and management for both stock age report and quantity checking.

4.1.4 Interfaces Data

Since eIMIS is intended to act as an alternative for procurement method practice in UTP, the UTP main website was studied in order to gather an understanding what makes a good website to represent UTP. A combination color of white, blue and gold are used for the interfaces and the navigations are made simple by mimicking the navigation on the UTP e-learning website.

4.2 Quantitative Data

At present, two survey has been conducted in the period of 8 months starting from Final year Project I in September 2011 until now, in completing the Final Year Project II in January 2012. The first survey as mentioned in the research methodology section is the acceptance survey and the second one conducted recently is the application usability test survey. The findings are as below:

4.2.1 Acceptance Survey

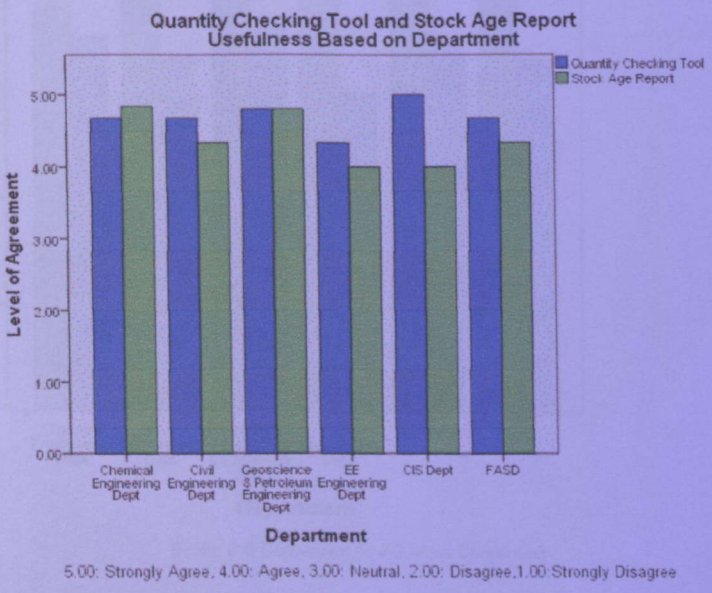


Figure 4-3: Quantity checking tool and stock age report usefulness

Based on the acceptance survey results, it is found that all 6 departments agree that the both quantity checking tool and stock age report are useful to the respondents. In addition to that, based on the responses received, it can be said that Chemical Engineering Department, Geoscience & Petroleum Engineering Department and Fundamental of Applied Science Department (FASD) finds that Stock age report is more relevant to the department's daily tasks compared to quantity checking tool while responses from Computer & Information Science Department, Electrical & Electronic Engineering Department and Civil Engineering Department shows that the Quantity checking tool is more useful compared to stock aging report.

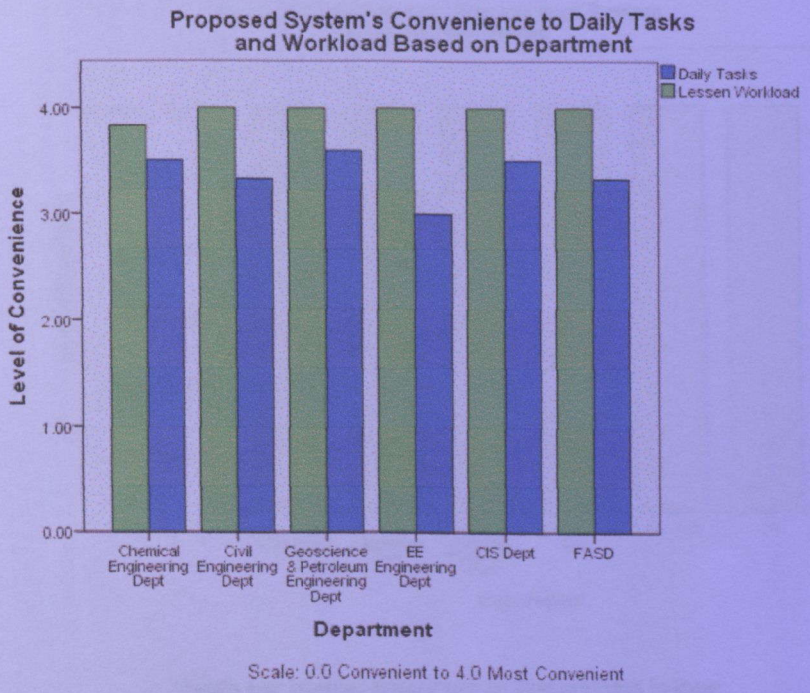


Figure 4-4: Proposed system's convenience to daily tasks and workload

The acceptance survey also covers the respondents' perceptions on the level of conveniences that the proposed system would bring should it be implemented. From the responses received, it is found that on average based on departments, respondents feel that the proposed system is convenient on a scale 3 to 4, with 4 being the most convenient to the respondents' daily tasks and workload.

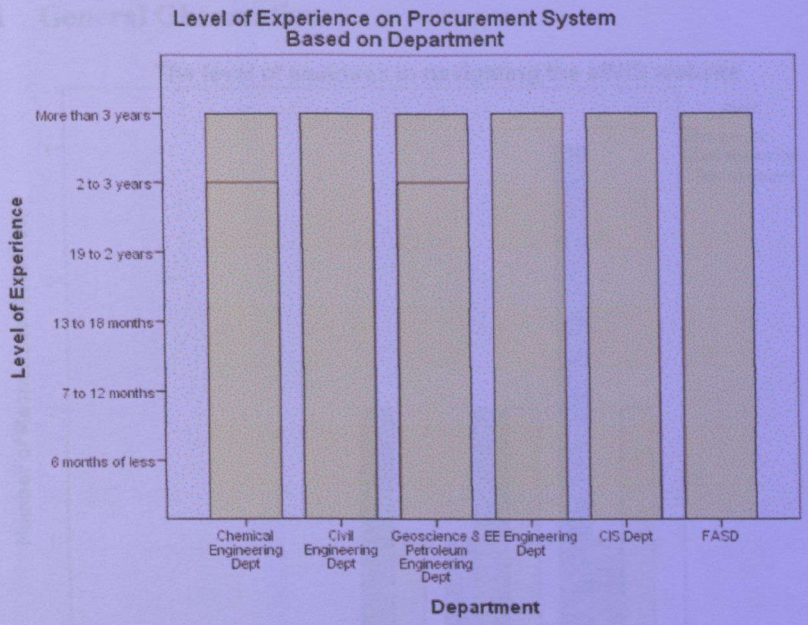


Figure 4-5: Level of Experience on Procurement System

Based on the figure above, on average all 6 departments have lab technicians with experience more than 3 years in using a procurement system, which shows that the validity towards user acceptance of the proposed system is reliable and favorable even for experienced user.

4.2.2 eIMIS Web Application Usability Test Survey

The survey has been conducted to 15 respondents with time constraint of 5 minutes per person in order to have a general browsing experience and to evaluate the general look and feel of the web application. Another 5 to 10 minutes was given to the respondents to go through eIMIS users' module – 5 persons each for each module (a) as the requester (b) as the lab technician (c) as the lab executive.

The survey which consists of 17 questions altogether, was divided into two sections, which (1) is the General Observation and (2) the System Usability Scale (SUS). The findings are as below:

4.2.2.1 General Observation

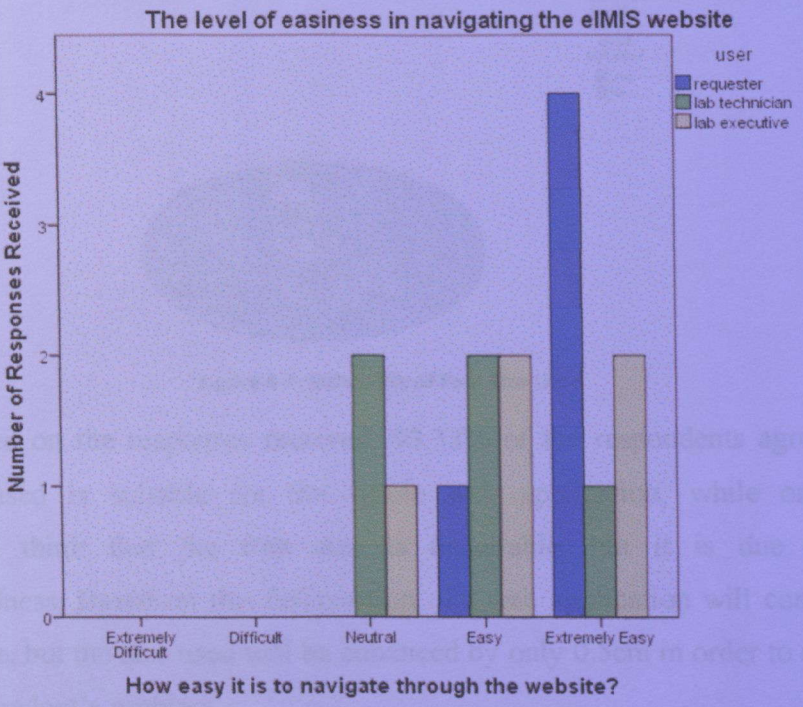


Figure 4-6: The level of easiness in navigating the eIMIS website

From the question "How easy it is to navigate through the website?" it is found that the mod of responses is under the *Extremely Easy* group while *Easy* hold the second most answered responses and *Neutral* received the lowest responses. Based on this information, it can be said that the web application is generally extremely easy to navigate, and this helps in deciding whether or not to make enhancement or changes on the web application way of navigations.

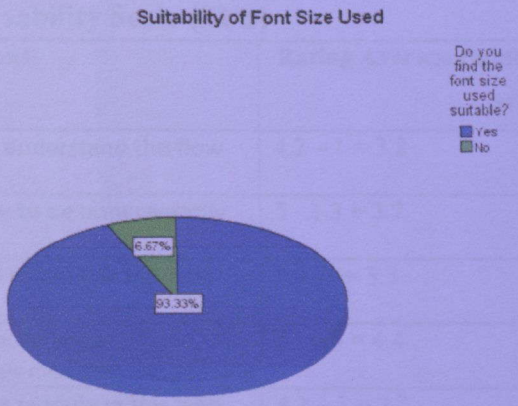


Figure 4-7: Suitability of Font Size Used

Based on the responses received, 93.33% of the respondents agree that the font size used is suitable for the whole web application, while only 6.67% respondents think that the font size is unsuitable, but it is due to his/her shortsightedness. Based on this information, the web application will continue with the font face, but the size used will be enhanced by only 0.5em in order to cater to the 6.67% respondent's problem.

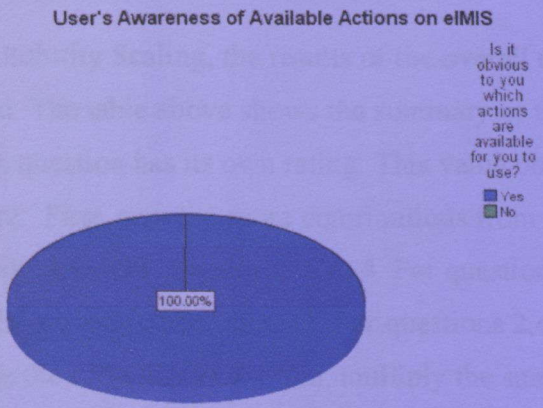


Figure 4-8: User's Awareness of Available Actions on eIMIS

Based on the 100% responses on user awareness of available actions to them on eIMIS, it can be said that eIMIS successfully manage to implement authorization level by limiting and classify different actions for different role of users.

4.2.2.2 System Usability Scale (SUS)

Questions	Rating Average (minus 1 or 5 minus the rating average)
1. I think it is easy to understand the flow of the module	4.2 – 1 = 3.2
2. I found the module to be unnecessarily complex	5 - 1.3 = 3.7
3. I think I would like to use this module frequently	4.3 -1 = 3.3
4. I thought there was too much inconsistency in this module	5 - 0.6 = 4.4
5. I found the various module in this web application were well integrated	4.2 – 1 = 3.2
6. I think that I need the support of a technical person to be able to use this module	5 - 1.9 = 3.1
7. I would imagine that most people would learn to use this module very quickly	4.0 – 1 = 3
8. I found the module is very cumbersome to use	5 - 1.7 = 3.3
9. I felt very confident in using this module	3.8 – 1 = 2.8
10. I needed to learn a lot of things before I could get going using the module	5 - 1.9 = 3.1
Total	32.9

Figure 4-9: SUS Results

By using the System Usability Scaling, the results of the overall usability of the system can be gathered. The table above shows the summary of the whole questionnaire and each question has its own rating. This value obtain can be used to calculate the SUS score. First, sum the score contributions from each question. Each question 's score contribution will range from 0 to 4. For questions 1,3,5,7,and 9 the score contribution is the scale position minus 1. For questions 2,4,6,8 and 10, the contribution is 5 minus the scale position. Then, multiply the sum of the scores by 2.5 to obtain the overall value of SUS. From the table, the total sum of all question is 32.9. Next, the sum will be multiplied with 2.5; 32.9 x 2.5 = 82.25. Based on this, the result is more that 50% which makes the eIMIS web application's level of usability is high. The Usability Hypothesis of H1 is proven.

4.3 Discussion

Based on the results, it can be said that the overall acceptance of the proposed system is favorable and will make users' daily tasks and workload much more easy and convenient. From the interviews conducted, it can be said that the proposed system will cater to more than 1 user and should be in a website form due to its nature of multi-user and information sharing. The flow of the proposed system would be as follow:

4.3.1 Use Case Diagram

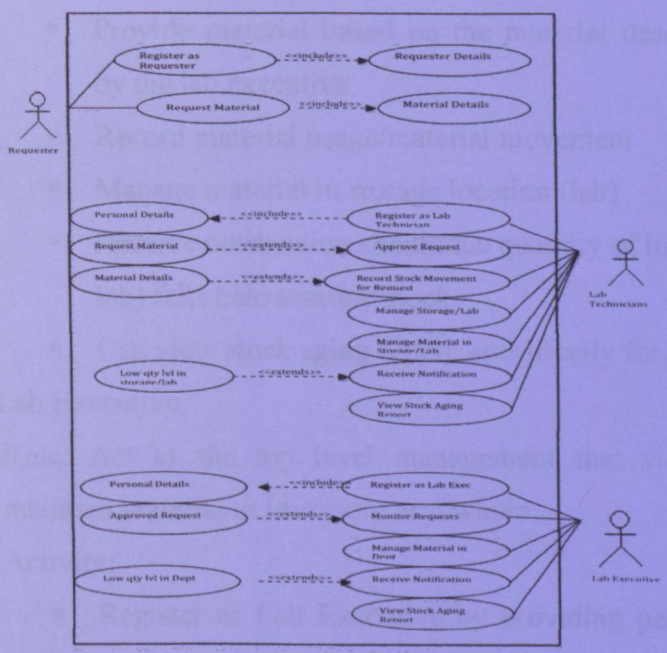


Figure 4-10: Use Case Diagram for eIMIS

The proposed system will cater to three different users, which are the Requester, Lab technicians and Lab executive.

- Actor: Requester

- Role: Request material for used
- Activity:
  - Register as requester by providing personal information upon registration
  - Provide material description that he or she wants to use

- Actor: Lab Technicians
  - Role: Act as the middle men that manages requests and monitoring inventory in his/her location
  - Activity:
    - Register as lab technician by providing personal information upon registration
    - Provide material based on the material descriptions allocated by the lab executive
    - Record material usage/material movement
    - Manage material in storage location (lab)
    - Receive notification should the quantity of inventory (in his/her lab) falls below safety stock
    - Can view stock aging report, specifically for his or her lab.
- Actor: Lab Executive
  - Role: Act as the top level management that views, monitor and maintain material in inventory as a whole
  - Activity:
    - Register as Lab Executive by providing personal information upon registration
    - Manage request approvals and do allocation for the lab technicians
    - Manage material as a whole department/faculty

- Receive notifications if any of the material in any of the labs fall below the safety level
- Can view stock aging report on all material in the department/faculty

4.3.2 SWOT Analysis

Based on the qualitative findings from the interviews, observations and online forum and journal reading, this is the proposed system's SWOT analysis:

Strength (S)	Weaknesses (W)
▪ Offers multi-user system, that allows more interactive and systematic ways in tracking inventory ▪ Low in cost	▪ No expertise on detailed information on material (e.g: DOSH requirement for chemical compound) ▪ Need to get approval from iPerintis for implementation, which might cost some time and effort
Opportunity (O)	**Threat (T)**
▪ Have space for enhancement since UTP have improper faculties level inventory management	▪ More advance inventory management system (e.g: if UTP decides to integrate all of its function using SAP instead)

Table 4.3-1: SWOT Analysis for eIMIS

4.4 Current System vs eIMIS' flow

The findings also show that there are some differences in how both current system and eIMIS work, which can be shown below:

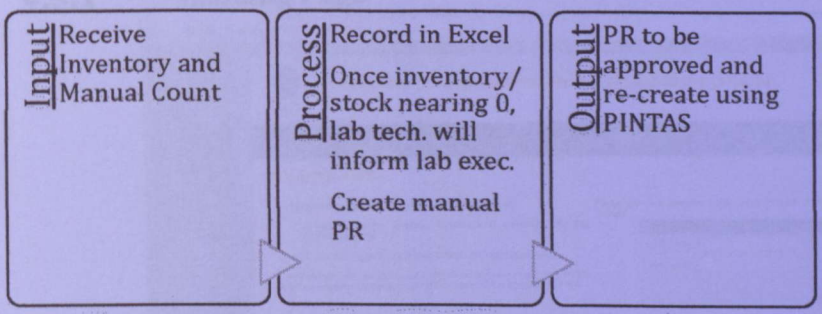


Figure 4-11: Current Manual System Flow

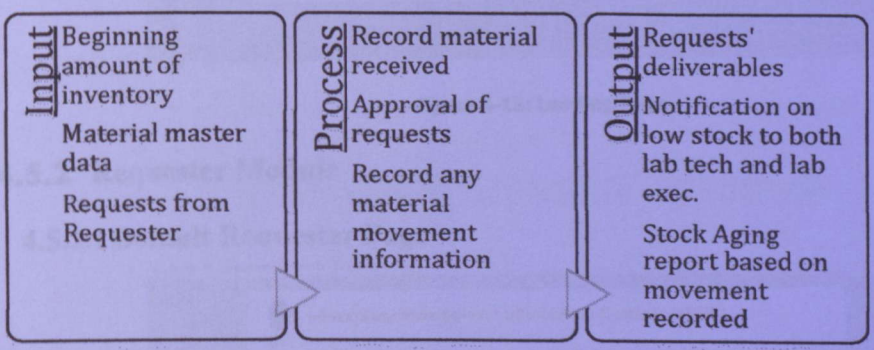


Figure 4-12: eIMIS flow

4.5 Deliverables Interfaces

4.5.1 Landing Page

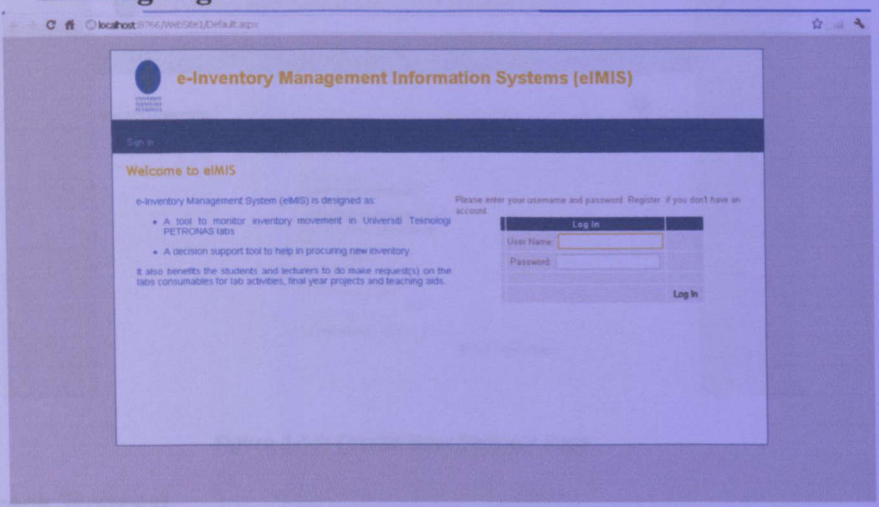


Figure 4-13: Landing Page

4.5.2 Requester Module

4.5.2.1 Default Requester Page

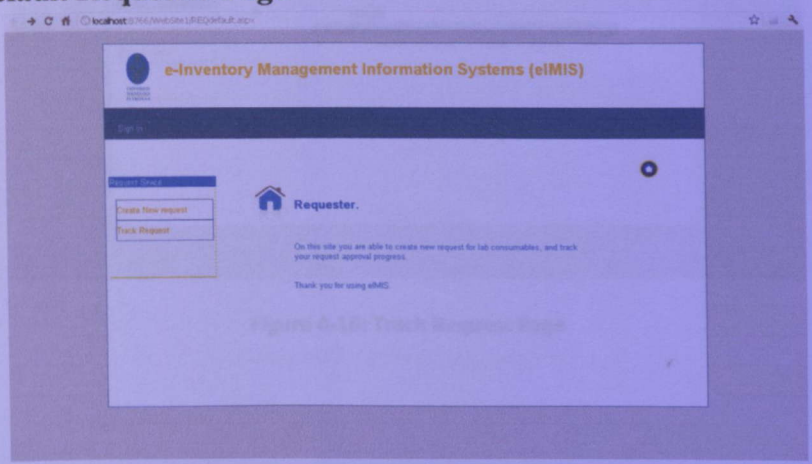


Figure 4-14: Default Requester Page

4.5.2.2 Create New Request

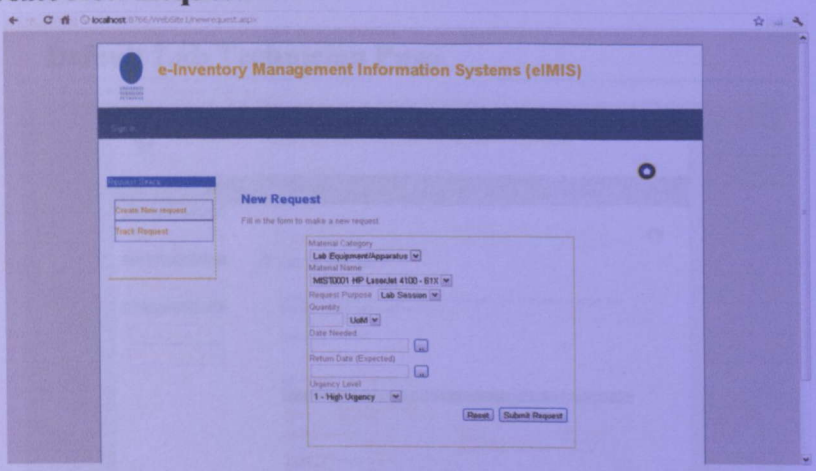


Figure 4-15: Create New Request Page

4.5.2.3 Track Request

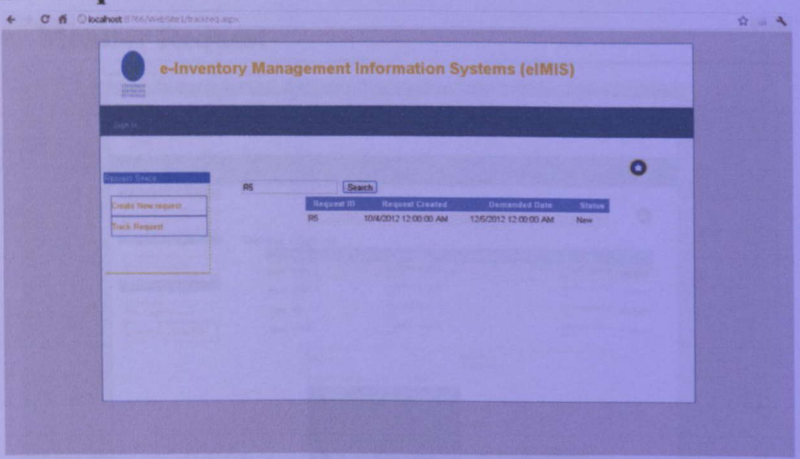


Figure 4-16: Track Request Page

4.5.3 Lab Technician Module

4.5.3.1 Default Lab Technician Page

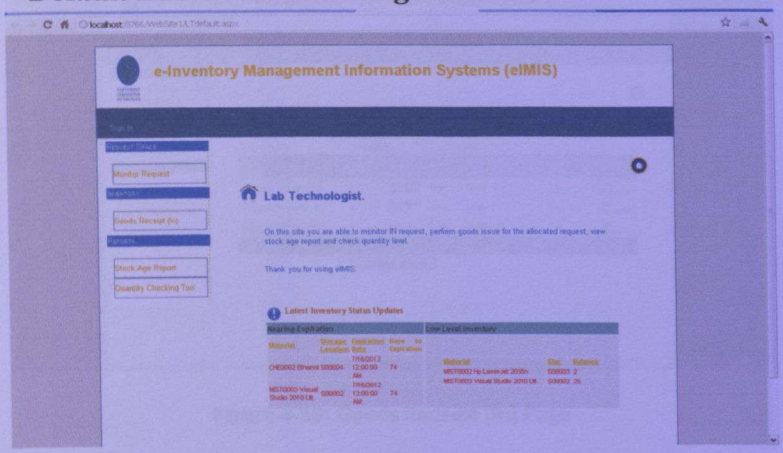


Figure 4-17: Default Lab Technician Page

4.5.3.2 Monitor Request

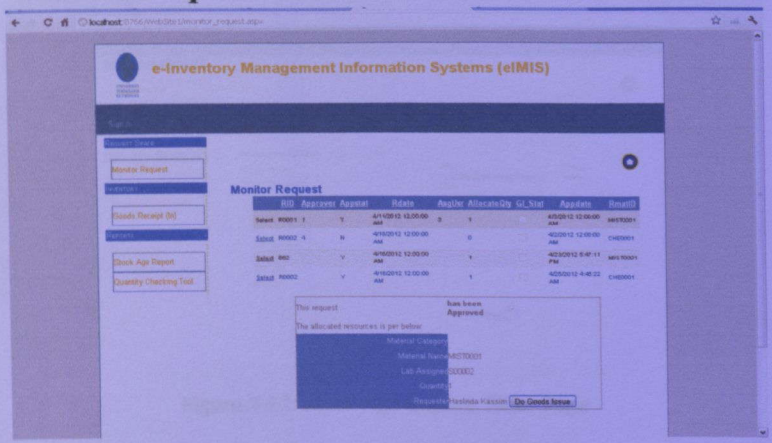


Figure 4-18: Monitor Request Page

4.5.3.3 Goods Receipt (In)

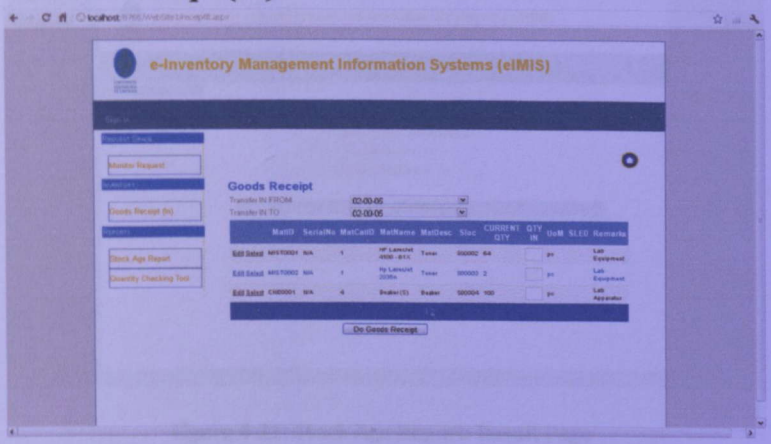


Figure 4-19: Goods Receipt (In) Page

4.5.3.4 Stock Age Report

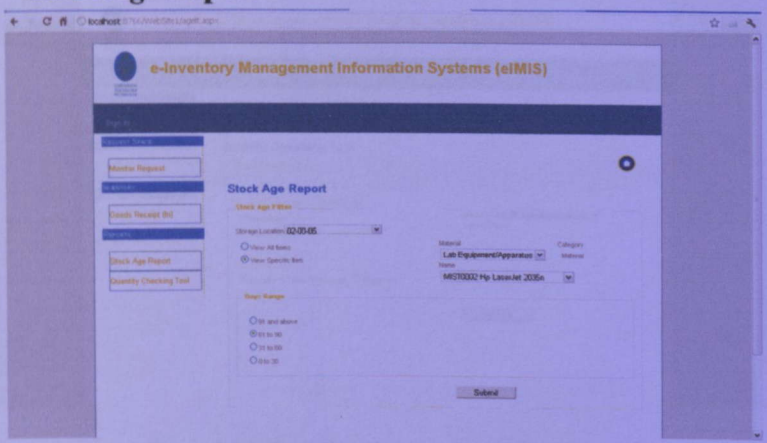


Figure 4-20: Stock Age Report: Filter Page

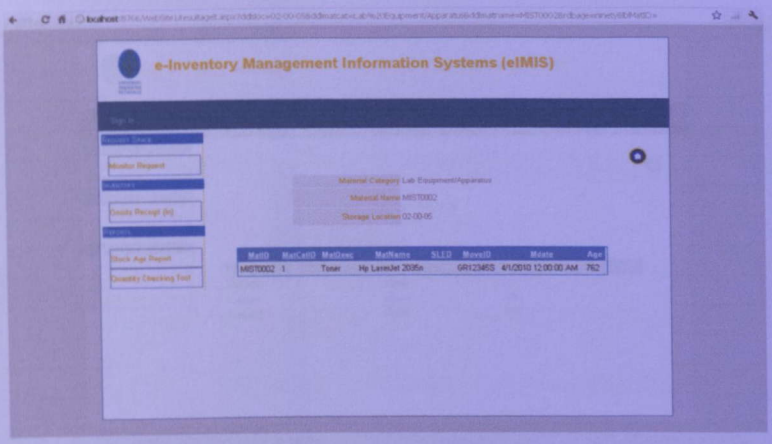


Figure 4-21: Stock Age Report: Result Page

4.5.3.5 Quantity Checking Tool

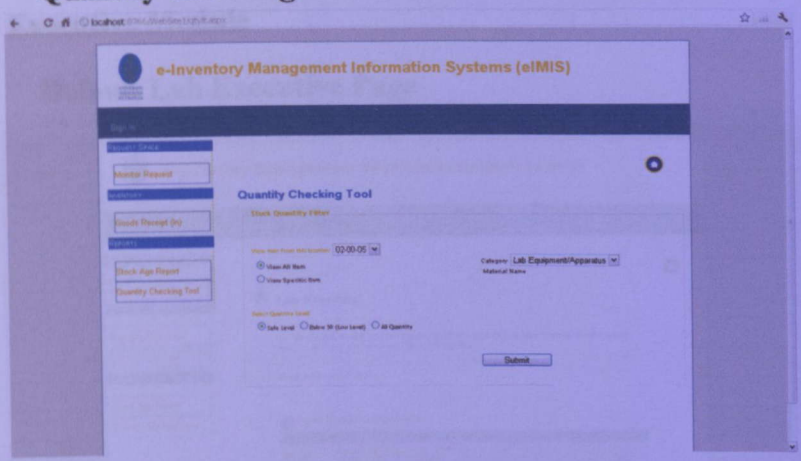


Figure 4-22: Quantity Checking Tool: Filter Page

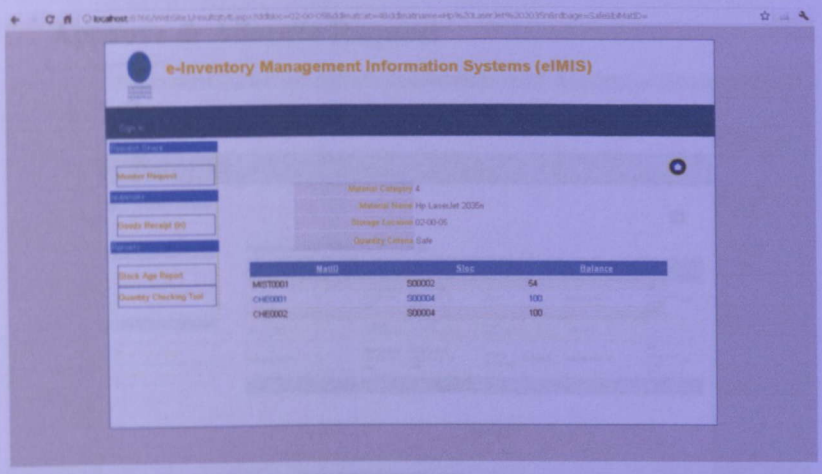


Figure 4-23: Quantity Checking Tool: Result Page

4.5.4 Lab Executive Module

4.5.4.1 Default Lab Executive Page

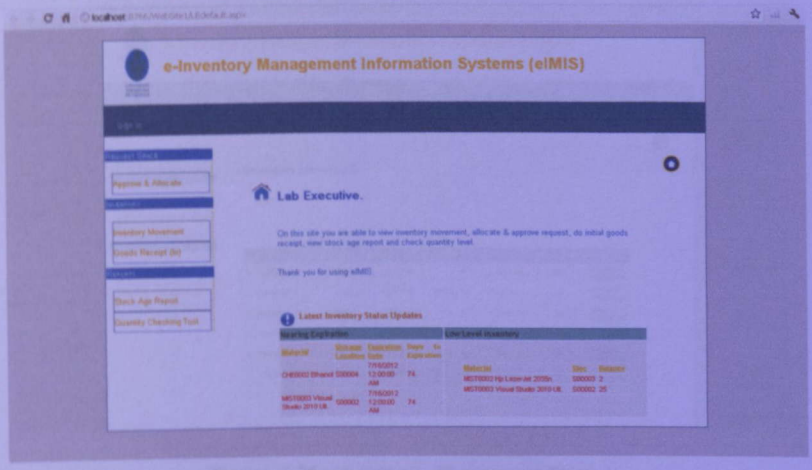


Figure 4-24: Default Lab Executive Page

4.5.4.2 Approve & Allocate Request

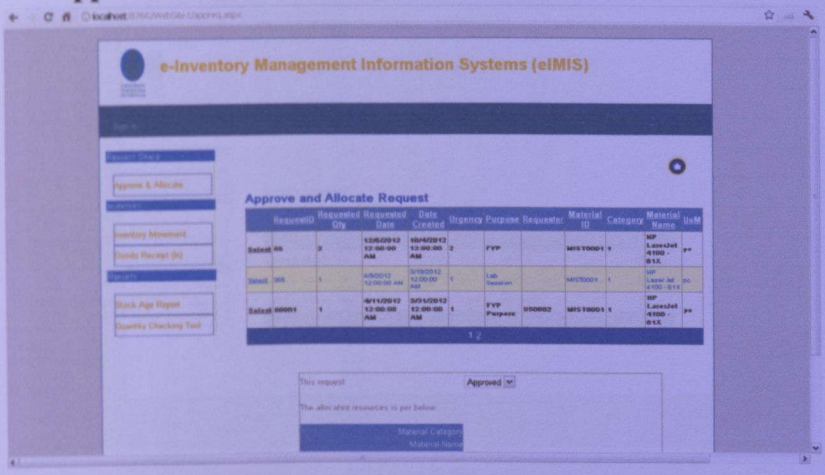


Figure 4-25: Approve & Allocate Request Page

4.5.4.3 Inventory Movement

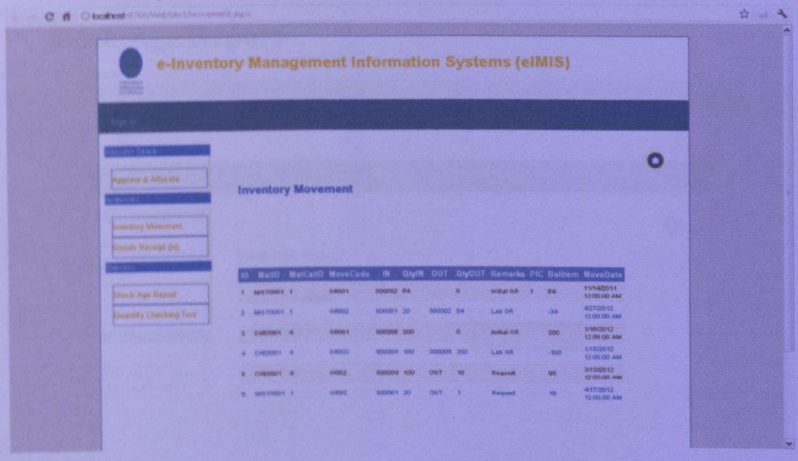


Figure 4-26: Inventory Movement Page

4.5.4.4 Goods Receipt (In)

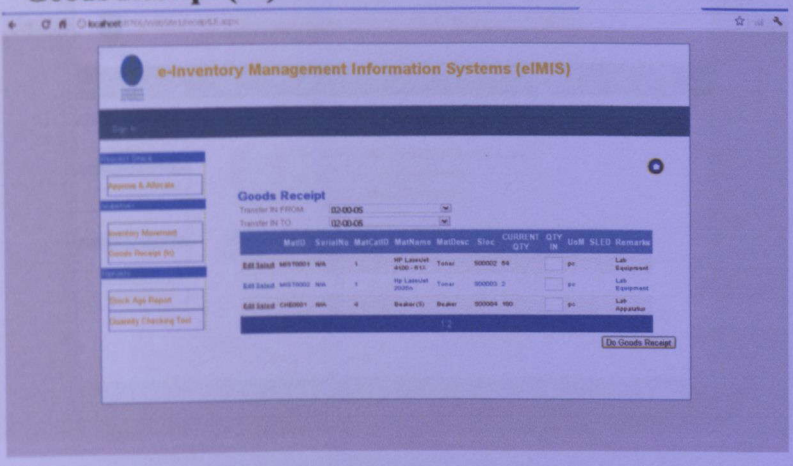


Figure 4-27: Goods Receipt Page

4.5.4.5 Stock Age Report

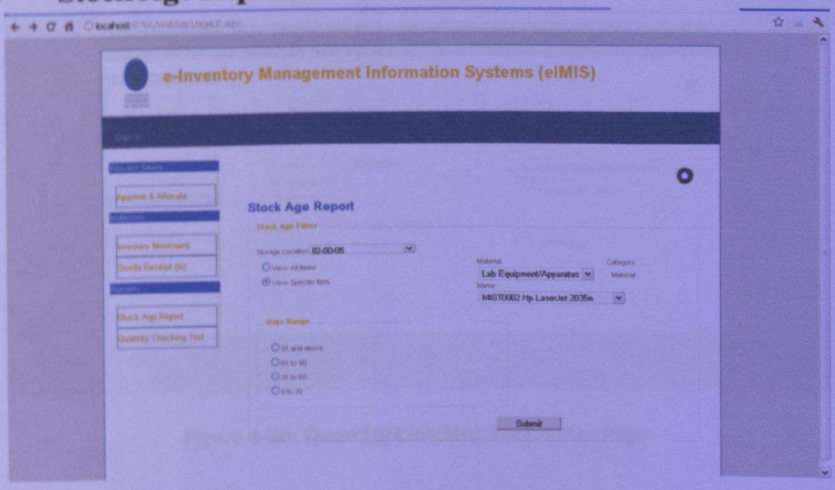


Figure 4-28: Stock Age Report: Filter Page

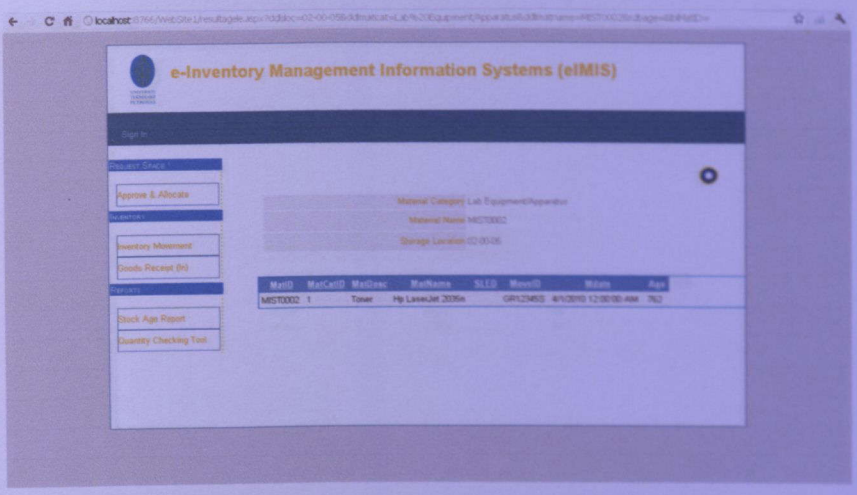


Figure 4-29: Stock Age Report: Result Page

4.5.4.6 Quantity Checking Tool

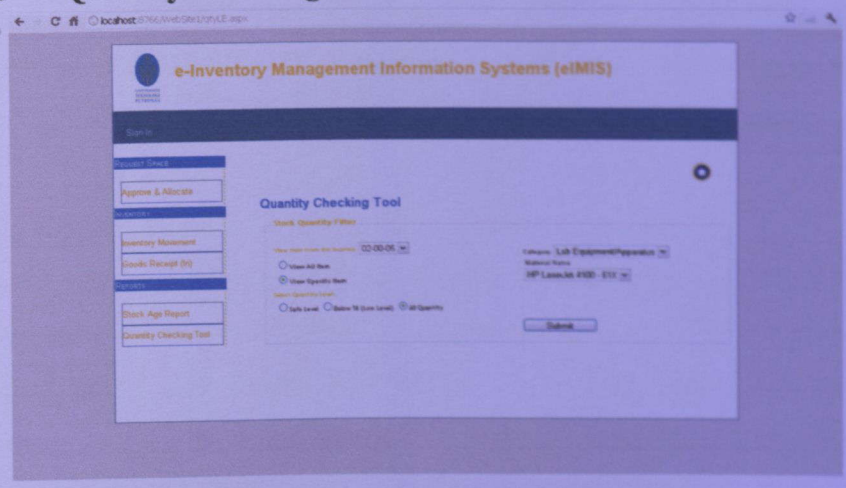


Figure 4-30: Quantity Checking Tool: Filter Page

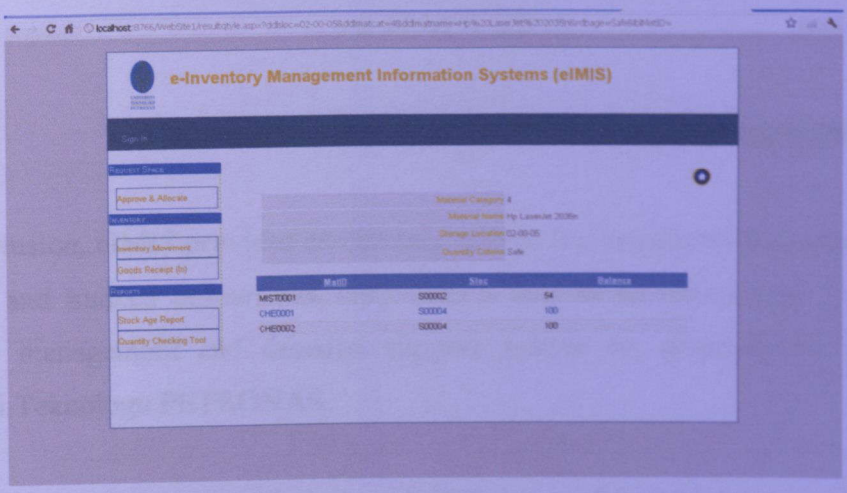


Figure 4-31: Quantity Checking Tool: Result Page

CHAPTER 5

CONCLUSIONS & RECOMMENDATIONS

In conclusion, eIMIS provides an online platform for request on lab consumables to be made and tracked online. Not only that, it acts as an online tool for a simple inventory management and decision support system for procurement practice in Universiti Teknologu PETRONAS.

Based on the research conducted and after going through the development and implementation phase, it can be said that eIMIS has room for improvements. For future enhancements, it is recommended that the staff and students registration should be integrated with the existing UTP database, which uses the existing student or staff IDs instead of email as the username as per current practice on the eIMIS.

Not only that, it is advisable to provide expertise description on material based on faculties - for example, lab consumables for Chemical Engineering Department needs a documentation for how to handle the consumables as well as the Department of Occupational Safety and Health (DOSH) as the Health, Safety and Environment (HSE) precautionary measures regarding the lab consumables. Last but not least, eIMIS could be improved by implementing a notification system to alert on low level and inventory nearing expiry via email. It is hope that eIMIS would able to give significant convenience to a day-to-day business operation.

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APPENDICES

Questions:

1) Can you briefly explain on your position and your daily tasks?
2) Are you familiar with the UTP's procurement procedure?
3) Can you tell me the average of Purchase Requistion you have to make in a month?
4) With the existing system in mind, can you tell me how do you make a decision to raise a purchase requisition? (on what basis)
5) I'm aware that you need to use PINTAS (an SAP system) to create your Purchase Requisition, which is good. However, do you need to create a manual PR before you can proceed with creating

Appendix 1. Interview Outline

Interview Outline	
Interviewer: Nur Dalila Radzali @ Razali	Interviewee:
Appointment Details	
Date: Start time: End time: Venue: Department:	
Objectives & Reminders	
• To gather user's background information (job scope, daily tasks, system relevancy) • To gather information on the current procurement flow • To gather any documents to be reviewed • To do observation on the flow of the existing system	
Agenda & Estimated Time	
Introduction Background on the project research objectives Background on the proposed new method • Topic 1: Questions on user • Topic 2: Questions on existing system and challenges faced General question:	1 min 5 min 2 min 7 min 10 min 5 min
General Observations:	
Questions: 1) Can you briefly explain on your position and your daily tasks? 2) Are you familiar with the UTP's procurement procedure? 3) Can you tell me the average of Purchase Requistion you have to make in a month? 4) With the existing system in mind, can you tell me how do you make a decision to raise a purchase requisition? (on what basis) 5) I'm aware that you need to use PINTAS (an SAP system) to create your Purchase Requisition, which is good. However, do you need to create a manual PR before you can proceed with creating it on the system? 6) Regarding question no 5, do you need any specific authorization level in order to access PINTAS? 7) I've been told by the Purchasing Department that you need to manually inform them about any PR that has been approved before they can proceed. Do you think this brings significant inconvenience to your daily tasks? 8) Do you have any experience in using a decision support system in making decision to procure	

Appendix 2: Acceptance Survey

The objective of this questionnaire is to find out the acceptance of implementing a new procurement method in Universiti Teknologi PETRONAS, which is through the decision support system that assists in decision making to raise a Purchase Requisition. The responses will be kept private and confidential and will be used solely for the final year project research purposes.

The proposed system will generate Stock Aging report which contains information on the age of the inventory (i.e chemical compound, printer toner to name a few), and the shelf-life/expiration information; as well as consists of Quantity checking system whereby it will determine how much inventory's quantity left and will notify the person in charge should the inventory falls below the safe level.

It is hope that every question will be answered. Thank you for your cooperation.

Please tick (√) or circle (O) where applicable.

1. Please select your department.

☐ Department of Chemical Engineering
☐ Department of Civil Engineering
☐ Department of Geosciences & Petroleum Engineering,
☐ Department of Electric & Electronic Engineering
☐ Department of Computer and Information Sciences (CIS
☐ Department of Fundamental & Applied Sciences.

2. Please indicate your age.

☐ 25 and below
☐ 26 to 35 years old
☐ 36 to 45 years old
☐ 46 to 55 years old
☐ 56 and above

3. Please indicate how much experience you have had with the procurement system.

☐ 6 months or less
☐ 7 to 12 months
☐ 13 to 18 months
☐ 19 to 2 years
☐ 2 to 3 years
☐ More than 3 years

4. Do you have any

experience using any decision support system (such as Stock Aging Report or Quantity Check Report) before you make a decision to raise a Purchase Requisition?

☐ Yes ☐ No

5. Do you agree that the quantity checking system is useful in assisting you making a decision to raise a Purchase Requisition?

Please select your extent of agreement with the statement below, from on of the options.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

6. Do you agree that the Stock Aging report is useful in assisting you making a decision to raise the Purchase Requisition?

Please select your extent of agreement with the statement below, from on of the options.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

7. Do you agree that the proposed system will lessen your workload?

Please select your extent of agreement with the statement below, from on of the options.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

8. How would you rate the level of convenience towards your daily tasks if the proposed system is implemented?

Please select from the scale - 1 being convenient, 5 being most convenient

1 2 3 4 5

9. How would you rate the level of convenience if the proposed system were equipped with auto notification on low inventory level?

Please select from the scale - 1 being convenient, 5 being most convenient

1 2 3 4 5

10. How would you rate the level of convenience if the proposed system were equipped with auto notification to Purchasing Department on Purchase Requisition made?

Please select from the scale - 1 being convenient, 5 being most convenient

1 2 3 4 5

11. If the decision support system for procurement were being implemented, what medium would you like to have to assist you in using the system? (You can tick more than one.)

☐ User Manual

☐ Training Workshop

☐ Courseware (CD)

Appendix 3: eIMIS Web Application Usability Test

This survey is conducted to find out the level of usability of the web application e-Inventory Management Information System (eIMIS). You are given 5 minutes to go

through the whole website and another 5 to 10 minutes to complete either one of the eIMIS user modules: (a) as a requester (b) as a lab technician (c) as a lab executive. Your answers will be much appreciated and will be used to improve the usability of the web application. Thank you.

General Observation

1. How easy it is to navigate through the website?

1	2	3	4	5
Extremely Difficult	Difficult	Neutral	Easy	Extremely Easy

2. Is it obvious to you which actions are available for you to use?

☐ Yes ☐ No

3. Look and Feel

   a. Is the website consistent from pages to pages?

☐ Yes ☐ No

   b. Do you find the font size used suitable?

☐ Yes ☐ No (Please specify why)_____

   c. Are the colors chosen suitable for the web application?

☐ Yes ☐ No(Please specify why)_____

   d. Do you find the sizes of the buttons available suits the web application?

☐ Yes ☐ No(Please specify why)_____

   e. Do you think the whole website look neat?

☐ Yes ☐ No(Please specify why)_____

eIMIS System Usability Scale (SUS)

[ ] Requester [ ] Lab Technician [ ] Lab Executive (Please tick which applicable)
(Rate the level of usability)

1. I think it is easy to understand the flow of the module

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

2. I found the module to be unnecessarily complex

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

3. I think I would like to use this module frequently

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

4. I thought there was too much inconsistency in this module

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

5. I found the various modules in this web application were well integrated

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

6. I think that I would need the support of a technical person to be able to use this module

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

7. I would imagine that most people would learn to use this module very quickly

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

8. I found the module is very cumbersome to use

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

9. I felt very confident in using the module

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

10. I needed to learn a lot of things before I could get going using the module

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree