# PROTOTYPE VERSION OF
# CHEMLAB INVENTORY MANAGEMENT SYSTEM

by

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

JUNE 2004

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# CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
Information System Programme
Universiti Teknologi PETRONAS
In partially fulfilment of the requirement for the
BACHELOR OF TECHNOLOGY (HONS)
(INFORMATION SYSTEM)

Approved by,

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June 2004

# 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 the original work contained herein have not been undertaken or done by unspecified sources or persons.

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RUPA D/O GOPALEN

# ABSTRACT

Chemical Engineering Department of Universiti Teknologi Petronas conducts lab sessions as part of the chemical engineering syllabus and for the final year students and postgraduate students to conduct their research. In order to conduct the lab session successfully, the department are required to purchase all the equipments, fixed assets and consumables to be used in conducting the research or experiment. Currently, the documents related to the equipments and consumables are stored in file cabinet and technicians and lecturers need to refer to the person-in-charge manually to get the required information. The problems that arises from this paper-based system are scattered documents, time consuming, difficult to spot the re-order level of consumables, technician unaware of the maintenance and testing of the equipment, and risk of loss of documents. A computerized system is required to overcome this problem. The aim of the project is to develop a prototype version of ChemLab Inventory Management System to overcome the problem faced by the current system by centralizing the database, triggering an email to remind the respective person when the consumable reach the critical level and reducing the risk of loss of documents. A combination of Rational Unified Process (RUP) model and Prototyping model will be used as a software development methodology to carry out the project. The RUP model consists of Inception, Elaboration, Construction, and Transition phase. The ChemLab IMS consists of 7 modules. The modules are Staff Detail, Vendor Detail, Principle Detail, Fixed Asset Details, Consumable Details, Asset and Operation Details, Search Module and Query Module. All the findings have been recorded for future enhancement and references. As a conclusion, the ChemLab IMS overcomes the problems faced by the current user by introducing computerized system which provide easy and quick access to the information anytime, anywhere.

# ACKNOWLEDGEMENT

During the period of conducting the Final Year Project, I have learned invaluable experiences and lessons which I have never encountered in lecture halls and classrooms. The project has given me the opportunity to interact with the chemical engineering lecturers and technicians. They gave full toleration towards the project and willing to spend their precious time to guide me in successfully developing the system.

I would like to thank my supervisor, Mr. Jafreezal Jaafar for his guidance, support and help throughout the project. His help and motivation is much appreciated, as well as anticipated, in order to make this project successfully.

A special thanks for Mr. Yusmieza, Professor Radha Krishnan and Mr. Zamri for their priceless help and kind co-operation in making the project fruitful and successful. Not to forget the chemical engineering technicians, Mr. Ahmad Jamal, Mr. Jailani and Mr. Fauzi for their co-operation and support.

Warmest gratitude to my friends, whom encouraged and supported me in many ways – Subhadra, Anuradha, Xian Yu, Ravi, Anis and others for their unforgettable contributions in producing an excellent set of results for the project.

Last but not least, my thanks to my beloved parent, Mr. Gopalen and Mrs. Punithavathi, for their help and motivation in directing the project to its destiny and my deepest thank to my fiancée Rugunathan who gave me continuous encouragement in completing the project successfully.

This project will never be without all of you. Thank You A Lot.

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# ABBREVATION AND NOMENCLATURES

The following are general abbreviations and nomenclatures throughout this dissertation:

| | |
|---|---|
| 1) UML | Unified Modeling Language |
| 2) RUP | Rational Unified Process |
| 3) IMS | Inventory Management System |
| 4) UTP | Universiti Teknologi PETRONAS |
| 5) PR | Purchase Requisition |
| 6) MSDS | Material Safety Data Sheet |
| 7) OO | Object-Oriented |

# CHAPTER 1
# INTRODUCTION

## 1 Introduction

As the technology evolves, the demand for an effective online management system also increases. More and more end users are using computer based online management system as their primary source of information, and have reassign paper documents as a secondary source. The online management system can provide quick access to the relevant information anytime and anywhere. In other words, when there is a computer, there is an access to the information.

In general, all the organizations need to plan and administer the equipments, fixed assets and consumables purchased. Since this activity will affect the organization's performance, a good Inventory Management System can be capable of storing all the related data's about the purchases and can provide a quick access to the related information. The Inventory Management System is greatly needed to store, retrieve, monitor, track, report and manage equipment, fixed assets and consumables. Effective and accurate management of equipments and consumables is critical especially if re-order are frequent and must be carefully controlled and managed. Inventory Management System can help to eliminate unnecessary purchases and minimize disposal costs by maximizing the use of available consumable supplies.

## 1.1 Background Study

Chemical Engineering Department of University Teknologi Petronas is responsible to educate their chemical engineering students to produce well-rounded students. Chemical engineering students are required to conduct lab sessions as part of their academic requirement. In order to conduct the lab sessions and to conduct research, chemical

department are required to purchase all the equipments, fixed assets and consumables to be used in the lab.

It is important to understand the processes carried throughout the purchasing of the equipments, fixed assets and consumables. Besides that, it is also important to understand the processes carried out on the maintenance of the equipments and fixed assets. Therefore, all the approaches for the purchase requisition need to be analyzed for delivering an effective Inventory Management System. Initial research and interview session was carried out and the author discovered that the purchase requisition is a semi-electronic process. What the author meant here is that the initial process of requesting fixed asset or consumables were done manually. Once the programme head approves it, the data will then be transferred to online system. Currently, Chemical Department is practicing the purchase requisition procedures prepared by the Procurement Department. Figure 1.1 below shows the purchase requisition flow:

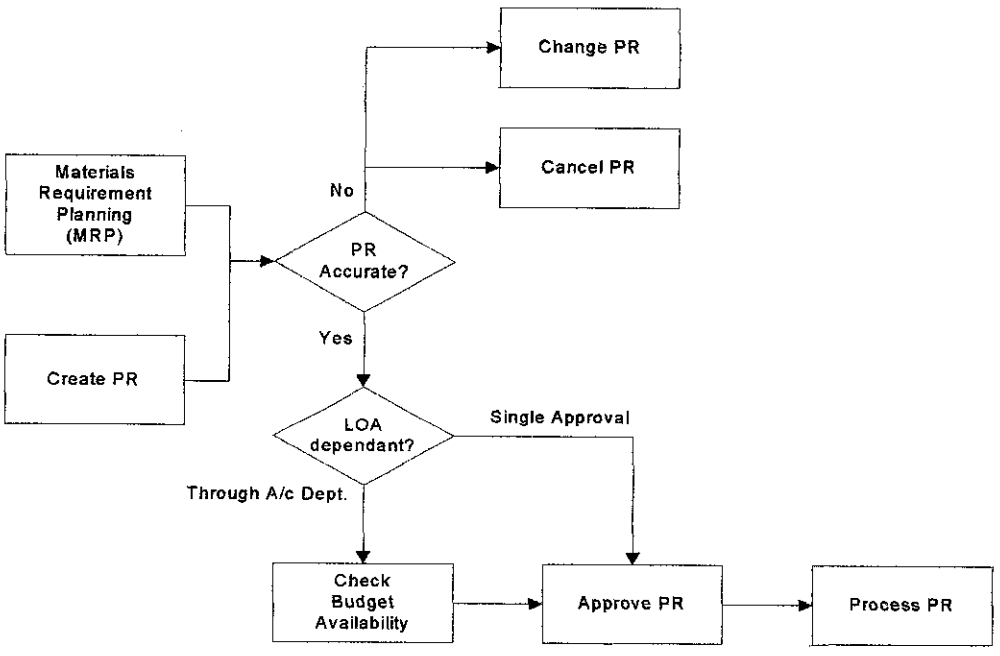


Figure 1.1 Purchase Requisition (PR) Flow

The main goal of this project is to integrate the computer system in developing the Inventory Management System specifically for the purpose of managing the documents and provide easy access and quick search on the data related to the materials, fixed assets and consumables. Inventory Management System will provide the information on the availability of the materials, the location of the materials, a brief description of the materials, and trigger an email to the respective person when a consumable reach the re-order level. Other than that, it also provides MSDS (Material Safety Data Sheet), which contains the safety measure that should be considered in handling the materials, fixed assets or consumables.

It is important for the author to acquire the requirements from the target users before developing the system. Therefore, interview sessions will be conducted with the target users to produce a user-friendly and an interactive system. The results and the findings obtained from the users will be applied in the development of the Inventory Management System. The system will help the Chemical Department users to manage and store the data and records properly. The main benefit of this system is that it enables information sharing and reduces the risk of losing the documents. Besides that, it also provides immediate access to the information and eliminates the duplication of the data entry.

## 1.2 Problem Statement

### 1.2.1 Problem Identification

Conventionally, the current system creates hassle to the users especially to the lab technicians and lecturers. Currently, all the important information of the materials, fixed assets and consumables is scattered and unmanageable. This irritates the chemical lab technicians and the lecturers especially when they need the information urgently. A computerized system is vital, in order to provide quick access to the information and to avoid lose of information. After conducted the interview sessions with the targeted users, several problems have been highlighted:

a. *Scattered documents*

It is difficult for the user to locate the documents since is it scattered everywhere. Each block has it's own location to store the documents. Chemical Department users wish to have a systematic way of storing all the documents in a centralized location.

b. *Time consuming*

It consumes time for the user to locate a document or to retrieve information about the materials. Each time a user require information about a particular material, the user have to go through several person to reach the document. This is because the documents are scattered everywhere. Besides that, to get description about a material, the users need to browse through the documents manually which will consume time and energy.

c. *Difficult to spot the re-order level of consumables*

Once the consumables reach the re-order level, the consumables need to be purchased again. The in-charge person needs to conduct a frequent check on the documents related to the consumables to confirm whether the consumables need to be re-ordered. As a consequence, it will consume time and energy of the person in-charge.

d. *Unaware of the maintenance and testing of the equipments*

The maintenance and the testing of the system were done by referring to the logbook. Some of the lab technicians and the lecturers were unaware of the maintenance and testing of the equipments.

e. *Risk of loss of documents*

The storage of the documents is done manually. The possibilities of losing the documents are high due to unorganized way of handling the documents.

### 1.2.2 Significance of the Project

The project helps the Chemical Department lab technicians to solve the problems that they are facing currently and also helps to provide the students with quick and easy access to the required information. By providing instant access to the information, it directly saves the users time and it also eliminates the hassle created by scattered documents. This system will enable the lab technicians to store, organize, manage and control the information more efficiently and effectively. With the available technology in the market, it is possible to complete the project within the time frame given. There were several techniques available to quickly identify the possible solutions for the problems such as fact-finding and researching technique. This can be done by distributing questionnaires, conducting interviews, or by having group discussions.

## 1.3 Objectives

The aim of this project is to overcome the problems encountered by the lab technicians, lecturers and students of Chemical Department, University Teknologi Petronas. The project will be conducted by designing and developing the prototype version of the ChemLab Inventory Management System. The objectives of the project are:

a. To centralize the database so that it can be easily accessible for the users.
b. To trigger an email automatically to the respective users as a reminder of the re-order and for maintenance and testing of the equipment.
c. To provide related information to the users through online system.
d. To reduce the risk of loss of documents by introducing a paperless working environment.

e. To develop the prototype version of the ChemLab Inventory Management System to overcome the problems faced by the current paper-based system.

## 1.4 Scope of Project

### 1.4.1 The Relevancy of the Project – Scope of Work

The project will be conducted by analyzing the current system. The fact-finding techniques such as distributing questionnaires and interviewing the targeted users will be conducted. A thorough research will be carried out on the languages to be used in designing and developing the prototype version of the system. The project does not focus entirely on the research area but also focus on designing and developing the ChemLab Inventory Management System. The project will give more concentration on the design and implementation of the prototype version of the system. Testing will be done to gain the feedback from the end users. The feedback will be used to improve the system.

Several modules will be incorporated in this system that covers the overall process of managing the information querying from the ChemLab Inventory Management System. Detailed description on these modules will be discussed in Chapter 4.

### 1.4.2 The Feasibility of the Project

*1.4.2.1 Technical Feasibility*

Currently, University Teknologi Petronas has it's own Domino Server. This will reduce the implementation cost of the system. Besides that, the staffs are quite familiar with the Lotus application. The decision to develop the online system is practical since the author is proficient of designing and developing the system.

#### *1.4.2.2 Operational Feasibility*

The proposed system is believed to eliminate the problems faced by the current manual system. Thus, the proposed system is assumed that it will fulfill the user's requirement.

#### *1.4.2.3 Economic Feasibility*

The solution is cost effective because all the processes are computerized. Paper-oriented management will be reduced and the online management of the process can be easily handled.

#### *1.4.2.4 Schedule Feasibility*

The system needs to be developed within the time constraint of 14 weeks including all the documentations writings. Due to this time limit, only a prototype version of the ChemLab Inventory Management System will be produced. To guide the author to complete the project successfully, the Rational Unified Process (RUP) will be used in planning the tasks throughout the project.

# CHAPTER 2
# LITERATURE REVIEW

## 2.1 Inventory Management System

R. Jerry Baker, Lee Buddress, and Robert Kuehne defines **inventory** as "The amount of property on hand at any given time, or an itemized listing thereof. A *physical inventory* is one determined by actual physical count of the items. A *book inventory* is one determined from records maintained in connection with day-to-day business activities. Industrial inventories typically consist of raw materials, work-in-process, finished goods, and M.R.O. (maintenance, repair, and operating) supplies." [1]

They also define **management** as "Management refers to the administration, control and supervision. It is the administration of a business concern or public undertaking. Management includes the actions of planning, organising, directing, coordinating, controlling and evaluating the use of people, money, materials and facilities to accomplish missions and tasks." [1]

To be successful in today's fast-paced, highly competitive environment, businesses need to have the necessary parts in stock or have reliable suppliers to meet customer demands at a moment's notice. Either way, businesses must have a practical, efficient method for managing inventory in order to stay in business and satisfy their customers. As mentioned by Andrew Grygus,

> "With Inventory, you have two conflicting goals: minimize the amount of money tied up in product and never be out of product when you receive an order." [2]

Information systems, properly applied, can be a big help in making the inventory a lot more profitable by optimizing the use of the inventory itself. Tight control of inventory reduces the amount of idle money tied up in slow moving or obsolete product, and

maximizes investment in items that pay a good return. It also can greatly reduce "*shrinkage.*" It is supported by Neil Jaffe in his article: This functionality is a significant leap forward in how software solutions handle forecasts, particularly when reacting to trends and seasonality. Much of this functionality was not available in the past, because antiquated legacy technology lacked the capacity to store the necessary history or process the data. Now, with newer technology, it is possible to run these algorithms in real time, and analyze the results without the difficulties that are encountered with most legacy systems. Users realize significant time savings, because there isn't a need to manually analyze each item's demand. [3]

Therefore, an inventory management system is crucial in every business. An inventory management system is greatly needed to monitor, track and manage equipments, supplies and consumables. It will provide the business with complete, accurate and up-to-date records of the inventory. Effective and accurate management of loose items, supplies and consumables is critical especially if re-supplies are infrequent and must be controlled and managed. The inventory management system enable the business to spot the critical level of reorder and makes it possible to reorder the item again before it is out of stock. As a result, inventory management system can trim the costs and saves time.

## 2.2 Time consuming paper-based system

According to Eli J. Remington (2003) "The lifeblood of any organization is information. Information on the hands of right people can turn data into the knowledge that thrusts a company forward. It is important that the right information be available at the precise moment it is needed in order to make profitable decisions." [4] Thus, information should be available anytime and anywhere to be reviewed quickly and to assist the decision-making. This is supported by Quark "With a paper-based workflow you waste an enormous amount of time producing and distributing multiple hard copies, tracking down documents to move them along the process, and manually collating comments. Long review cycles can be extraordinarily inefficient and result in missed deadlines." [5]

Historically, paper-based systems have been used in almost all the businesses to carry out their daily activities and for record keeping purposes. These systems are time-consuming, cumbersome, and inefficient. Most of the companies are now shifting to automating their system because they deem that the previous paper-based system is time-consuming and less efficient.

According to Chris Yankee "Like any traditionally paper-based administrative process, the collection, manipulation, and submission of information to regulatory authorities is often unnecessarily time-consuming, expensive, and resource intensive." [6] As outlined by Ronald S. Wilner, the traditional application deployment is time consuming, expensive and difficult to maintain. Paper-based system has the high chances of losing documents if it is not kept properly. [7] In addition, Chris Yankee also mentioned "With the advent of electronic data management and submissions, volumes of data will be exchanged and reviewed faster and with less effort. [6] Chris Yankee believed that computerized system is necessary to overcome this problem. Other than that, the computerized system provides an added advantage of security against interfering and physical damage though threats are still there from viruses and system hackers.

Michael Barry also has the same view as Chris Yankee: Other manual, paper-based processes were impacting productivity, as well. Air Force IT managers, responsible for monitoring the base's inventory of computers, printers and other technology assets, relied on a paper-based system for tracking inventory. The manual, paper-based system made it difficult to track IT assets. For example, personnel couldn't sort or search, except manually. We began to explore technology solutions which would increase the efficiency of its operations, improve employee productivity, and increase the quality, timeliness and accessibility of critical information. [8]

It is supported by Rossi in his journal:

"Historically, we would perform comprehensive statistical analyses that could require hours to complete and delivered reams of tables and charts" [9]

The effects of previously used paper-based and the computerized system in Kraft's business are shown in the Table 2.1 below:

| | | | |
|---|---|---|---|
| Analytic Reporting | 1 hour | Minutes | Time |
| Decision-making based on analytic reports | Hours | Minutes | Time |
| | | | |
| Communication | Hard to digest reports | Easier to extract intelligence from reports | Time |
| Trellis Graphics | Hard to compare results | Easier to compare results | Time |
| Faster Analytics | Waiting for results | Faster access to important information | Time and indirect costs |
| Using resources wisely | Time-consuming reporting process | Fast and easy analytic reporting | Better insight into product formulation. |
| Improved morale | Complex reporting was less intuitive | Easy-to-understand reports makes gaining intelligence faster | Less time to gain insight to change product formulation. |
| More confident decision-making | Time consuming analytic reports required interpretation and cross-checking. | Easy-to-read one page reports based on robust analytics provide information for confident decision-making. | Better decisions. |

Table 2.1 **Effects of previously used paper-based and computerized system in Kraft's business**

## 2.3 Paperless Society

Ziming Liu and David G. Stork stated, "For the past 20 years, the evolution of the paperless office has been predicted as an inevitable result of technology advances – the fully electronic high-tech office-in-the-future in just around the corner." [10] More and more companies are shifting to paperless office by integrating technology and networking in their business.

Recent advancements in technology have made it possible to move documentation and data management away from paper-based system. New web programming languages that take advantage of high-end database technology are finally delivering on the promise of

paperless office. Companies are already reaping the benefits of these advances and are re-shaping the way they think about and use the information.

According to Eli J. Remington:

"A web-based business system manages and stores data in an electronic format. Any type of documentation or record that is needed can be completed using a customized online form displayed in a web browser. Once a complete document is submitted to the system, it is categorized and stored. It is instantly available to any authorized user to view, edit and reference. Unlike paper, electronic documents and records can never be lost on anyone's desk and are always perfectly preserved. Such a system ensures that all records remain legible, readily identifiable and retrievable. The data itself in stored in databases on a web server, which can then be backed up and safeguarded from any permanent data loss." [4]

This article also states that the companies that have embraced with this technology have seen significant cost savings. Many users report saving significant amounts of time, as much as 15% to 30%, due to their ability to easily search for documents and do their own research. It has been estimated that 80% to 90% of internal document costs are associated with searching for paper documents after they have been created. [4]

Paper-based storage is exposed to hazards such as flooding, fire and general deterioration. Once the system was installed, the benefits associated with a reduced level of risk were also noted although the computerized system is exposed to risk of viruses and system hackers. The computerized system has also greatly reduced the time spent in the retrieval of documents whereby the documents are now available in seconds. Back-up storage is also a simple procedure and provides peace of mind. Electronic storage also takes up a fraction of the space previously used by the countless filling cabinets that were necessary to store the documents in paper format. [4] Computerized system will increase the productivity by making staff access the company information easier.

According to Gill Brittle, the previous paper-based system was inefficient and time consuming. The amount of time it took to administer the system with filing, collating and distribution was significant. Often people complained they were not receiving the information they needed on time. [11] Once you begin implementing the paperless office, you can improve your firm's speed, security, accuracy, and ease of document retrieval, along with eliminating the need for additional physical storage space for client files. [11]

The explosive consumption of paper in the office has highlighted the need, if not for a paperless office, then at least for a "less-paper" office. Professionals in today's business world spend about 60 percent of their time handling the vast quantity of paper flowing into their office daily [12]. The process is highly inefficient, suggest these survey findings [13]:

- Large organizations lose one document every 12 seconds;
- 3% of all documents are incorrectly filed;
- 7.5% of documents are lost forever;
- Disorganization in the workplace may cost executives up to six weeks of time per year;
- The average executive spends three hours per week hunting for mislabeled, misfiled or lost documents.

## 2.4 Comparison between RUP Model and Waterfall Model

Before choosing the best methodology to be used in carrying out the project, a study on the available methodologies has been conducted by the author. A comparison has been done between Waterfall Model and Rational Unified Process Model. Waterfall is theoretically straightforward because it produces a single deliverable. The fundamental problem of this approach is that it pushes risk forward in time, where it is costly to undo mistakes from earlier phases. It tends to mask the real risk to a project until it is too late to do anything meaningful about them. Figure 2.1 below shows the comparison between development progress and project schedule for the development using the Waterfall model and the RUP Model. It shows that iterative development projects can avoid late, large-scale design breakage through continues integration.

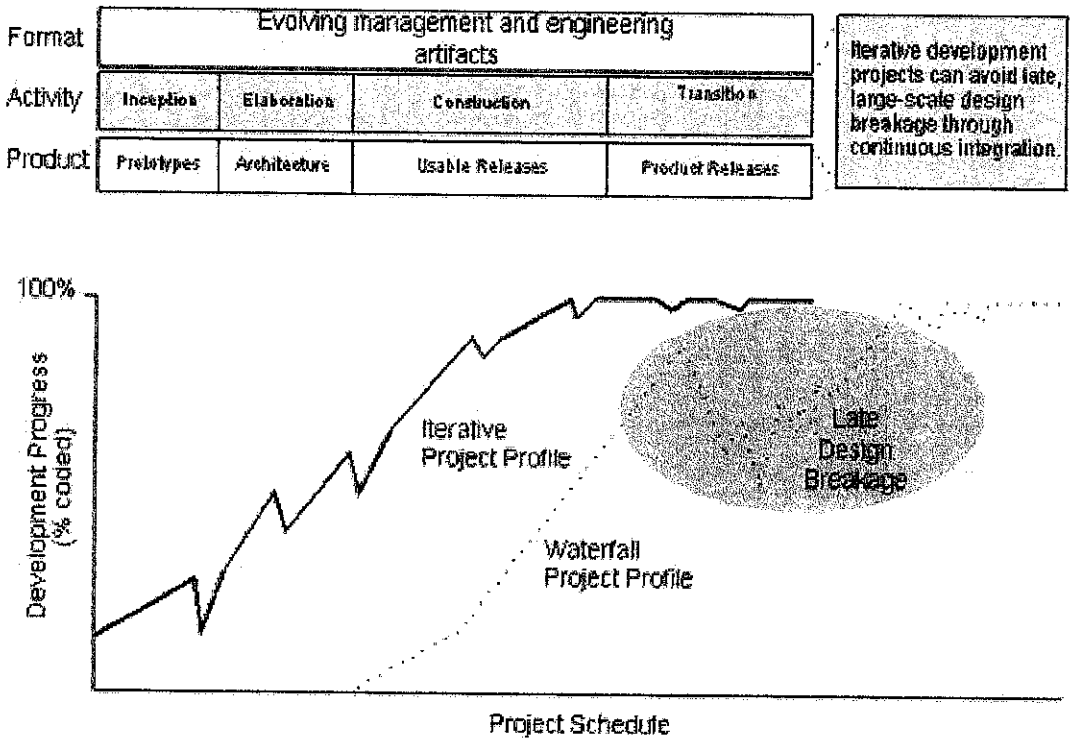


Figure 2.1: **Comparison between Waterfall Model and RUP Model**

[Source: Journal – The Rational Edge_Apr2003][15]

# CHAPTER 3
# METHODOLOGY AND PROJECT WORK

## 3.1 Methodologies and Project Work

Object-oriented (OO) approach would be the best solution to overcome the disadvantages caused by waterfall model. The Rational Unified Process is a guide for how to effectively use the Unified Modeling Language (UML). The UML is an industry-standard language that will allow the developer to clearly communicate requirements, architectures and designs. The UML was originally created by Rational software, and is now maintained by the standards organization Object Management Group (OMG). [16]

A software development model developed from the combination of the Rational Unified Process model and Prototyping model are used in developing the system. Prototyping and iterative design offers to create vastly improved products in less time than with the waterfall methodology, with a condition that the role of prototyping is well understood, and that it is managed properly.

Although the Rational Unified Process model has the iterative philosophy of prototyping, it focuses on the iteration concept. This model concentrates on the delivery of an operational product with each iteration. Early iterations are stripped down versions of the final product. Such model is useful for a project with a tight deadline. Furthermore, the iterations can be used to ascertain technical risks.

The prototype paradigm is a mechanism for identifying software requirements, and can be worked as the initial system. Ideas for improving the product, in which can be in terms of requirements, understanding the users, or designing a solution, will much occur within the early phases of each minor development stage. Thus, proper use of prototyping helps to focus the development effort at such times until the solution is well defined. The disadvantage is having cost of change increases exponentially with the passage of time.

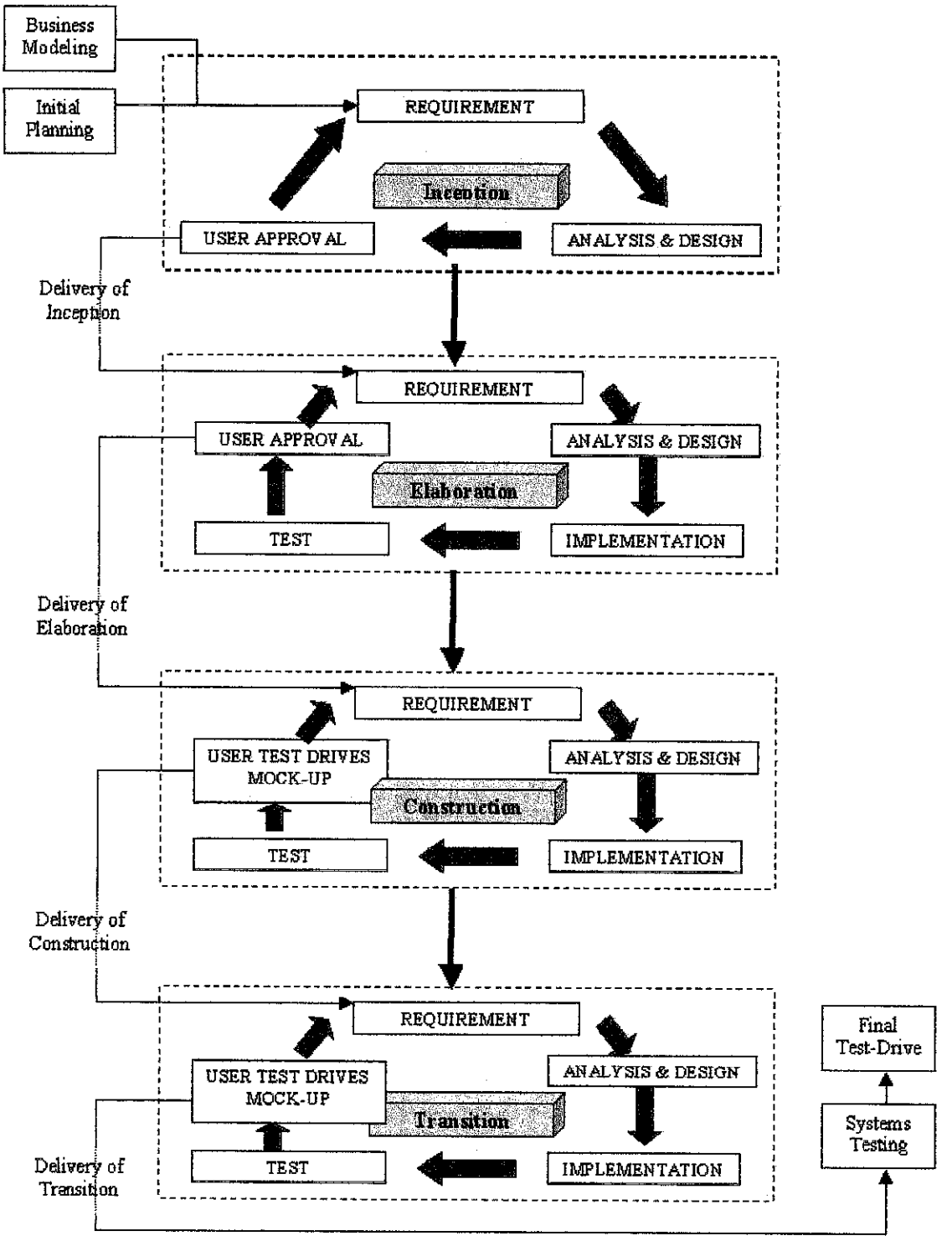


Figure 3.1: **Software Development Framework**

Figure 3.1 above acknowledges the importance of user involvement for each increment, whether it is a major or minor stage. Figure 3.1 shows the software development framework. The acknowledgment can be seen through the introduction of the essential phase on seeking the approval from the user, before proceeding to the next major development. The main reason of emphasizing on such a move is to tackle the scenario of not being able to identify the degree of complexity of input, processing, and output requirements. In addition to that, the software developer might be unsure of the efficiency of the algorithms, and the form that human interaction should take.

The relevancy of the software development lifecycle with the project is as follows:

### 3.1.1 Inception:

During the inception phase, the business case for the system will be established and the project scope will be defined. To accomplish this, all external entities with which the system will interact (actors) must be identified and the nature of this interaction must be defined at a high-level. This involves identifying all use cases and describing a few significant ones. The business case includes success criteria, risk assessment, and estimate of the resources needed, and a phase plan showing dates of major milestones. [17, 18].

During this phase, a preliminary data gathering will be conducted by the author. Preliminary information gathering involves the seeking of information in depth, of what is observed. This could be done by talking informally to several people in the work setting or to users, or to the relevant sources, thereby gathering information on what is happening and why. Some of the methods used to gather data are as follow:

- Interview

In order to gather data of the current system, an interview was conducted with the users. An interview was conducted with chemical engineering lecturer,

Mr. Yusmieza and three of the chemical engineering lab technicians, Mr. Ahmad Jamal, Mr. Jailani, Mr. Yusof and Mr. Fauzi. Before conducting the interview, some preparation has been done by referring to "The Steps in Planning the Interview" suggested by Kenneth & Julie E. Kendall, 1999 as shown in Figure 3.2 below. The interviewees had been informed about the interview in advance through telephone to get them prepared for the interview. The interview was conducted to get a clear understanding of the current inventory management method and to get their opinion regarding automating the process to computerized system. The author started the interview session by distributing the questionnaires to collect information of the current method and their suggestion on how to improve the current system. Please refer to appendix ii for the sample of questionnaires used to collect data.

Source: Kenneth & Julie E. Kendall, 1999

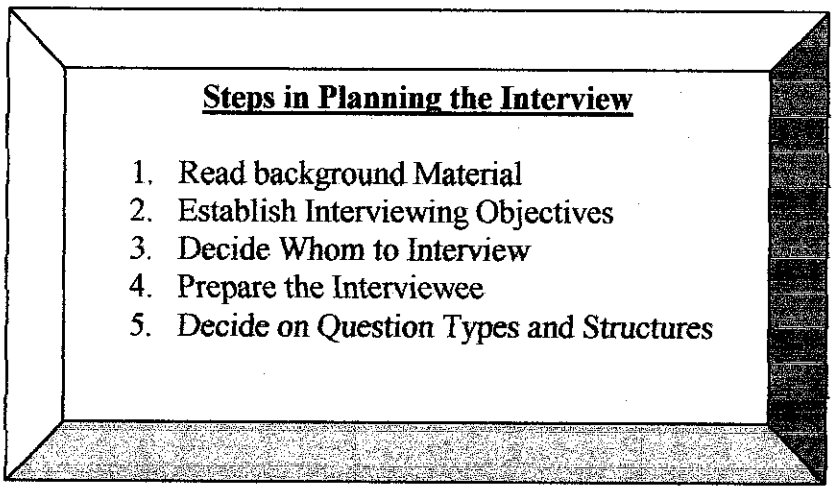


Figure 3.2 **Steps in Planning the Interview**

The author proceeded with the interview session by referring to the questionnaire submitted by the interviewees. Mr. Yusmieza explained the detailed description of the current system and the problems occurred by adapting to the current system. Basically, the current system is managed manually using the paper-based oriented system. According to Mr. Jamal, chemical lab technician, the documents related to the assets and consumables

are kept in file cabinets in each of the labs. The technician attached to each of the lab is responsible to handle the documents. Please refer to appendix iii for the samples of questions asked and the samples of data gathered.

During the interview session, Mr. Yusmieza requested to consider the security issues in developing the computerized system to replace the manual paper-based system. This is because of the variety of the users who will be using the system. He divided the user into four categories, which are post-graduate students and final year students, technicians, authorized technicians and administrator. The post-graduate students and the final year students are allowed to search the database and to view the results of the search. The technicians are allowed to search the database and to view some important data in the database but are not allowed to delete or update the database. The authorized technicians are allowed to search, read, view, update and delete. The administrator carries the same function as the authorized technician and he also gives the access to the users.

In reality, Mr. Yusmieza together with his colleague, Professor Radha Krishnan had worked together to develop the system using Microsoft Access. They planned to develop a complete computerized system but they could not finish it due to lack of skill and time constraint. The uncompleted system has been given to the author as a reference in developing the proposed system.

Mr. Yusmieza listed the information to be included in the system:

- Fixed Asset
- Consumables
- Asset Operation
- Staff Information
- Vendor Information
- Principle Information

- Internet

In order to get more information about the software development methodologies, a thorough precedence study was done on both the subject matter. The study began with the first and foremost reliable source, which is Internet. Surfing was done over hundreds of WebPages on the net to collect succinct information on the best software methodology that can be used to further with the project. Please refer to reference for the list of web sites being referred in conducting the project.

- Printed Material

Besides Internet, print media will be the second material of reference. This will include all the printed articles and books on Software Development Methodologies that can be found in libraries.

- Literature Survey

Further research was done based on the information gathered through literature survey by referring to articles, online journal, bibliographic databases, abstract databases or full text databases on Software Development Methodologies in order to cater the needs of software development projects. Through the literature survey, it ensures the important facts of are not left out of the thesis. It could even ensure that problem statements are made with precision and clarity. In addition, this method give clearer idea, thus help in development of the theoretical framework for the future testing.

Based on the interview, some important information is generated such as the business activity, people involved in the process, the location of the work, and how the current procedures are performed in the business. A feasibility studies have been conducted on the technical, operational, schedule and economic area. The outcome of this phase is the system requirement specification document, the initial use case model and a project plan, showing the phase and iterations, feasibility studies, and hardware and software specifications. The author reviews

the outcome of this phase with the user to seek for their approval. Once the users have approved the outcome, the author continued with the next phase.

### 3.1.2 Elaboration:

The purpose of the elaboration phase is to analyze the data gathered to identify the problem domain, analyze the system specification, establish a sound architectural foundation, develop the project plan, and eliminate the highest risk elements of the project Architectural decisions have to be made with an understanding of the whole system: its scope, major functionality and nonfunctional requirements such as performance requirements. The elaboration phase activities ensure that the architecture, requirements and plans are stable enough, and the risks are sufficiently mitigated, so that the cost and schedule for the completion of the development can predictably determined.

In this phase, it emphasizes more on the analysis and design of the system. The author develops the logical design based on the information collected during the inception phase. The Unified Modeling Language (UML) approach is adopted to construct the design models. The author continued with the development of the activity diagram and planning on installation of hardware and software. The user interface of the system is then been developed. The outcome of this phase is the architecture design of the system, the activity diagrams, the user interface design and the mock-up installation of the hardware and software. The installed lotus domino software is tested to confirm that it is working well with the hardware. The author reviews the outcome of this phase with the user to seek for approval. The user interface design has been reviewed with the user and some necessary amendments to the user interface have been made. The author proceeds to the next phase once the user has approved the amendments.

### 3.1.3 Construction:

During the construction phase the product is moved from the architectural baseline to a system complete enough to transition to the user community. The architectural baseline grows to become the completed system, as the design is refined into code. This phase is treated as the heart of the software project where the detailed design of the system will be transitioned to the user.

During this phase, the author continued with designing the actual system. The installation plan is reviewed and the server is installed and configured. The detailed design of the application and the development of the source code are continued. The working version of the system is constructed. The design outputs from the previous phase will serve as a blueprint for the system and helps to detect problems in the system. The outcome of this phase is the working prototype version of the system.

The system will be tested against the occurrence of any bugs or errors. The testing involves running the system and the author will observe whether it is running according to what is being coded.

The author reviews the working prototype with the user to get approval on the functional requirements of the proposed system. The end users will determine whether the developed system meets the intended user requirements. The author proceeds with the next phase once the user has made the approval.

### 3.1.4 Transition:

The purpose of the transition phase is to transition the software product to the user community. The goal is to ensure that the requirements have been met to the satisfaction of the user community. Once the product has been given to the end user, issues usually arise that require the author to develop new releases, correct some problems, or finish the features that were postponed. This phase is often

initiated with a beta release of the application. Other activities include site preparation, manual completion, and defect identification and correction. The transition phase ends with a postmortem devoted to learning and recording lessons for future cycles. The user testing will be done to get feedback from the users regarding the performance and the effectiveness of the system. The feedback will be used as the final enhancement to correct any errors occurred or any new requirement posted.

## 3.2 Systems Testing and Final Test-Drive

No formal testing has been conducted to determine the usability of the system, but a fundamental testing has been done to determine the effectiveness of the system. To determine how well target users can understand and use the system, the author collect feedback from the user by allowing the user to use the system and answer a simple questionnaire regarding their opinions towards the new system. This test was conducted to measure the ease of use and effectiveness of the system. It also identifies usability problems with the system and helps establish solutions for those problems. Once those solutions are implemented, the system is easier to use, requires less support, and should be better received by the user. Please refer to appendix iv for the questionnaire prepared to conduct the testing.

Once the testing has been conducted and the feedback has been gained, the feedback will be evaluated to decide whether modifications have to be made or not. If any modifications is to be done, the system will be tested again as a final test-drive before release the system to the user.

The system is tested in the areas related to:

### 3.2.1 Accessibility of the system

- Is load time appropriate to content, even if the server is slow?
- Is the system easily accessible if the server connection is available?

### 3.2.2 Clarity of communication

- Does the system convey a clear sense of its intended user?
- Does it use language in a way that is familiar to and comfortable for its users?
- Is it conversational in its tone?

### 3.2.3 Content of the system

- Is the content of the system concise and understandable?
- Does the system provide the necessary information needed by the user?

### 3.2.4 Consistency

- Does the system have a consistent, clearly recognizable "look-&-feel"?
- Does it make effective use of repeating visual themes to unify the system?
- Is it visually consistent even *without* graphics?

### 3.2.5 Navigation

- Does the system use (approximately) standard link colors?
- Are the links obvious in their intent and destination?
- Is there a convenient, obvious way to maneuver among related pages, and between different sections?

### 3.2.6 Usability of the system

- Does the system meet the user's expectation?

## 3.3 Tools Required

There are several different tools and technologies used for developing the prototype version of the ChemLab Inventory Management System.

### 3.3.1 Hardware Specifications

1. Personal Computer with Network Interface Card attached
2. Minimum system memory (RAM) of 16 MB]
3. Minimum hard disk space of 30 MB

### 3.3.2 Software Specifications

a. Product Development

- **Lotus Domino Designer release 5.** The structure of the Lotus programming language is very simple, particularly as to the executable code. It supports combination of several other programming languages such as Lotus Script and Java Script. This software in intended for Domino application developers. The essential features of Notes are listed in the Table 3.1 below:

| **Lotus Notes features** | |
|---|---|
| 1. Client/server architecture | 8. Comprehensive data access |
| 2. Nonrelational, object-oriented database architecture | 9. Integrated Development Environment |
| 3. Messaging | 10. Extension and add-ins |
| 4. Distributed architecture and replication | 11. Web server |
| 5. Security | 12. Web browsers |
| 6. Support for mobile users | 13. Directory services |
| 7. Support for multiple computing platform | 14. Manageability |

Table 3.1 **Lotus Notes Features**

- **Lotus Domino Administrator release 5** – This is the Lotus Notes client with the administrator's interface added. It is intended for Domino system administrator to administer the overall system process.
- **Lotus Domino Server release 5** – This is the standard Domino Server, similar to the Domino server of earlier release. It included the features of the Domino Mail Server and adds Web application services, and connectivity to data sources external to Domino.
- **Lotus Script** – Use during the code development as the additional script.
- **Internet Explorer 5.0** – This is used especially during the execution of the system interface to support the design view through Internet Explorer web browser.
- **Adobe Acrobat Reader 4.0** – Used as the essential tool for universal document exchange.

b. Documentation

- **Microsoft Word 2000** – Used to compile the reports and prepare the documentation
- **Microsoft Project 98** – Used to develop the project schedule
- **Microsoft Visio** – Used to design the UML diagrams

c. Design Tools

- **Adobe Photoshop** – This program is used to edit photographs, pictures or icons
- **Paint Tools** – This program is used to edit photographs, pictures or icons.

3.3.3 Other tools

a. Network Connection (LAN)

# CHAPTER 4
# RESULTS AND DISCUSSION

## 4.1 Data Gathering and Analysis

### 4.1.1 Interview

After the interview has been conducted, the author identifies the problems faced by the user of the current system. The author had carried out an analysis on the data gathered and had produced the process model and architectural model of the proposed system. Listed below are the problems encountered in the current system:

- Scattered documents

There are all together 147 chemical labs in Block 3, Block 4, Block 5 and Block 19. Each of the labs has its own documents stored in a file cabinet. The documents for each of the labs will be managed by the technician-in-charge. The author focused on the labs at ground floor of block 3 and come up with the table below:

| **Lab** | **Number of documents (Roughly)** |
|---|---|
| TCR | 120 |
| Preparation Room (Process Control) | 125 |
| Process Control Laboratory | 250 |
| Workshop (Welding/Glass Blowing) | 220 |
| Workshop (Metal) | 150 |
| Unit Operation Laboratory | 120 |
| Workshop (Non Metal) | 150 |

| | |
|---|---|
| Technician Room (Unit Operation) | 250 |

Table 4.1 **Number of Documents at the labs at Ground Floor Block 3**

Based on Table 4.1 shown above, it can be concluded that the documents are scattered everywhere and they are not centralized.

- Time consuming in finding the documents

There are hundreds of documents stored in each of the labs as shown in Table 4.1. To find for a document, the technician will have to browse through each of the documents to get the intended document. It will be time consuming to browse through each of the documents.

- Time consuming in reaching the person in charge of the document

The documents are scattered everywhere. If a user needs documents urgently, the user has to find out the person in charge for the particular document. There are 3 ways to find the documents and the person in charge. It is through telephone, email or meet face-to-face with the person in charge. Table 4.2 shows the number of hours the technicians will be available in the technician room to answer the call or to be able to help the user to find the necessary information.

Based on Table 4.2, it shows that most of the time the technicians will not be available in the technician room to answer the call or to help others to find the necessary information. This will be time consuming to the users who wanted the information or to locate the equipment urgently.

| Technician | Lab | Number of hours available (per day) |
|---|---|---|
| Mr. Ahmad Jamal Hair | 03-00-01 to 03-00-08 and 04-00-10 to 04-00-16 | 3 |
| Mr. Mahathir Mohammad | 03-01-01 to 03-01-09 | 4 |
| Mr. Fauzi | 03-02-01 to 03-02-09 and 04-02-01 to 04-02-13 | 3 |
| Mr. Asnizam | 03-02-10 to 03-02-17 | 4 |
| Mr. Yusof Mohammad | 04-00-01 to 04-00-09 | 4 |
| Mr. Firdaus | 04-01-01 to 04-01-14 | 4 |
| Mr. Jailani | 04-02-14 to 04-02-24 | 4 |
| Mr. Shaharudin | 05-00-01 to 05-00-05 | 4 |
| Mr. Zaaba | 05-00-06 to 05-00-10 | 3-4 |
| Mr. Khir Nor Affendi | 05-01-01 to 05-01-17 and 05-02-01 to 05-02-17 | 3-4 |
| Ms. Nurhaniza | 19-02-01 to 19-02-1 5 | 5 |
| Mr. Sharizan | 19-02-01 to 19-02-1 5 | 5 |

Table 4.2 **The number of hours the technicians will be available in the technician room**

- Difficult to spot the re-order level of consumables

The consumables need to be reordered when it reaches the critical level. The reordering process must be done earlier before the consumables are out of stock. To do this, the technicians must frequently check the current stock of consumables and check for the appropriate documents to find the critical level of reorder. It is difficult to spot the reorder

level of consumables by referring to the documents frequently and by checking the current stock level of the consumables. It will be time consuming and troublesome for the technician.

- Unaware of the maintenance and testing of the equipments

The maintenance and testing for the equipments will be recorded in a logbook. The information recorded is the date of testing, venue, type of testing and person involved in the testing. The technician needs to refer to the logbook frequently to check when they will be involved in the testing. According to Mr. Ahmad Jamal during the interview, he mentioned that there exists case whereby the technicians or the lectures did not turned up for the testing and maintenance. This is because they are not aware of the maintenance and testing.

- Risk of loss of documents

When the documents are stored in file cabinet, there is possibility of losing the documents. According to Mr. Jailani, this problem frequently occurs. Mr. Ahmad Jamal supports this fact by stating that at least there will be two cases of loss of documents per semester. He also added that this is a serious problem and something must be done to prevent this problem from occurring.

To overcome the forth problem mentioned above, which is the difficulty to spot the re-order level of consumables, Mr. Yusmieza requested the author to develop the system with the ability to automatically trigger an e-mail to the respective technicians when the consumables reach the critical level.

## 4.2 Design

### 4.2.1 Use Case Model

USE CASE (HIGH-LEVEL)

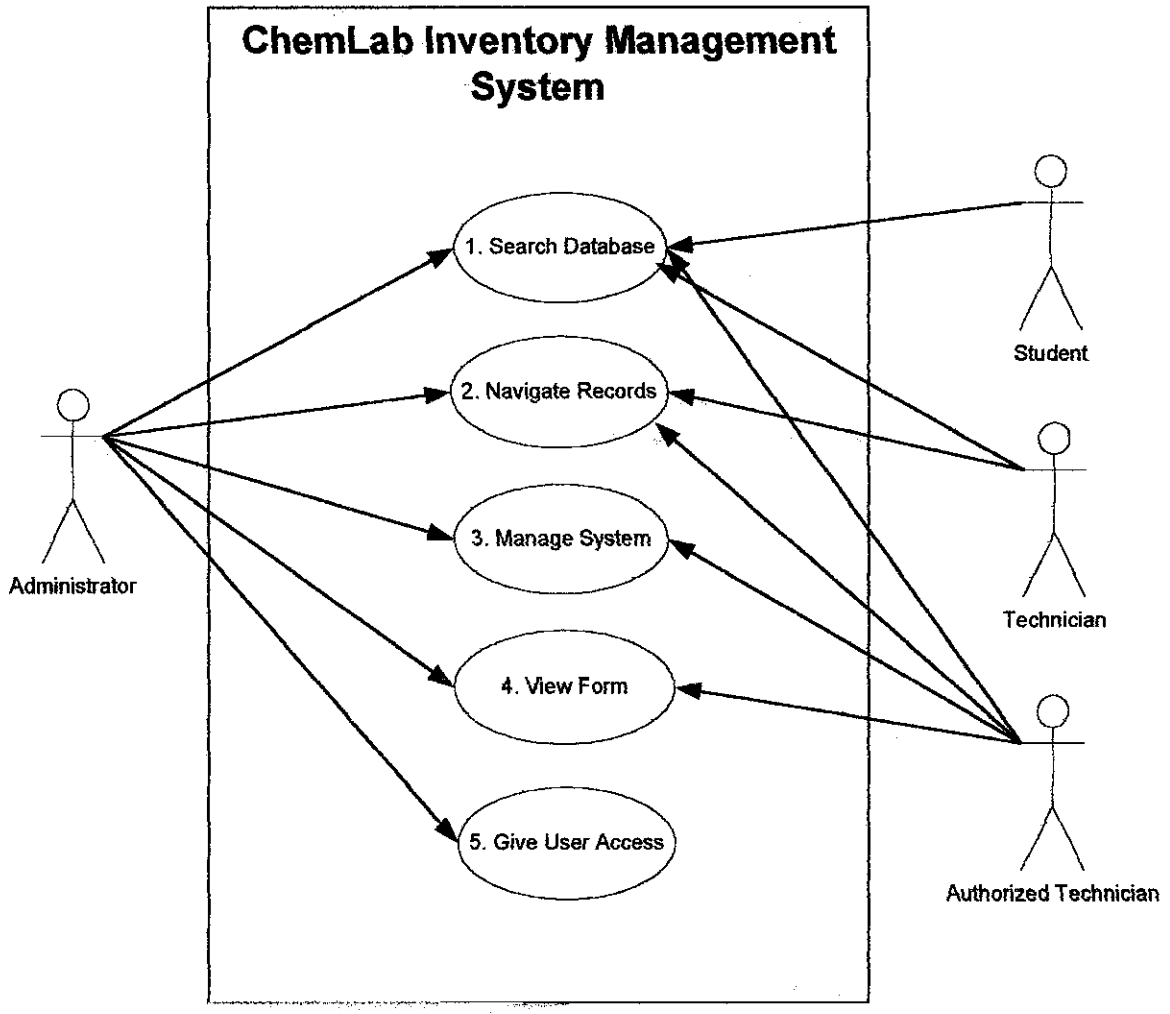


Figure 4.1 **Use Case (High Level)**

1. Description for "Search Database" use case

The user enters the data that they want to search. The system will search the database and display the result.

2. Description for "Navigate Records" use case

The user navigates the records to find the required records. The system will display the required records.

3. Description for "Manage Systems" use case

The administrator will maintain any data entered by the user. The system will save any changes made by the administrator and authorized technicians.

4. Description for "View Form" use case

The user will view the forms available in the system. The system will display all the data entered into the system to be viewed by the authorized user.

5. Description for "Give User Access" use case

The administrator will enter the details of the authorized user into the system to give authorization to the user. The system will save the details and give authentication to the user.

USE CASE – (LEVEL 1 – SEARCH DATABASE)

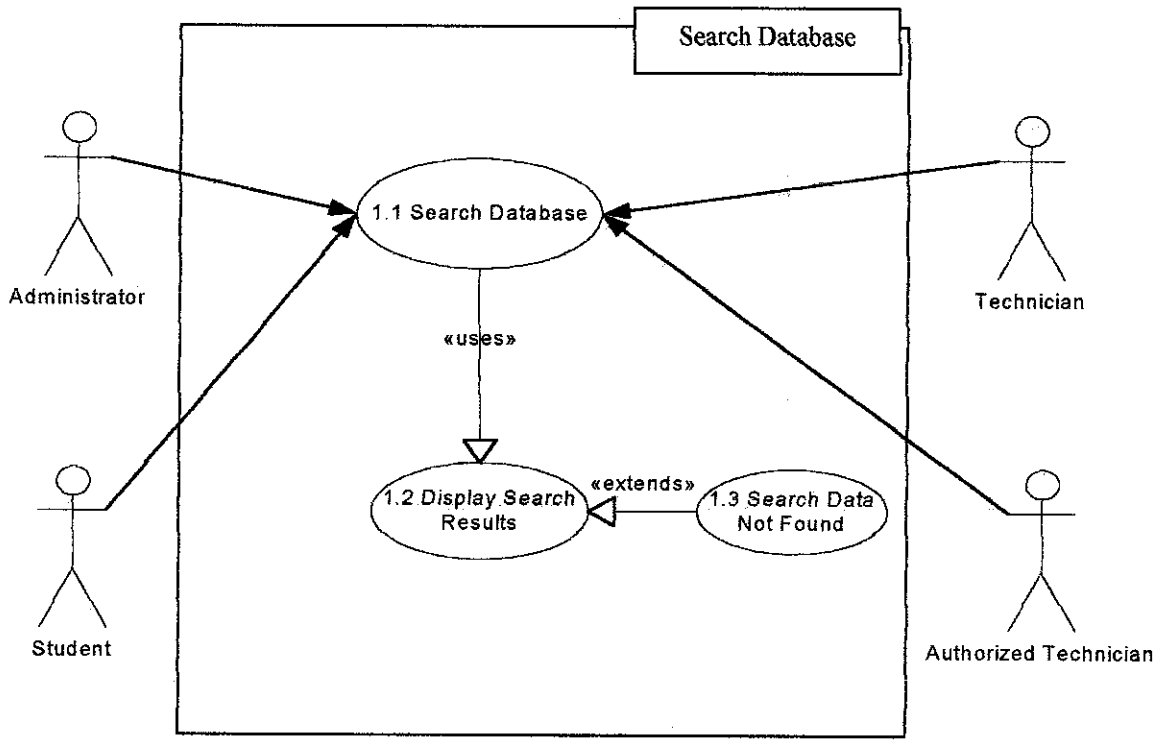


Figure 4.2 **Use Case (Level 1 – Search Database)**

1.1 Description for "Search Database" use case

The user will enter the desired data to be searched. The system will search the database and display the results.

1.2 Description for "Display Search Results" use case

The system will display the search results. The user will view the results displayed by the system.

1.3 Description for "Search Data Not Found" use case

In use case "Display Search Results" if the system finds no matching search, then the system displays an error message and allows the user to enter a different data to search against.

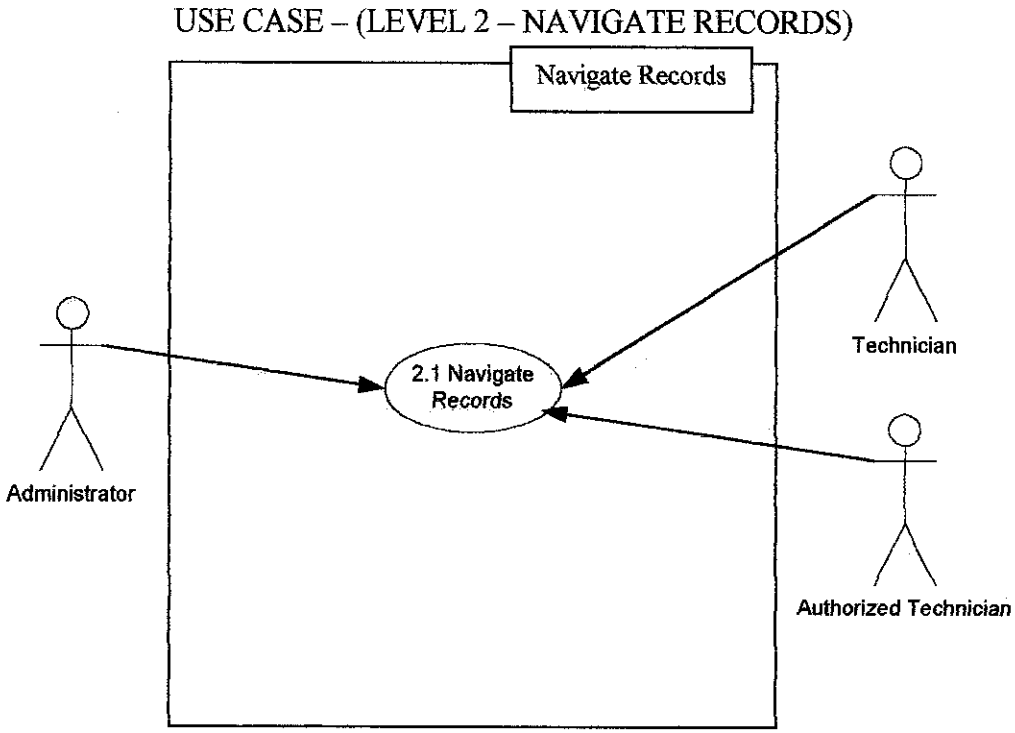


Figure 4.3 **Use Case (Level 2 – Navigate Records)**

2.1 Description for "Navigate Records" use case

The user will navigate all the data entered into the system using the forms available in the database.

USE CASE – (LEVEL 3 – MANAGE SYSTEM)

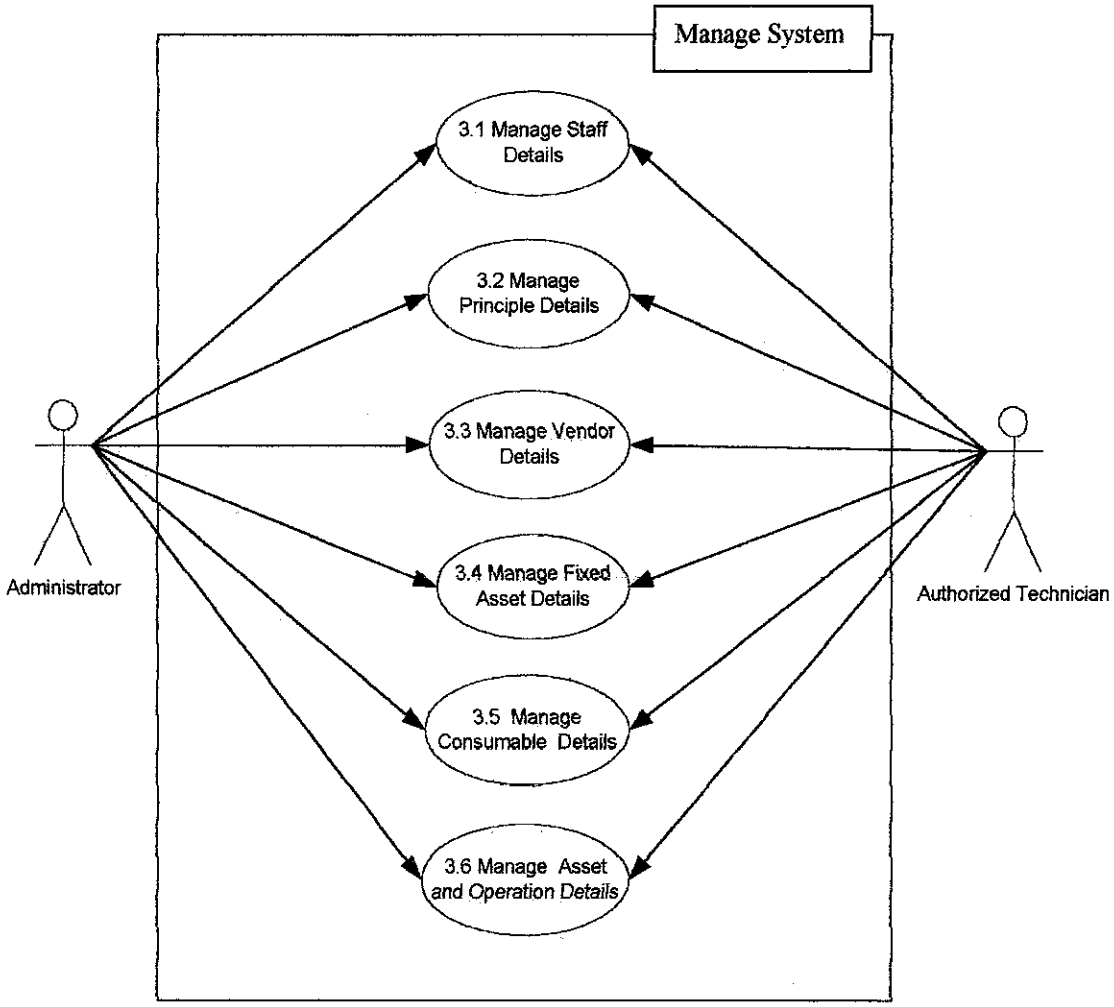


Figure 4.4 **Use Case (Level 3 – Manage System)**

3.1 Description for "Manage Staff Details" use case

The administrator or the authorized technician will update the available staff details using the staff data entry form. They will create new record or delete records when necessary.

3.2 Description for "Manage Principle Details" use case

The administrator or the authorized technician will update the available principle details using the principle data entry form. They will create new record or delete records when necessary.

3.3 Description for "Manage Vendor Details" use case

The administrator or the authorized technician will update the available vendor details using the vendor data entry form. They will create new record or delete records when necessary.

3.4 Description for "Manage Fixed Asset Details" use case

The administrator or the authorized technician will update the available fixed asset details using the fixed asset data entry form. They will create new record or delete records when necessary.

3.5 Description for "Manage Consumable Details" use case

The administrator or the authorized technician will update the available consumable details using the consumable data entry form. They will create new record or delete records when necessary.

3.6 Description for "Manage Asset and Operation Details" use case

The administrator or the authorized technician will update the available principle details using the principle data entry form. They will create new record or delete records when necessary.

USE CASE – (LEVEL 4 – VIEW FORM)

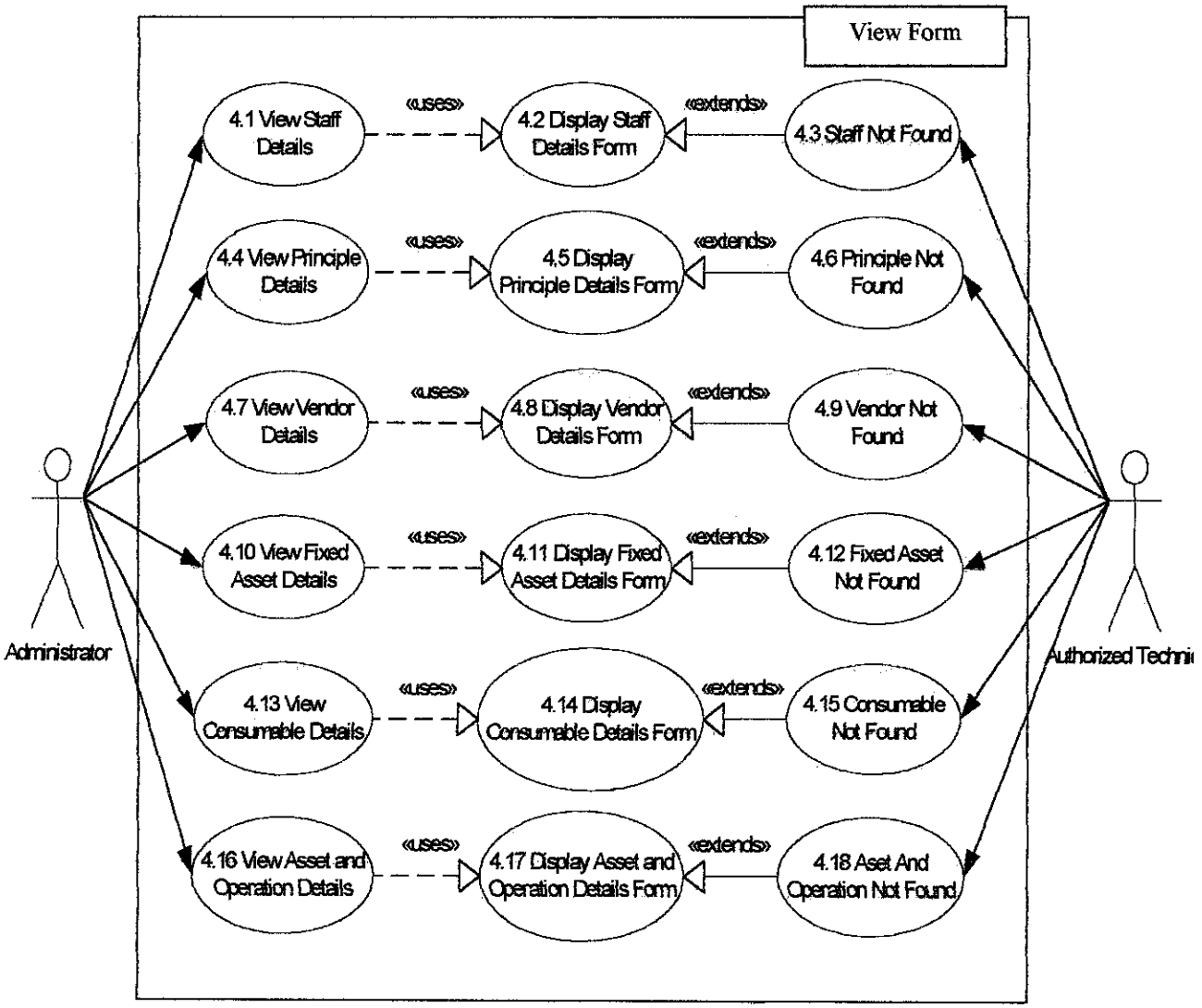


Figure 4.5 **Use Case (Level 4 – View Form)**

4.1 Description for "View Staff Details" use case

The administrator and the authorized technician are allowed to view the staff data entered into the system. The system will display all the data entered into the system.

4.2 Description for "Display Staff Details Form" use case

The user will search for the staff ID. The system will display the staff details according to the staff ID being searched.

4.3 Description for "Staff Not Found" use case

In use case "Display Staff Details Form" if the system finds no matching staff ID, then the system displays an error message and allows the user to enter a different staff ID to search against.

4.4 Description for "View Principle Details" use case

The administrator and the authorized technician are allowed to view the principle data entered into the system. The system will display all the data entered into the system.

4.5 Description for "Display Principle Details Form" use case

The user will search for the principle ID. The system will display the principle details according to the principle ID being searched.

4.6 Description for "Principle Not Found" use case

In use case "Display Principle Details Form," if the system finds no matching principle ID, then the system displays an error message and allows the user to enter a different principle ID to search against.

4.7 Description for "View Vendor Details" use case

The administrator and the authorized technician are allowed to view the vendor data entered into the system. The system will display all the data entered into the system.

4.8 Description for "Display Vendor Details Form" use case

The user will search for the vendor ID. The system will display the vendor details according to the vendor ID being searched.

4.9 Description for "Vendor Not Found" use case

In use case "Display Vendor Details Form" if the system finds no matching vendor ID, then the system displays an error message and allows the user to enter a different vendor ID to search against.

4.10 Description for "View Fixed Asset Details" use case

The administrator and the authorized technician are allowed to view the fixed asset data entered into the system. The system will display all the data entered into the system.

4.11 Description for "Display Fixed Asset Details Form" use case

The user will search for the fixed asset ID. The system will display the fixed asset details according to the fixed asset ID being searched.

4.12 Description for "Fixed Asset Not Found" use case

In use case "Display Fixed Asset Details Form" if the system finds no matching Fixed Asset ID, then the system displays an error message and allows the user to enter a different fixed asset ID to search against.

4.13 Description for "View Consumable Details" use case

The administrator and the authorized technician are allowed to view the consumable data entered into the system. The system will display all the data entered into the system.

4.14 Description for "Display Consumable Details Form" use case

The user will search for the consumable ID. The system will display the consumable details according to the consumable ID being searched.

4.15 Description for "Consumable Not Found" use case

In use case "Display Consumable Details Form" if the system finds no matching consumable ID, then the system displays an error message and allows the user to enter a different consumable ID to search against.

4.16 Description for "View Asset and Operation Details" use case

The administrator and the authorized technician are allowed to view the asset and operation data entered into the system. The system will display all the data entered into the system.

4.17 Description for "Display Asset and Operation Details Form" use case

The user will search for the asset and operation ID. The system will display the asset and operation details according to the asset and operation ID being searched.

4.18 Description for "Asset and Operation Not Found" use case

In use case "Display Asset and Operation Details Form" if the system finds no matching Asset and Operation ID, then the system displays an error message and allows the user to enter a different Asset and Operation to search against.

USE CASE – (LEVEL 5 – GIVE USER ACCESS)

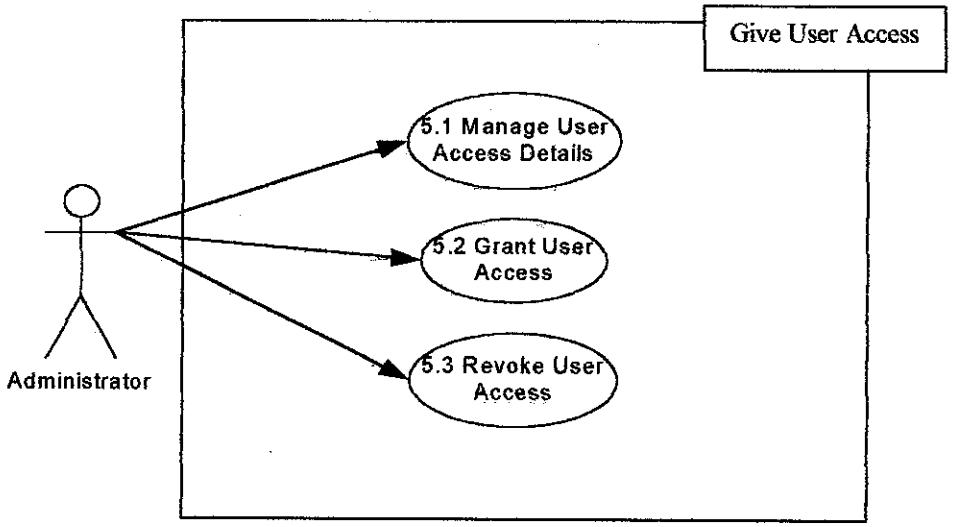


Figure 4.6 **Use Case (Level 5 – Give User Access)**

5.1 Description for "Manage User Access Details" use case

The administrator will update the available user access details using the user access entry form.

5.2 Description for "Grant User Access" use case

The administrator will add new record about the user to give authentication to the user. The system will save the user data into the user access list in the database.

5.3 Description for "Revoke User Access" use case

The administrator will delete the existing record of the user to revoke the authentication of the user. The system will delete the user data from user access list in the database.

### 4.2.2 Class Diagram

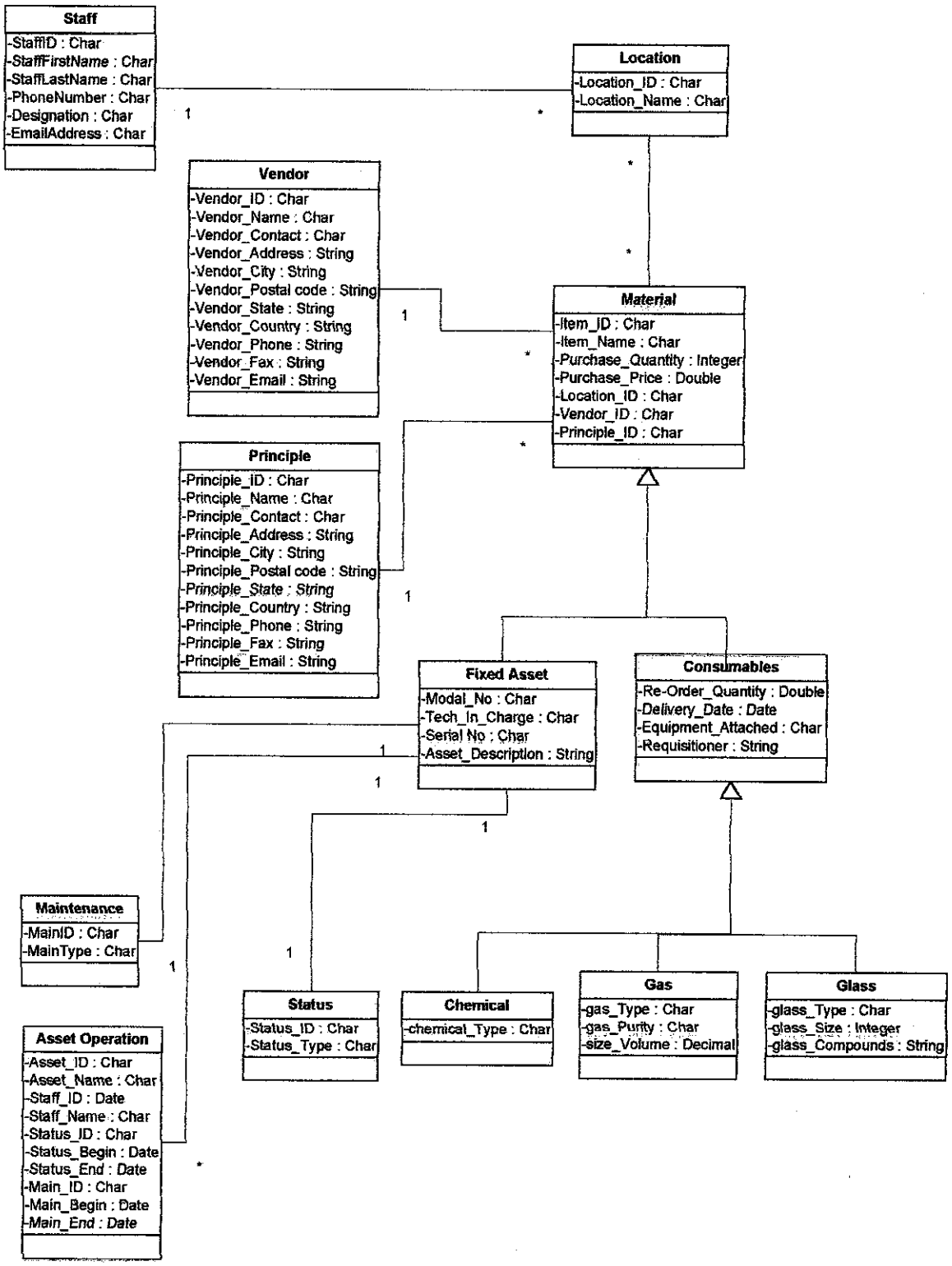


Figure 4.7 **Class Diagram**

Figure 4.7 shows the class diagram for the proposed system. It contains 13 classes, which includes staff, location, vendor, principle, material, fixed asset, consumable, maintenance, asset operation, status, chemical, gas, and glass.

### 4.2.3 Process Flow of the proposed system

The project has six main modules which consist of staff module, vendor module, principle module, fixed asset module, consumable module and asset operation module. It also contains 4 important functions that are search, query, report, and e-mail trigger. Figure 4.8 below shows the main process flow of the system:

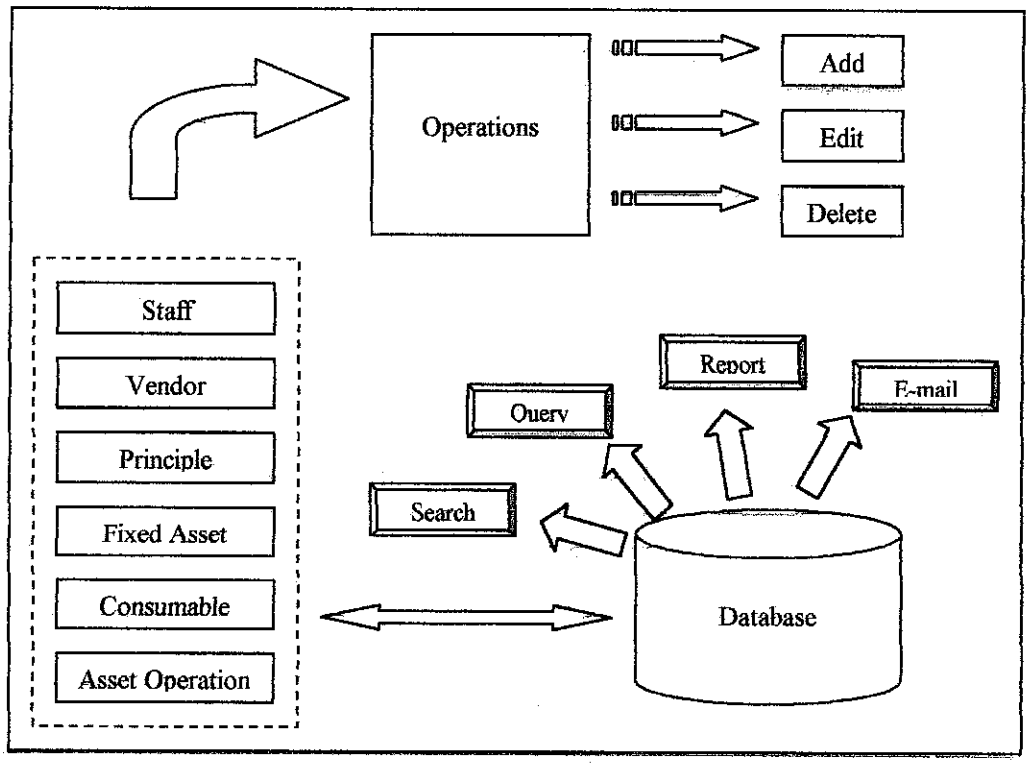


Figure 4.8 **The Main Process Flow of the System**

### 4.2.4 Architectural Model of the proposed system

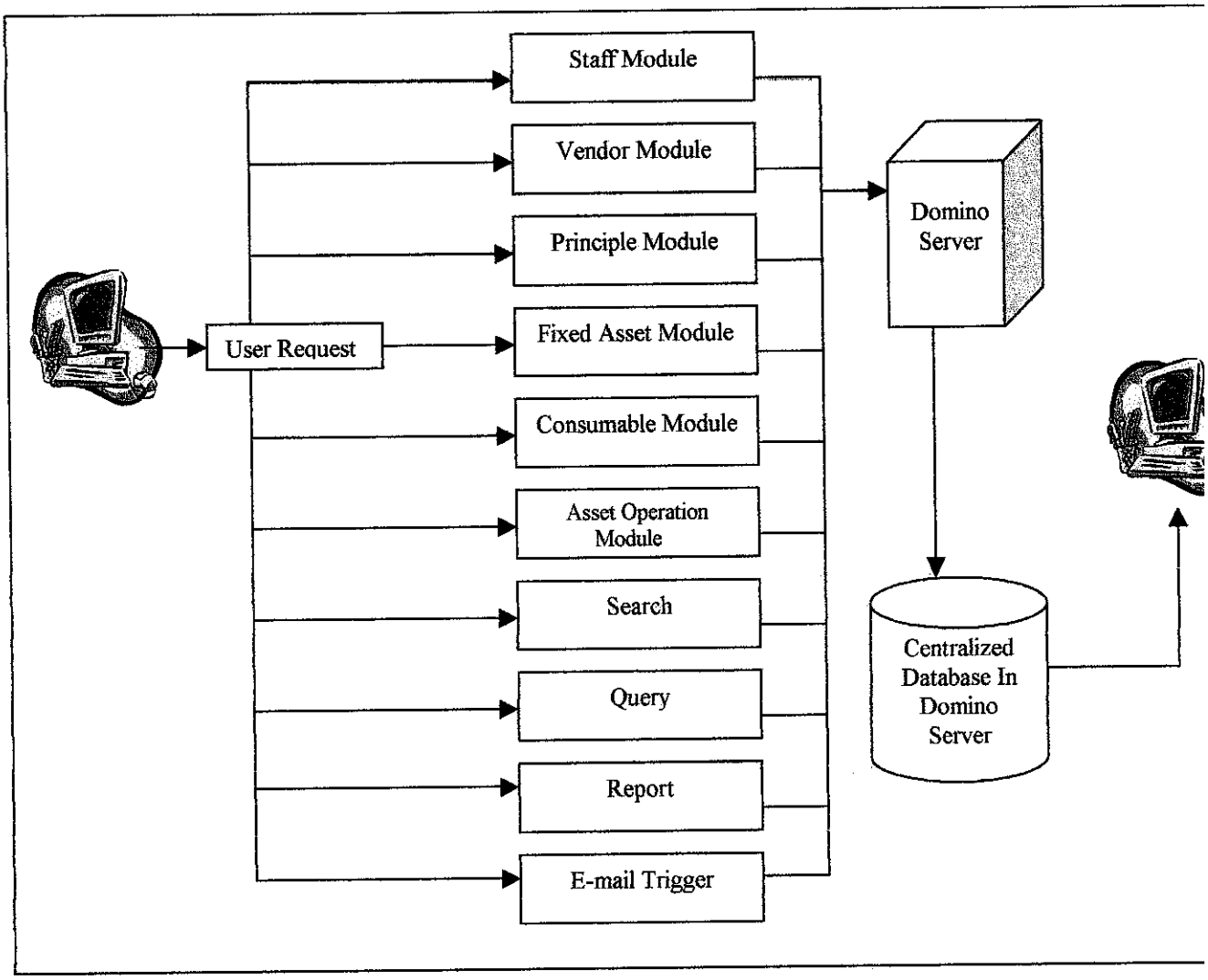


Figure 4.9 **Architectural Design**

The diagram shows the architectural model for ChemLab Inventory Management System. A centralized database is engaged because all the data and information are stored in the Domino Server. In the domino server, a single database will manage and store all the data entered by the user into the system.

## 4.3 Implementation

The user interface design is an important element to be considered to produce a user-friendly system. A bad interface design will waste the user time and irritate users. The author referred to the guidelines gathered from the research to develop the user interface design. The system consists of several pages and the author will discuss the main pages of the system.

### 4.3.1 The Main Interface

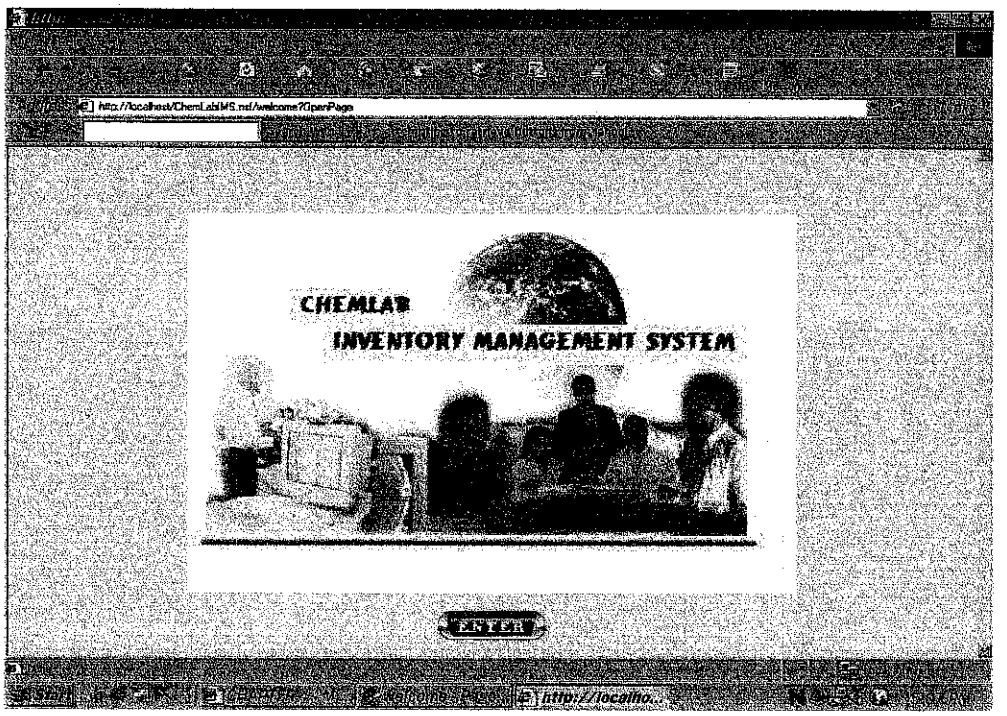


Figure 4.10 **Main Menu**

Figure 4.10 shows the main page of the system. It displays the name of the system and an "ENTER" button. When the user clicks the enter button, the log in page will be displayed. The formula used to display the log in page is:

@Command([Compose];"login")

### 4.3.2 Main Log In Interface

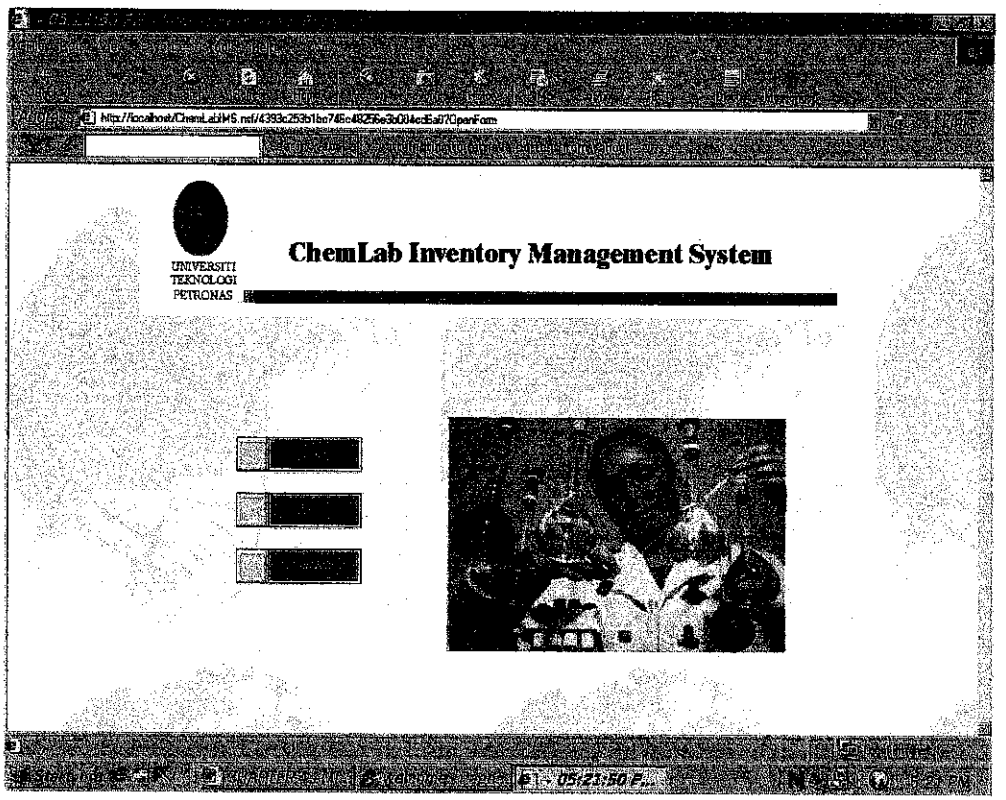


Figure 4.11 **Main Log in Page**

Figure 4.11 displays the log in button for three different users. The users are students, staffs, and administrator. Students are not authorized to log in into the staff module or administrator module. To access the system, the student should register their name with the administrator. The purpose for having different log in page is to limit the unauthorized users from accessing the sensitive information.

### 4.3.3 Search Page

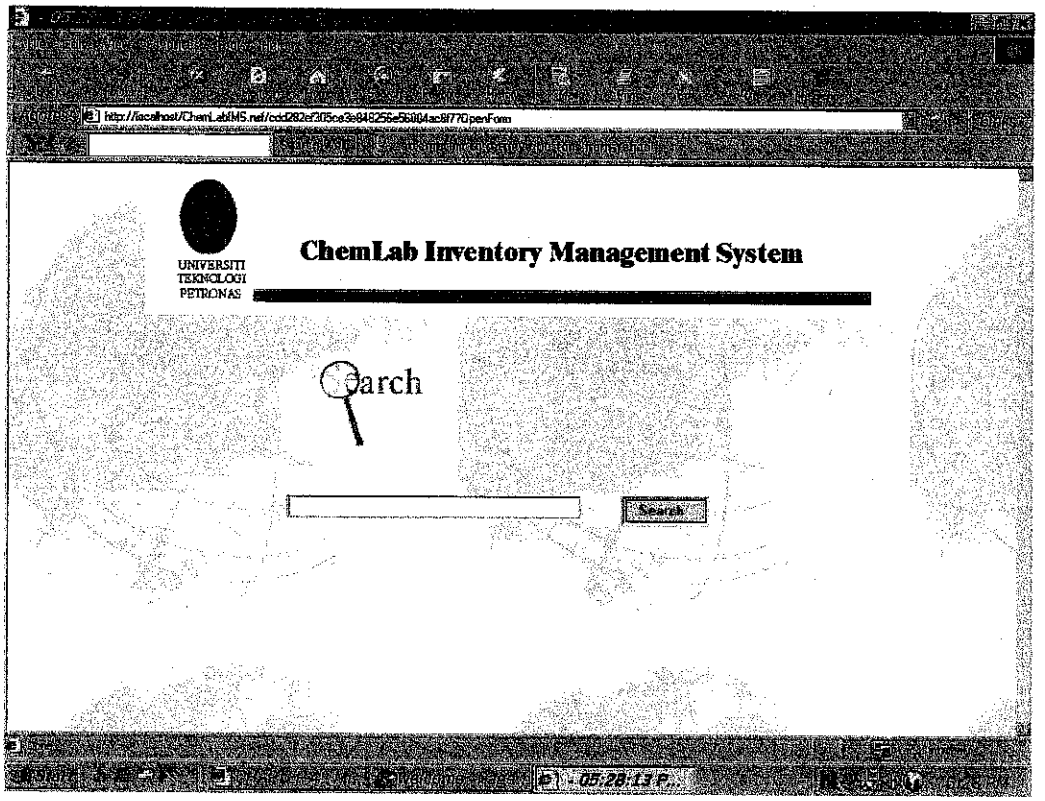


Figure 4.12 **Search Page**

This page allows the users to search for the relevant information easily and quickly. The search results will be displayed if the relevant information is found. A link will be provided together with the result so that the user can click on the result and be directed to the search page.

### 4.3.4 Search Results

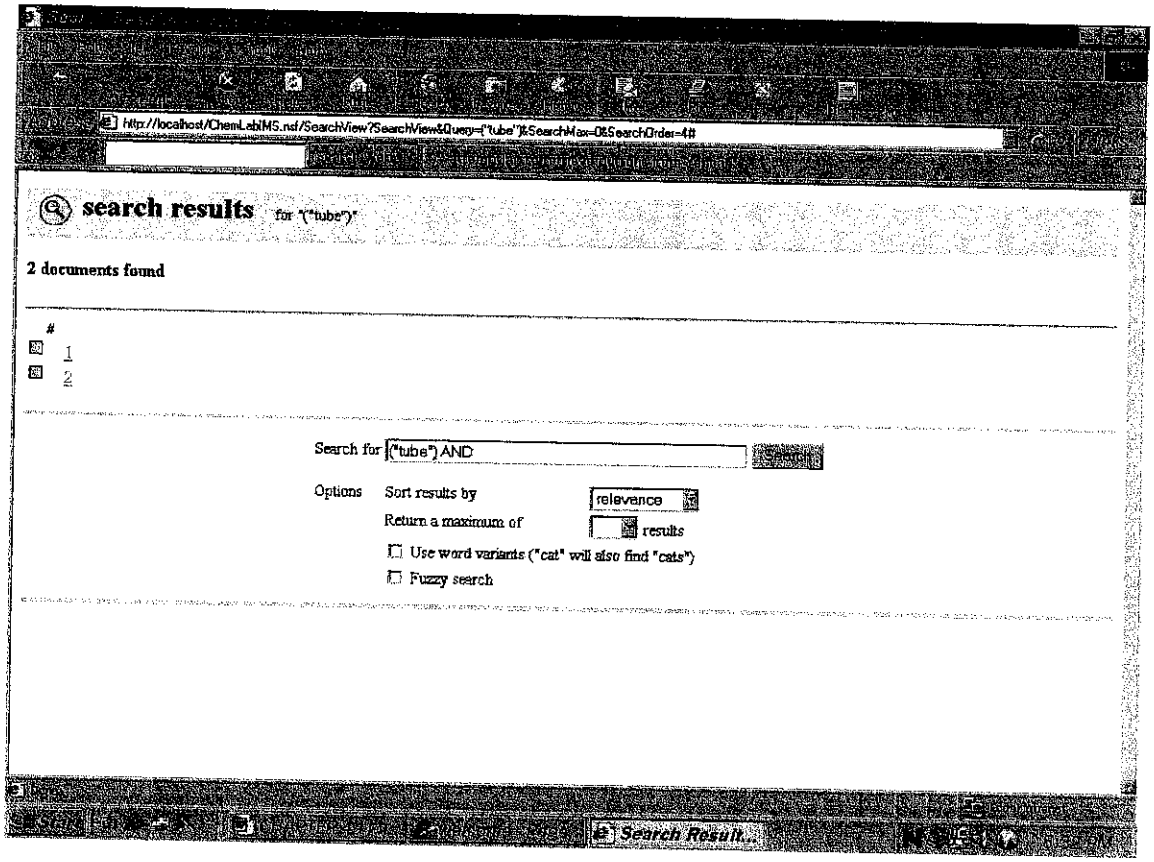


Figure 4.13 **Search Results**

This page displays the search results. It will list down all the documents found in the database and provide a link to the documents to enable the user to view the documents.

### 4.3.5 Staff Module

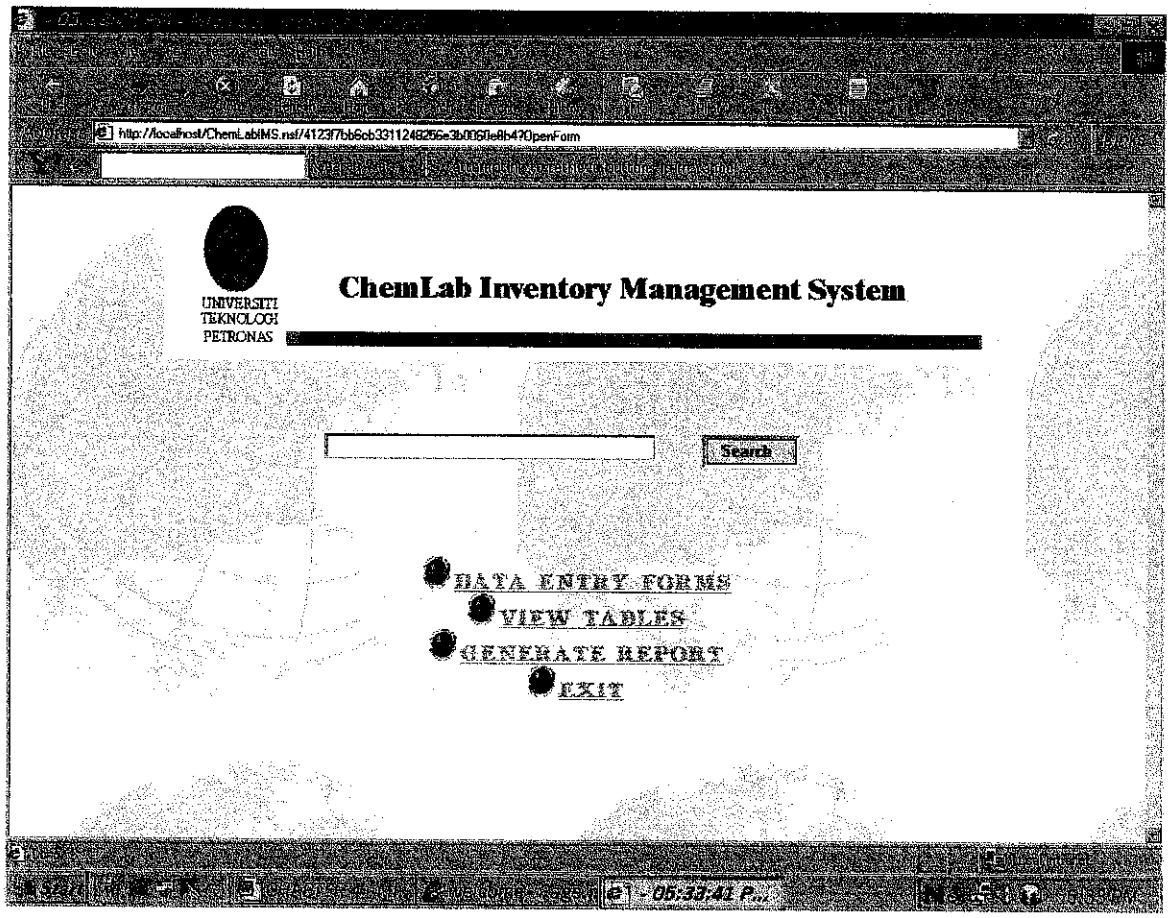


Figure 4.14 **Staff Module**

This page is divided into 4 categories which are the data entry forms, view tables, generate report and exit the system. Data entry forms provide the staff with all the data entry forms includes staff, vendor, principle, fixed asset, consumable, and asset operation data entry forms. The view table module provides the user with the capability to view the data entered into the system by table form. The reports are generated based on three sections which are by asset operation, by fixed asset and by consumables.

### 4.3.6 Staff Data Entry Form

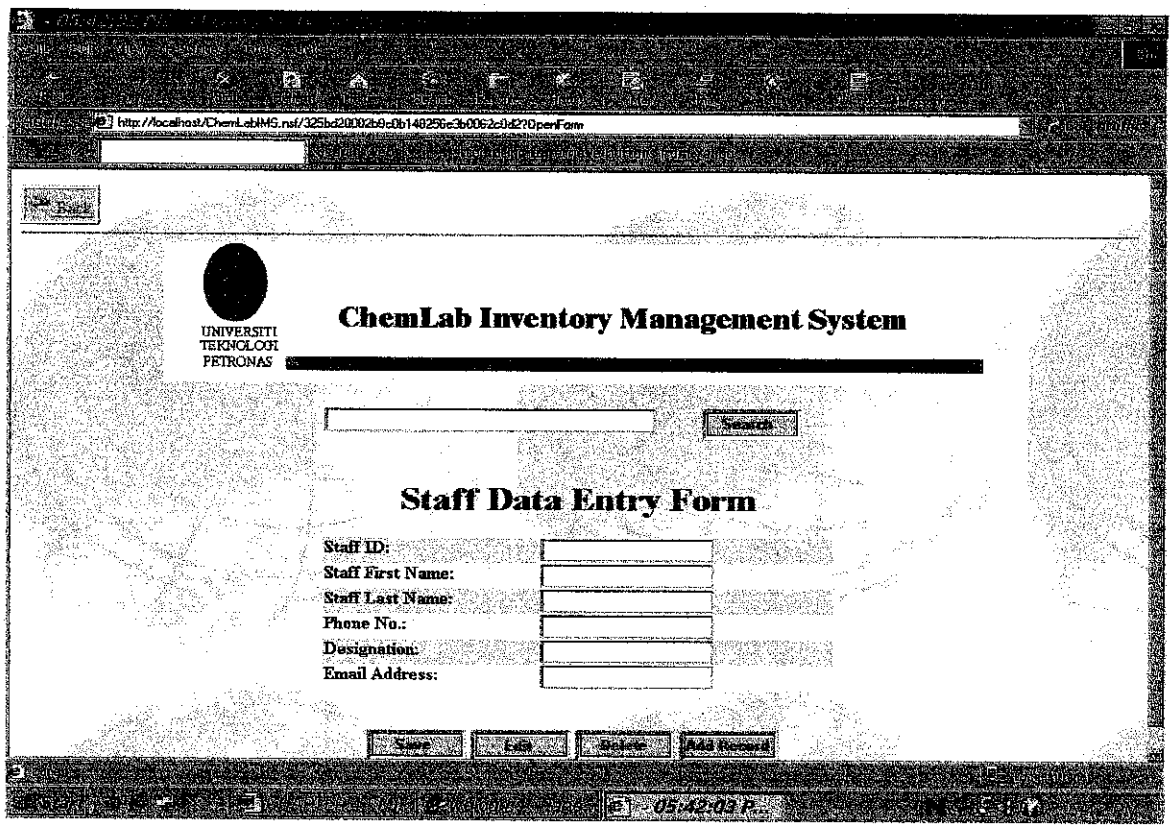


Figure 4.15 **Staff Data Entry Form**

Figure 4.15 shows the staff data entry form. This form is used to enter data related to the staff. Some of the data entered is staff id, staff first name, staff last name, phone number, designation, and email address. Four buttons are provided to the user namely Save, Edit, Delete and Add Record button to enable the user to save any changes, to edit the record, to delete any record or to add a new record.

### 4.3.7 View Staff Table

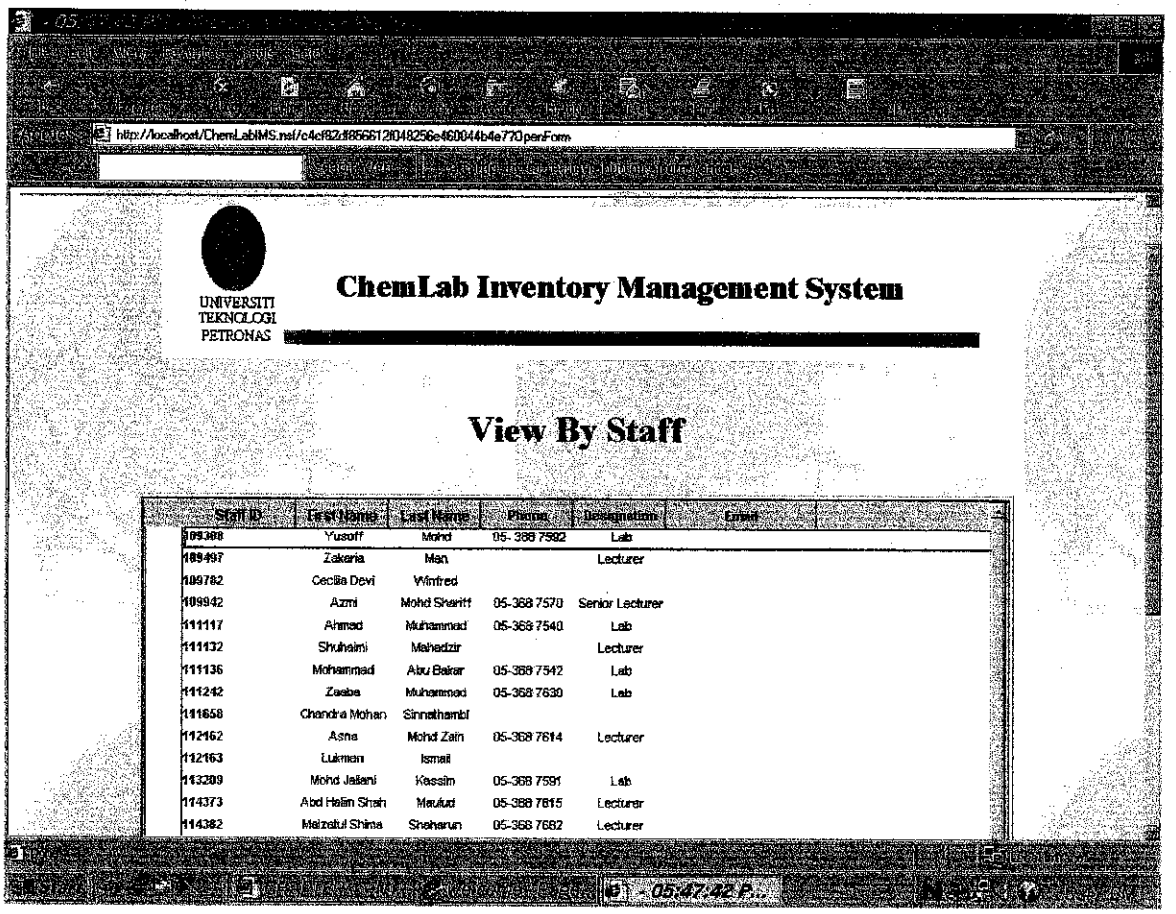


Figure 4.16 **View Staff Table**

This page displays the data entered in a table form. To make any changes to the record, the user can click on the record to display the form where the data has been entered. When the page has been displayed, the user can click on the edit button and start making any necessary changes and save it.

### 4.3.8 Report generated for Fixed Asset by Location

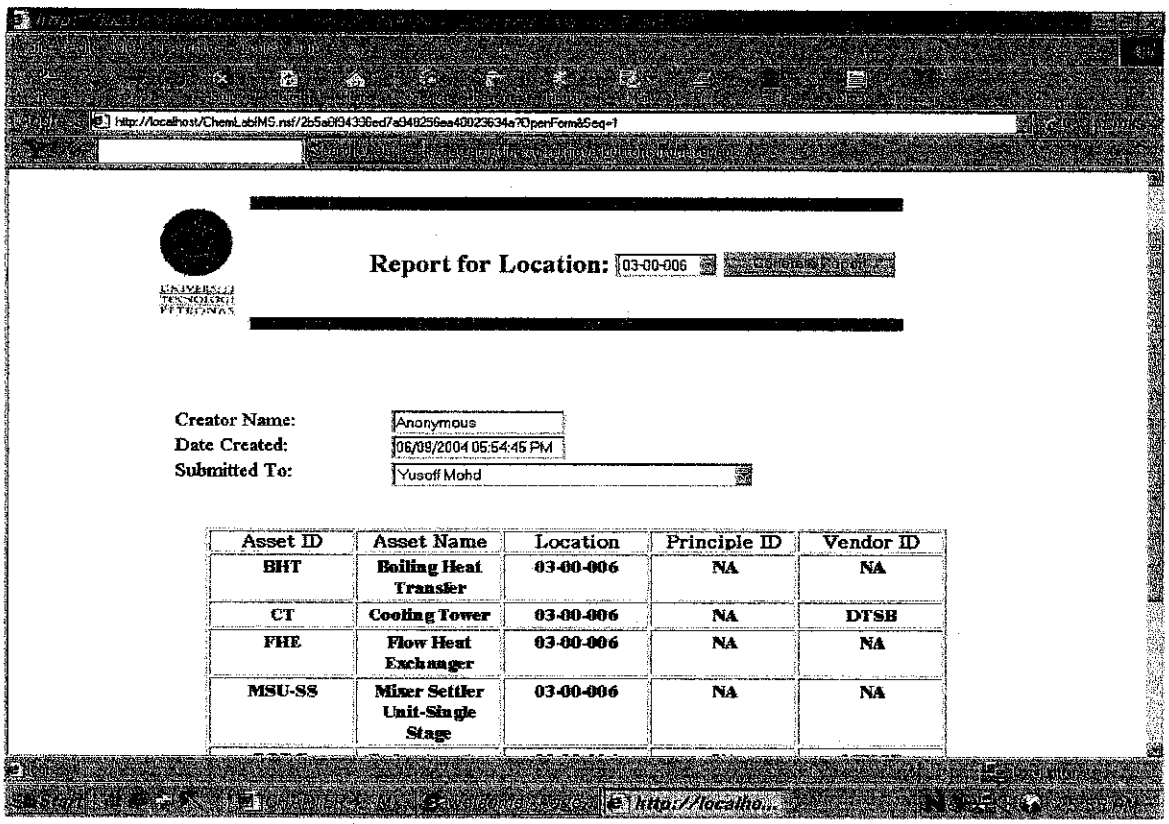


Figure 4.17 **Report for Fixed Asset by Location**

Figure 4.17 shows the report generated for fixed asset by location. The users are required to select the desired location and click the "Generate Report" button. Once the button is clicked, the system will search for the required information and display the data in a table form. The name of the user will automatically be displayed in the "Creator Name" field. The date where the report is generated will also be generated automatically by the system and displayed in the "Date Created" field.

## 4.4 Software Testing

### 4.4.1 Testing Results

The testing was done based on a sample size of ten users. Please refer to appendix v for the results obtained from the users. The results of the test is shown in Table 4.3 below:

| Subjects | Valid | Mean |
|---|---|---|
| Accessibility | ✓ | 4.2 |
| Clarity | ✓ | 3.8 |
| Content | ✓ | 4.6 |
| Consistency | ✓ | 3.9 |
| Navigation | ✓ | 4.0 |
| Usability | ✓ | 4.7 |

Table 4.3 **Testable Statements of the system**

Based on the testing conducted, it can be seen that the users are satisfied with the system and the system meets their expectations. The effectiveness and the usability of the system can be described in a pie chart as shown below:

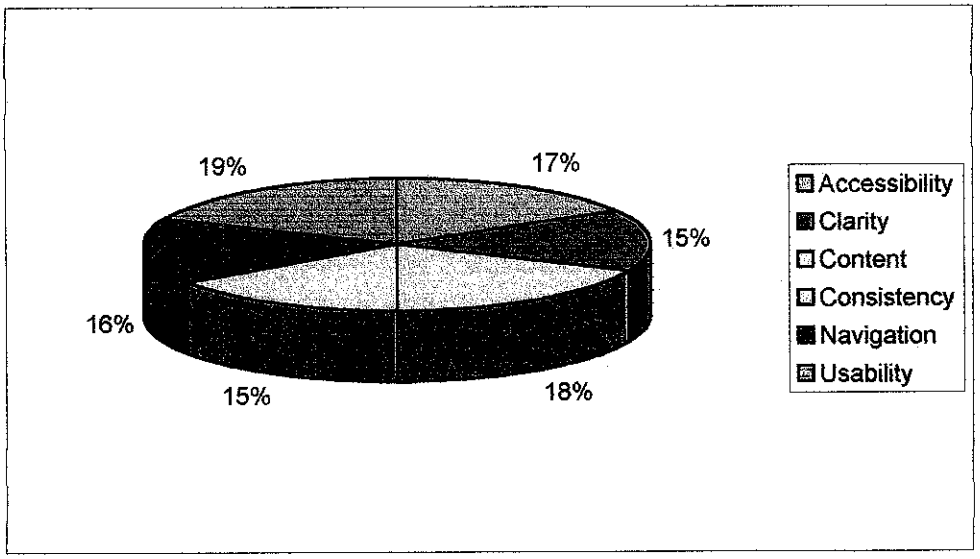


Figure 4.18 **The Effectiveness of the system**

# CHAPTER 5
# CONCLUSION AND RECOMMENDATIONS

## 5.1 Summary

The ChemLab Inventory Management System for UTP technicians, final year students, and lecturers enables easy and quick access to the information. The paper-based way of managing the system previously has incurred a few problems which has become the interest of the author to solve it by introducing technology to computerize the system. By conducting the preliminary data gathering, the author managed to find out the problems faced by the current users and the solutions the users are expecting to solve the problem. The initial research was done to gather information concerning this project including inventory management system, security issues, software development methodologies, design using the UML approach and the development of the prototype version of the system. This system consists of data entry forms, automatic electronic mail trigger, searching capability, and query and reporting. The users will be able to search for the specific information that they wanted to search. Other than that, the users are able to store the data, update the data or delete the data from the database. The automatic email trigger will trigger the respective technician when the consumable reach the critical level of reorder. The users are also able to query the database to get the relevant information and a report for the query would be displayed and the user are given the option to save the query.

The advantages of using this system are:

- The system managed to centralize the database so that the documents are stored at one location.
- The information can be retrieved anytime by the user without having to wait or call the technician to get the documents.
- An email notification will be triggered automatically to the respective technician when the consumables reach the critical level.
- It also creates awareness to the person involved in maintenance and testing when the system triggers the automatic email.
- By automating the system, the risk of losing the documents can also be reduced or prevented because all the documents are stored electronically and the database are backed-up.

## 5.2 Recommendations

This section discusses the recommendations for future enhancement of the system. There are four recommendations suggested as the future enhancement of the system. They are as follows:

### 5.2.1 Report produced by the query need to be displayed in a more professional manner.

The proposed system produces report when the user queries the database. Once done with the query, the system will generate a report and display it to the user. The manner in which the report is been displayed need to be enhanced so that it looks more professional. Currently, the results are displayed in a table form. It is suggested that the system must be able to display the report in a form and a printer-friendly version.

### 5.2.2 Enhance the current interface

Since this project just focused on the prototype version of the system, not much research has been conducted on the areas related to good interface design. It is recommended that a thorough research to be taken in the area related to interface design guidelines to produce a better quality interface. The navigation of the system, the consistency of the elements of the system and etc need to be taken into consideration to deliver a efficient and effective system to the user.

### 5.2.3 Make it accessible on Internet

The system can be accessible to the users within an organization. Users beyond the organization do not have access to the system. It is recommended to make the system available in the Internet so that the users beyond the organization can have access to the system.

### 5.2.4 Link with other systems

To make it more effective, the system can be linked with other systems such as the Procurement System. By linking these two systems, information can be shared between this two system and it will make it easier for the user to update the data directly from the procurement system.

### 5.2.5 Include staff picture in the staff form

It is recommended to include the staff picture in the staff form. Whenever a new staff enters the department, they can refer to the staff form to get to know their colleagues.

## 5.3 Conclusion

The author managed to provide one of the solutions to the problems encountered by the current users in chemical department. By using this system, all the documents will be stored in one location and can be retrieved easily and quickly. The risk of losing the documents can be reduced because the computerized system stores the data electronically and the database can be backed-up in case of occurrence of any problems or database corruption. The proposed solutions will help the users to reduce the workload by automatically triggering an email when the consumable reach the critical level which needs to be reordered. Besides that, the user can quickly search for their intended information by using the search module whereby the system will display the information that the user searches. The user-friendly interface produced will guide the user along the site to navigate the system easily. Generally, this system is an effective and user-friendly system because the users are satisfied with the overall performance of the system and it managed to reduce the problems faced by the current users.

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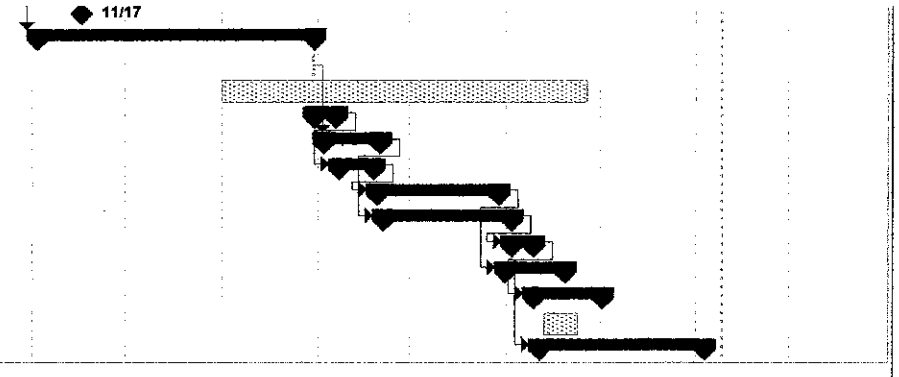
# APPENDIX 1 – PROJECT GANTT CHART

| | | | | | |
|---|---|---|---|---|---|
| 4 | 3. Approval of Topic | 1 day? | Mon 11/17/03 | Mon 11/17/03 | Yes |
| 5 | **4. Preliminary Research / Design Work** | **65 days?** | **Mon 11/3/03** | **Fri 1/30/04** | **No** |
| 12 | 5. Submission of Preliminary Report | 1 day? | Fri 1/30/04 | Fri 1/30/04 | No |
| 13 | 6. Submission of LogBook | 89 days? | Thu 1/1/04 | Mon 4/26/04 | No |
| 14 | **7. Continuation of Project Work I** | **7 days?** | **Sat 1/31/04** | **Fri 2/6/04** | **No** |
| 18 | **8. Progress Report** | **15 days?** | **Tue 2/3/04** | **Fri 2/20/04** | **No** |
| 21 | **9. Continuation of Project Work II** | **9 days?** | **Sun 2/8/04** | **Wed 2/18/04** | **No** |
| 25 | **10. Continuation of Project Work III** | **28 days?** | **Fri 2/20/04** | **Mon 3/29/04** | **No** |
| 28 | **11. Dissertation Final Draft to Supervisor** | **31 days?** | **Sun 2/22/04** | **Fri 4/2/04** | **No** |
| 32 | **12. Dissertation Final Draft to Supervisor and External Examiner** | **6 days?** | **Sat 4/3/04** | **Fri 4/9/04** | **No** |
| 36 | **13. Continuation of Project Work IV** | **15 days?** | **Thu 4/1/04** | **Mon 4/19/04** | **No** |
| 40 | **14. Oral Presentation** | **16 days?** | **Sat 4/10/04** | **Sat 5/1/04** | **No** |
| 43 | 15. Exhibition | 9 days? | Tue 4/13/04 | Fri 4/23/04 | No |
| 44 | **16. Project Dissertation** | **40 days?** | **Mon 4/12/04** | **Thu 6/3/04** | **No** |




Project: IMS Timeline
Date: Wed 6/9/04

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

# APPENDIX I1 – QUESTIONNAIRE DURING THE ANALYSIS PHASE

# INVENTORY MANAGEMENT SYSTEM QUESTIONNAIRE

I have been asked to investigate the current process of the Inventory Management System. Your input concerning this system will be very valuable. We would really appreciate it if you could complete the questionnaire and return it by January 30, 2004.

1. Is the current system flow convenient to be used? *Please tick your answer.*
   ☐ Yes ☐ No

2. What are the problems encountered in the current process flow?

   _____

   _____

   _____

   _____

3. Roughly, how long it will take to locate a material? *Please state in hours, days or weeks.*

   _____

4. Do you have to locate the material yourself or through another person?

   _____

5. How do you trace document for a particular material?

   _____

   _____

6. How are you notified on the maintenance and the testing on the asset?

   _____

   _____

   _____

7. How the documents related to the materials are being kept? *Please tick your answer.*
   ☐ Centralized (Stored at one location only). ☐ Decentralized (Stored at different locations).

8. Will you agree on an automated system for this process? *Please circle your answer.*

| Strongly Disagree | Not Agree | Agree | Strongly Agree |
|---|---|---|---|

9. What are the areas in the current system that needs to be improved?

   _____

   _____

   _____

10. How do you propose the new automated system to be?

    _____

    _____

    _____

**Thank You For Your Cooperation**

# APPENDIX 1II – SAMPLE OF QUESTIONS DURING INTERVIEW

# Interview Questions

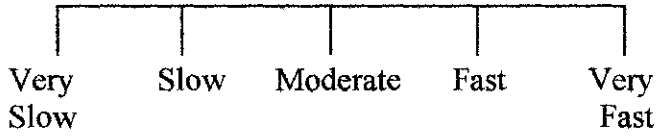
1. Could you please explain to me how the current system works?
2. What are the problems that the current users are facing?
3. How the documents are stored in each lab?
4. Who is the person in charge for the documents?
5. When the asset or consumable reach UTP, how they are further processed?
6. Do you agree to computerize the system?
7. How you want the automated system to be?
8. What are the limitations of current system that need to be improved?
9. What are the things to be considered before ordering a consumable or fixed asset?
10. How many labs are there in Block 3, Block 4, Block 5 and Block 19?
11. Who are responsible for each of the lab?
12. Roughly, how many documents are stored in one lab?
13. How often consumables are reordered?
14. How often checking will be done on the documents to track reorder level?
15. How often testing and maintenance occur?
16. Is there any case of person involved in the maintenance and testing did not turned up?
17. Is there any case of loss of documents?

# APPENDIX IV – QUESTIONNAIRE TO CONDUCT THE TESTING

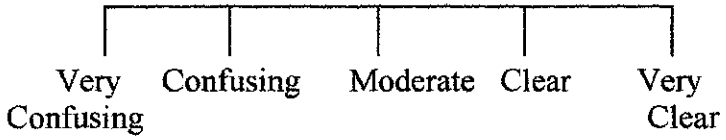
## INVENTORY MANAGEMENT SYSTEM QUESTIONNAIRE

The purpose of this questionnaire is to get the user response of the computerized version of the ChemLab Inventory Management System. Your input concerning this system will be very valuable. We would really appreciate it if you could complete the questionnaire and return it by April 9, 2004.

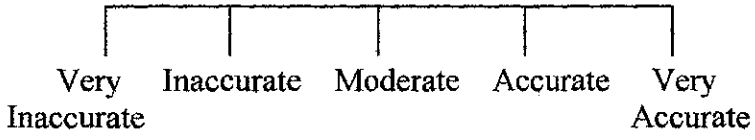
1. How long does it take to access the system?



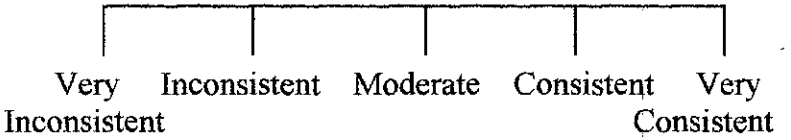

2. Are the contents of the system are clear and easy to understand?



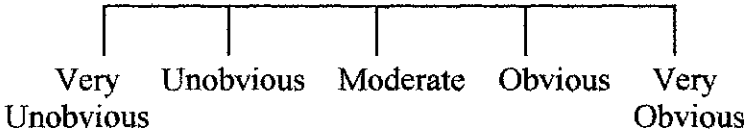

3. Does the system provide necessary information needed by the user



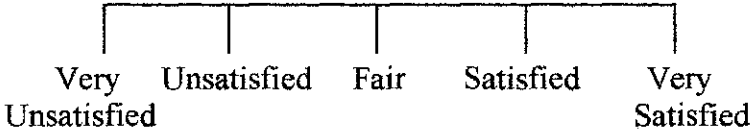

4. Does the system have consistent look and feel?




5. Are the links obvious in their intent and destination?




6. Does the system meet the user's expectation?




**Thank You For Your Cooperation**

# APPENDIX V– RESULTS OF THE QUESTIONNAIRE

## User Response For The Questionnaires

| | Accessibility | Clarity | Content | Consistency | Navigation | Usability |
|---|---|---|---|---|---|---|
| User 1 | 4 | 4 | 4 | 4 | 4 | 5 |
| User 2 | 4 | 4 | 5 | 4 | 4 | 5 |
| User 3 | 4 | 3 | 5 | 4 | 3 | 5 |
| User 4 | 4 | 4 | 5 | 4 | 3 | 5 |
| User 5 | 3 | 4 | 5 | 4 | 4 | 5 |
| User 6 | 5 | 3 | 4 | 4 | 4 | 4 |
| User 7 | 5 | 4 | 4 | 4 | 5 | 4 |
| User 8 | 4 | 4 | 4 | 4 | 4 | 5 |
| User 9 | 4 | 4 | 5 | 4 | 4 | 4 |
| User 10 | 5 | 4 | 5 | 3 | 5 | 5 |
| **MEAN** | 4.2 | 3.8 | 4.6 | 3.9 | 4.0 | 4.7 |