HSE Document Repository for Universiti Teknologi PETRONAS

by

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16162

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

MAY 2015

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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
Information Communications and Technology Programme
Universiti Teknologi PETRONAS
In partial fulfillment of the requirement for the
BACHELOR OF TECHNOLOGY (Hons)
(INFORMATION AND COMMUNICATION TECHNOLOGY)

Approved by,

_____

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UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

May 2015

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 acknowledgments, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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NUR HIDAYAH BINTI MAHIYUDDIN

ABSTRACT

In recent years, increasing awareness of organisations around the world can be seen in terms of sustainability and environmental management. Higher learning institutions are also actively participating in numerous campaigns to reduce their environmental impacts. Different approaches have been introduced by these organisations as it is influenced by the nature of business and the size of the organisation. Thus, it is of utmost importance for an organisation to take part in this global effort towards better compliance with applicable laws, regulations, and other environmentally oriented requirements. However, the current practice of environmental management of Universiti Teknologi PETRONAS seems quite lacking in a few areas. Therefore, the aim of this research is to study how other universities have incorporated environmental management systems in support of the organization's sustainability agenda. This will lead towards the development of a web-based HSE Document Repository for Universiti Teknologi PETRONAS as the first step to implement Environmental Management System (EMS). In this research, the focus is placed on the Health, Safety & Environment department of the university as the goal of this department correlates with many environmental aspects. Interviews with the department have been conducted as a mean of needs analysis and to obtain the user requirements. The results obtained showed a few gaps in the current practices of the department in terms of document sharing and expiry dates tracking. After the completion of development, system testing was done where HSE executive and UTP employees participated. Most users agreed that the system achieve its objective in trying to increase the department's efficiency and communication effectiveness. The system has successfully solve the problem and is very user-friendly with its direct design of interfaces.

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Organisations awareness of the importance to control their environmental impact has increase as they enter the 21st century. An increasing number of organisations including corporations and academic institutions are aiming to reduce their environmental impact and increase operation efficiency. A few approaches to reduce these impacts have been taken, for example by implementing an Environmental Management System (EMS). EMS is a management tool that acts as a framework for an organisation to manage its possible and actual environmental threats and opportunities. It incorporates environmental management into an organization's day to day operations, long-term planning and other quality administration frameworks (Bozena, Jens and Eklund, 2003; Ambika and Amrik, 2004; Burnett and Hansen, 2007). Implementation of an EMS provides effective guidance for organisations to establish, review and develop their practices towards both corporate and environmental goals.

National and worldwide EMS accreditation plans rose in the early 1990s and have since developed to become organized so they correlate with other standard benchmarks (IEMA, n.d.). The ISO 14001 standard is the specified standard for environmental management system that can be evaluated by external bodies. This standard provides an umbrella for other ISO14000 series which cover an extensive environmental issues including auditing, labelling and life-cycle evaluation (IIED, 2009).

Famous organisations such as IBM, Nikon and Kimberly-Clark are examples of organisations that have been implementing EMS. IBM acquired a solitary, worldwide ISO14001 accreditation for 26 of its Manufacturing and Development (M&D) locations in 12 nations in 1997. IBM stated that the cost of implementing an

EMS was affordable and brought profits that surpassed their expectations (Srinivas, n.d.).

1.2 Problem Statement

Universiti Teknologi PETRONAS aims to become a more sustainable and environmentally friendly institution. However, up until now, there is no effective system implemented to manage the university's environmental documents. The involved party in this issue is the Health, Safety and Environment (HSE) Department. The current approach and practice of the department in monitoring and reporting the university's environmental performance is lacking in efficiency. A needs analysis interview conducted with the Senior Manager of the Health, Safety and Environment Department revealed the following gaps in the current practice:

a) The first problem lies in the monitoring permit and certification expiration. The compliance permits and certifications need to be checked manually by opening the document one-by-one to check its expiration.
b) The second problem is the inefficient practice where the university's staff need to communicate with HSE person in charge in providing related compliancy documents and training attendance lists. This practice takes a lot of time and creates hassle for the person in charge when there are too many requests by staffs.

From the problems mentioned above, I believe that a web-based system that acts as a centralized document repository for HSE documents, integrated with a notification system for the HSE department can improve the current situation.

1.3 Objectives

The primary aim of this project is to develop a web-based HSE Document Repository for Universiti Teknologi PETRONAS to increase its operational efficiency. In order to fulfil the primary aim, the following objectives are proposed to be met:

a) To create a website interface for the HSE department
b) To create a document repository to store HSE documents
c) To embed the notification feature in the context of certification expiration to end users.

1.4 Scope of Study

This project will create a web-based system that will be used by the Health, Safety and Environment (HSE) Department of Universiti Teknologi PETRONAS, Perak. The system incorporates the following features:

i. a web interface for the HSE department and UTP staff to download documents for laboratory and chemical compliance
ii. document repository for documents such as chemical register list, HSE training attendance list and certifications or permits acquired by the university
iii. a notification feature for permit expiration for the HSE executives.

CHAPTER 2

LITERATURE REVIEW

2.1 Environmental Management System (EMS)

A set of processes and practices that assists an organization to lessen their effects on the environment and increase its operating efficiencies is the general definition of an Environmental Management System (EMS). It consists of a few contributing elements such as overall practices, processes and resources for developing, implementing, achieving, reviewing and maintaining university policy in order to acquire a sustainable environment (Alshuwaikat and Abubakar, 2007). In addition, Alshuwaikat and Abubakar (2007) also stated that EMS provides a sense of responsibility to the university to plan their activities and adopt environmental practices and regulations in a consistent manner to lessen their impacts to the environment.

For educational institutions, EMS can be an effective instrument to handle wide environmental concerns and improve sustainability of the campus (Barnes and Jerman, 2002). By adopting EMS, an effective direction to build, develop and evaluate operations and practices of an organisation in a more environmentally and socially responsible manner will be given (Piper, 2002). EMS application and accreditation assist universities to integrate their environmental, health and safety management systems and in some instances, their quality management systems as well. According to Morrow and Rondinelli (2002), the implementation of EMS affects everyone directly or indirectly by virtue of its general objectives like continual environmental enhancement, greater recycling, and waste reduction.

There are different kinds of EMS models that are being implemented by organisations globally. The most popular one is the one utilising the ISO 14001 certification and model. There are authors that believe the ISO 14001 model for EMS is ideally suited for all kinds of organisations including universities (Noeke, 2000;

Fisher, 2003; Price, 2005). However, some authors believe that universities need a unique EMS model (Viebahn, 2002; Savely, Carson, Delclos, 2007).

There are also some institutions that have found benefits in acquiring the formal certification for their EMS while most chose to follow informal EMS models that means they are not seeking certification. This models are from different structure levels and are based on ISO 14001, EMAS or BS 7750 guidelines (McDonach & Yaneske, 1996; Carpenter & Meehan, 2002).

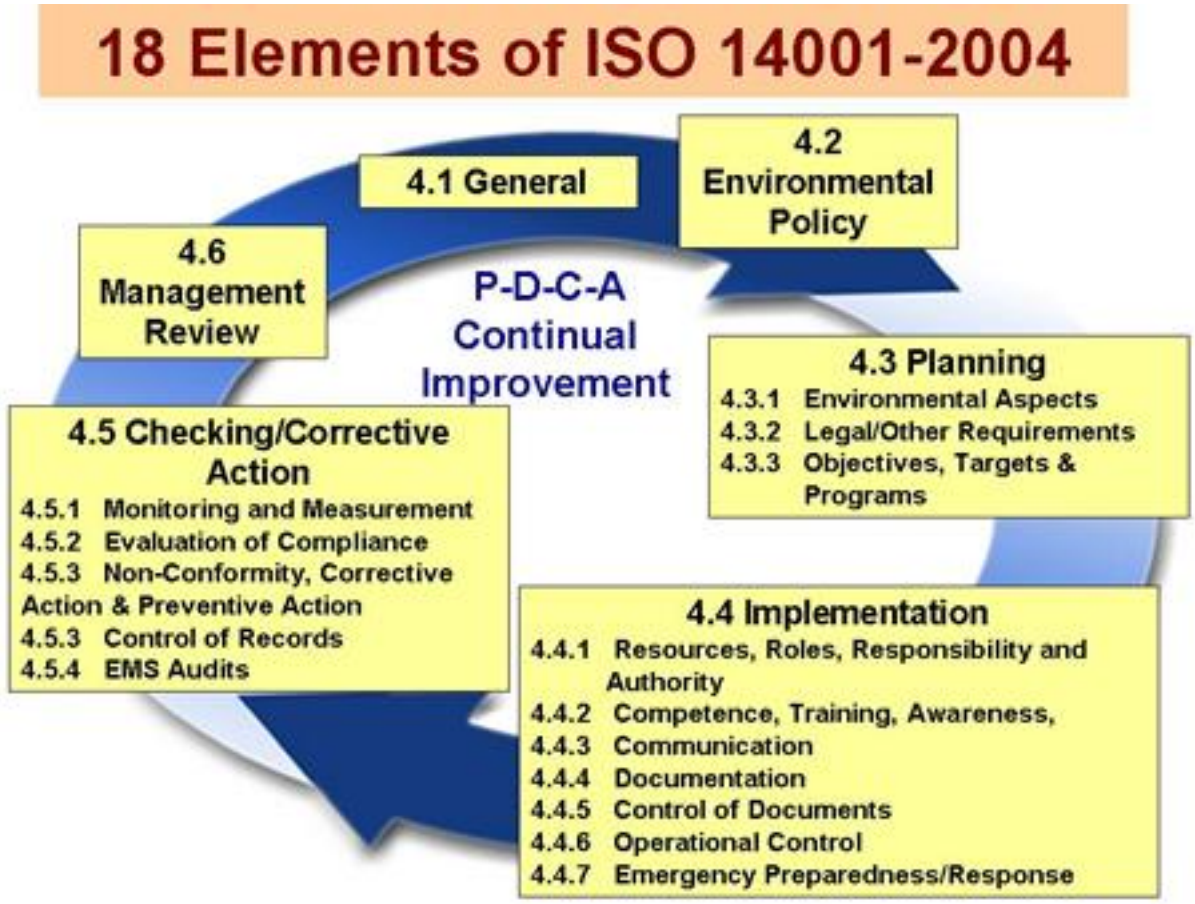


Figure 2.1: 18 Elements of ISO 14001 (Environmental Protection Agency, 2004)

The above figure shows the elements included in implementing ISO 14001. It comprises of a continual process that is call Plan-Do-Check-Act Continual Improvement. Most organizations aspiring to acquire this standard accreditation are already in the planning element but facing problems in the implementation phase. This is due to the absence or lack of systematic method in documentation and control of documents.

2.2 Environmental Management & Monitoring Software

One of the informal method in implementing Environmental Management System is by having a software to assist organizations in handling all related environmental documents. Tools that allow efficient management of EMS implementation and maintenance tasks are used by organizations to aid in project scheduling and management, documentation management, and internal auditing and corrective/preventative actions. According to Global Environment & Technology Foundation (2004), some key implementation management and tools are commonly found in multiple EMS software which are listed below:

- Easy access to routine environmental and EMS documents and records
- Database query, reporting, and updating
- Document repositories
- Notification reminders
- Calendar and EMS milestone and progress functions
- EMS report generation tools

Among the popular environmental software being utilized by big organizations around the world are Intelex Environmental Management System, EMS EH&S Web Application by ChemicalSafety and Envoy by Entropy International.

Based on the official website of Intelex Technologies, Intelex's Environmental Management System consists of a flexible set of software applications to effectively manage organization's environmental data and processes. This software focuses on the overall compliance to the ISO 14001 standard and also includes incident management.

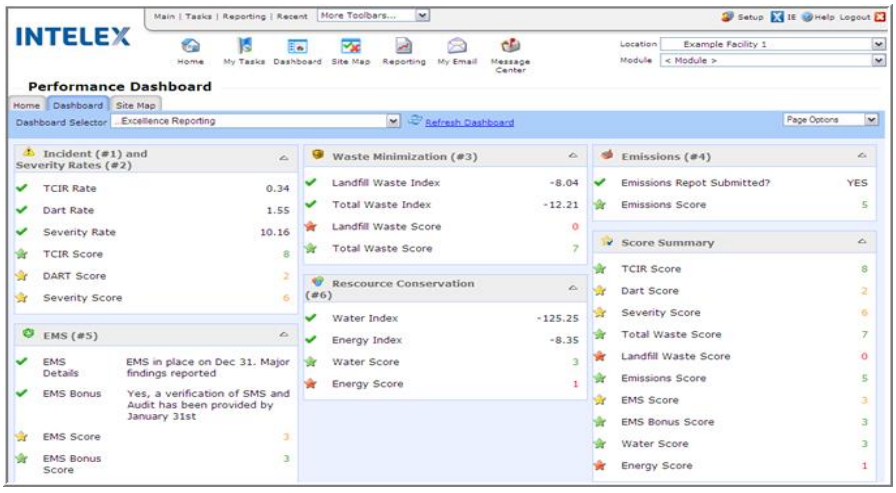


Figure 2.2: Intelex Performance Dashboard (Nwaozomudoh, 2008)

EMS EH&S Web Application on the other hand focuses more on chemical management. According to the website of Chemical Safety, the main feature is to provide MSDS database and GHS labels solution to its users. MSDS is an acronym for Material Safety Data Sheet. It is a written document that summarises all information and procedures in working with and chemicals handling (Helmenstine, 2014). It contains physical and chemical property information, potential hazard information, emergency procedures, and manufacturer contact information. The GHS is an acronym for The Globally Harmonized System of Classification and Labelling of Chemicals. It is a system for standardizing and coordinating the classification and labelling of chemicals (Occupational Safety & Health Administration, 2011).

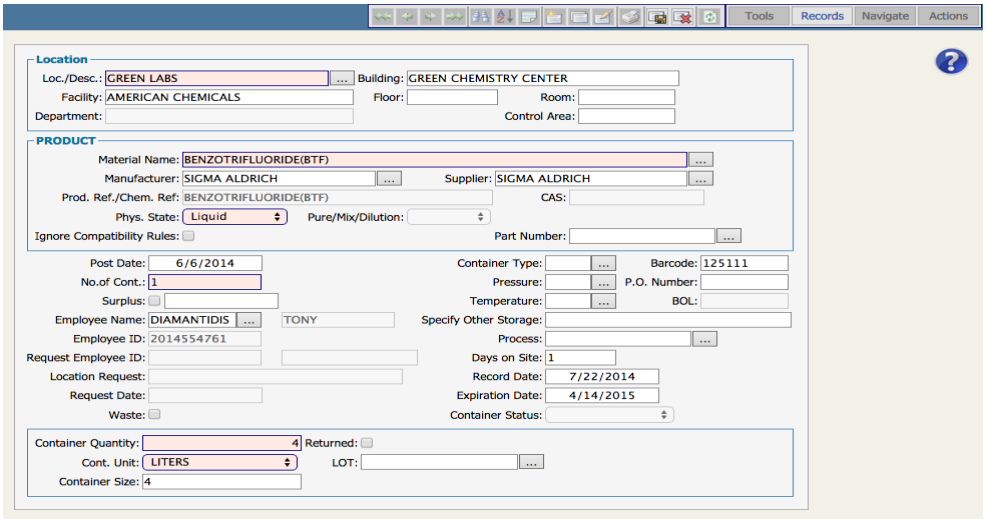


Figure 2.3: Tracking Chemicals (ChemicalSafety, n.d.)

As stated in the website of The British Standards Institution, Entropy on the other hand provides a powerful management solution that focuses on cost and effort minimisation to proactively manage risk, performance and sustainability activities. It is not only focusing on the environmental aspects but also work safety as a whole as it complies with standards such as ISO 9001, ISO 14001, ISO 13485 and OHSAS 18001.

Figure 2.4: BSI Action Manager – Entropy Software (BSI-Entropy, 2013)

From the above software, it is clear that an organisation may focus on different aspects in Environmental Management System. The nature of the business, the industry an organisation operates in, the complexity of the operation and even the size of the organisation are some factors that influence the way organisations implement EMS. Thus, an organisation need to identify their own requirements in choosing the right software for them.

2.2.1 Comparison of Existing Technologies

EMS software tools are targeting both public and private organizations. However, the needs of organizations are different in terms of technological capabilities, scalability to small organizations and different operational sectors. Although an organization's approach to EMS implementation may be identical to each other but there are fundamental, organizational differences between public and private sector entities. EMS implementation experience has revealed that the features needed and capability of the software may vary between different organizations. The needs of a particular organization varies widely depending upon organizational size, internal capabilities and resources, and approach to EMS. The main component of a software tool for EMS implementation and maintenance is its ability to control and manage documentation and records.

This comparison will involve the top three EMS available in the market. The comparison is based on two major criteria that are deemed as important for the EMS. The criteria are as below:

i. **Document repository** - Documents are uploaded and updated in a timely manner and easily accessible for viewing.
ii. **Milestone / task management and tracking** - A management tool that produces automatic reminders/notification to individuals or groups, for example reminders of projects, tasks, and permit requirements. This function may be linked to calendar management tools.

Table 1: Comparison of evaluation criteria of Intelex, Chemical Safety and BSI Entropy

Evaluation Criteria	Intelex EMS	ChemicalSafety EMS EH&S	BSI Entropy
Document Repository	No	Yes, documents are maintained and stored within a central document library.	Yes, documents are maintained and stored within a central document library.

Milestone/ Task Management and Tracking	Yes, automatic email notification with direct link to activity and related documents.	Yes, automatic notifications and task reminders (via email), including a notification calendar and schedule.	Yes, reminder function for completion dates and reviews.

Table 1: ISO 14001 Software Comparison Matrix (Global Environment & Technology Foundation 2004)

2.3 EMS Implementation in Oversea Universities

Being the number one ranked in the 2014 GreenMetric Ranking of World Universities released by Universitas Indonesia on 16th January 2015, University of Nottingham, United Kingdom has been widely known for its many sustainability programs (Universitas Indonesia, 2015). The university aims to become a leader for green university. Environmental sustainability is clearly one of their priorities and it is also one of nine guiding principles in the university's Strategic Plan. According to the official website of the university, the methods used by the university to reduce carbon emissions are listed as below:

- Generating own energy from renewable sources such as solar panels, solar water heating and biomass boilers
- Installing low-energy lighting
- Came up with designs for new buildings to be as energy saving and take advantage of natural daylight
- Improving hallway ventilation systems
- Reduce the usage for air conditioning
- Improve inefficient boilers and equipment
- Running a number of green IT projects to cut down on printer use, shut off PCs automatically at night, and promote greener ways to use IT

Glasgow Caledonian University (GCU) is another example of the universities committed in minimising the environmental impact it has caused. In the university's official website, a special 'Sustainability' section is available to inform others on the university's achievement and contribution in protecting the environment. GCU has implemented an environmental management system (EMS) which is certified EcoCampus Platinum (4 February 2015) and ISO 14001:2004 (3 March 2015). GCU's EMS is externally audited and enables them to develop a better understanding of their environmental impacts and opportunities for reducing them. EMS helps them by minimising risk coming from environmental emergencies or non-compliance with environmental legislation.

Besides having a certified EMS, the university is also active in investing lower carbon energy by installing photosensitive and movement sensors light switches, switched lighting to LED and set up a power management system for the computers used in the institution.

2.4 EMS Implementation in Malaysia's Universities

Transformation of universities in Malaysia has begun since the increased awareness of the public regarding sustainable living. It is the role of universities as higher learning institutions to actively promote and educate the young generations of Malaysia in pursuing environmental sustainability. In Malaysia, the universities that are well known for their sustainability and green campus programs are Universiti Sains Malaysia (USM), Universiti Malaya (UM), Universiti Teknologi Malaysia (UTM), and Universiti Putra Malaysia (UPM)

USM is the second university established in Malaysia. USM offers courses ranging from Natural Sciences, Applied Sciences, Medical and Health Sciences, Pharmaceutical Sciences to Building Science and Technology, Social Sciences, Humanities, and Education (Universiti Sains Malaysia, 2015). The vision of the university is "Transforming Higher Education for a Sustainable Tomorrow" makes it one of the leading universities in Malaysia with great sustainability programmes. USM

has its own Centre of Global Sustainability Studies that is formed to mainstream sustainability into the entire aspect of the university. CGSS (2013) quoted that:

> This Centre is aimed to work with all other relevant sections of the university, regional and international sustainability organizations, national and regional governments, private sector, civil society groups and NGOs to promote sustainable development, paying particular attention to the disempowered bottom billion.

CGSS has developed a Sustainability Assessment Methodology (SAM) and a set of indicator based Sustainability Worksheets to monitor and to assist in sustainability integration into teaching courses and research projects related to sectors such as water, energy, health, agriculture and biodiversity and cross-sectorial issues such as climate change, disaster risk management, production, consumption, population and poverty (SEASN, 2014).

University of Malaya, or also known as UM, Malaysia's oldest university, is situated on a 750 acre (309 hectare) campus in the southwest of Kuala Lumpur, the capital of Malaysia. (UM, 2014). UM also has its own sustainability centre that is known as UMCares. UMCares - The Community & Sustainability Centre was established in April 2014. The centre is a portrayal of UM's commitment to community engagement and engagement for sustainability. It is handled by a passionate, diverse team of staff who are driven by the need to do what they can to help others (UMCares, 2015). UMCares green office is one of the product of this effort. This office will be the university's first environmentally-friendly, innovative and functional green workspace. With the collaboration of Panasonic, the office will be furnished by furnitures made by recycle materials. UMCrops Experimental Farm is also one of the initiatives of the centre. Through this project, organic waste from the café is planted directly into the soil at the farm, an innovative and less odorous method of composting. This will result in the germination of healthy production that can be harvested and given back to the café for sale which indicates a complete organic food and waste cycle with a low carbon footprint.

UTM is Malaysia's innovation-driven, entrepreneurial research university in engineering, science and technology (Zen, Bandi, Zakaria and Saleh, 2013). Accommodating large number of students and utilising large academic buildings and

facilities makes UTM feel responsible in managing their environmental impacts. The Sustainable Campus Initiative at UTM is a continuous effort to create synchronised, long-term cross-campus greening. Some efforts have been introduced such as 'Monday is UTM Recycling Day, 'Green Office' and 'Arked Lestari'. UTM implements the Living Lab approach that allows the interaction between the basic elements of a campus society; students, academic and administrative/professional staff (Moore, 2005; Mcmillin and Dyball, 2009).

Besides that, UTM is also involved with a government project as a pilot partner for Low Carbon Cities Framework (LCCF) and Assessment enables the campus to become a test bed for the carbon calculator created by the Malaysia Green Technology Corporation (MGTC), Ministry of Energy, Green Technology and Water.

Sustainable Energy Management Program (SEMP) is one of the successful achievement of UTM in its sustainability program. In this program, a few example activities are done such as listed below:

a) Operation hours of the air-conditioners are changed to off from 5 p.m. to 4.30p.m.
b) Classes on weekends are only held in rooms with split unit air-conditioners to control the usage of centralized air-conditioners
c) Retrofit energy saving lamps T5 of 60000 units
d) Starting 19th July 2011, UTM switched to Off-peak Tariff Rider (OPTR) allowing them to get 20% discount off.

The above efforts have made UTM to be one of Malaysia's universities that are excellent in their Energy Management Program. Some awards have been won by UTM such as ASEAN Energy Award 2012 and 2 times recipient of EMGS AEMAS at Energy Conference in the year 2011 and 2013.

UPM is a research university located in a semi-urban setting that offers a variety of academic programmes. Serdang, which is the main campus has been transformed into the university's agriculture park. This is not surprising as UPM is known to be the first university in Malaysia that offers an agricultural program since 80 years ago. UPM's commitment to sustainability can be seen from their Green Policy where their objectives are to offer services and to develop principles of sustainable development in improving the quality of life and ensure a sustainable living environment. Educating awareness on sustainable development, global

warming, environmental conservation and biological diversity are also the commitments of the university.

According to Ishak (2014), UPM is currently adopting Environmental Management System MSISO 14001. Office of the Registrar has been appointed as a representative of management and aided by experts in the field. The Quality Assurance Division UPM will serve as the Secretariat for the implementation of ISO 14001 EMS. Based on EMS implementation plan, UPM hope to achieve MS ISO 14001:2004 certifications in 2014. In general, the application of EMS at UPM is applied through EMS Steering Committee and the Working Committee on EMS. The scopes of the EMS are narrowed to educating and learning activities and all related matters. UPM is dedicated to implement effective management system through:

- compliance with laws, regulations and other requirements regarding the environment, especially pollution prevention,
- development of goals and objectives based on environmental impact assessment aspect,
- reassessment and modification of policies, objectives and targets for continuous improvement and,
- to nurture good practices towards environmental sustainability.

Besides that, UPM also introduced some other creative ideas that are applied in the university as its effort to become a greener organisation. Programs such as 'Serdang Green Town', research and development on solar power for energy and zero polystyrene and used cooking oil collection in cafeteria has proven to make UPM a more sustainable campus. This achievement can clearly be proven as UPM emerged as the highest ranked university from Asia in the UI-Green World University Ranking. In 2013, UPM is ranked 16th while the top 15 spots were monopolized by universities from Canada, United States of America and other European countries.

2.5 Environmental Management System: A Case Study of Universiti Teknologi PETRONAS

Over the years, HSE department of Universiti Teknologi PETRONAS has been doing their best to make the university complies with the standards related to health, environment and safety. With this as their priority, the department has been handling and monitoring plenty of related documents such as permits and certifications.

In UTP, where there are a lot of safety regulations involved especially in chemical handling making this as top priorities for involved parties. Having said that, HSE being the responsible department have always been requested by the university's staff to provide documents for Chemical Register list, Legal Register list to even the attendance list of the training attended. Current practice of the HSE department in providing information to the requester is in fact time consuming and less efficient.

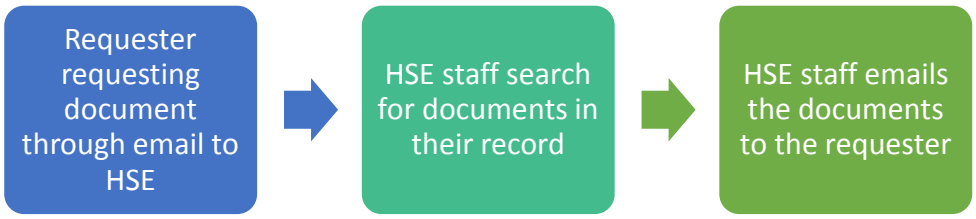
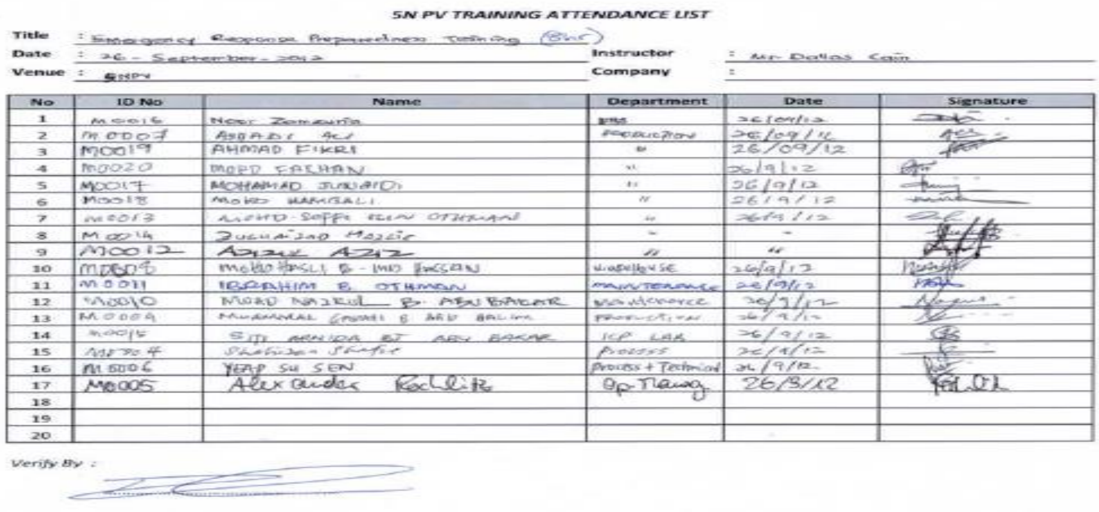


Figure 2.5: HSE process flow

The process flow above shows the sequence of process that is currently practiced by HSE department. This process may seem simple on the surface. However, as the document library of the department are not centralized, this work has become tedious as the HSE staff need to go through different folders that are stored in different directories in the computer system. Absence of a centralized database makes the work to be more time consuming, repetitive and unorganized.

Besides that, the current practice of the HSE executive in tracking expiration dates of permits is also not efficient. There is no reminder or earlier notifications for permits that are nearing expiration. HSE executives need to manually check the dates on the specific permit documents one by one.



SN PV TRAINING ATTENDANCE LIST

Title : Emergency Response Preparedness Training (BNC)
Date : 26 - September - 2012
Venue : [illegible]
Instructor : Mr Dallas Cain
Company :

No	ID No	Name	Department	Date	Signature
1	M0016	Noor Zamzurin	[illegible]	26/09/12	
2	M0007	Asbadi Ali	Production	26/09/12	
3	M0019	AHMAD FIKRI	"	26/09/12	
4	M0020	MOHD FARHAN	"	26/9/12	
5	M0017	MOHAMAD JUNAIDI	"	26/9/12	
6	M0018	MOHD HAMBALI	"	26/9/12	
7	M0013	MOHD SOFFI BIN OTHMAN	"	26/9/12	
8	M0014	Zulhaizad Mazlie	"	"	
9	M0012	Azizul Aziz	"	"	
10	M0009	MOHD HASLI B. MD HASSAN	WAREHOUSE	26/9/12	
11	M0011	IBRAHIM B. OTHMAN	MAINTENANCE	26/9/12	
12	M0010	MOHD NAJRUL B. ABU BAKAR	MAINTENANCE	26/9/12	
13	M0009	MUHAMMAD [illegible] B. ABU BALIM	PRODUCTION	26/9/12	
14	M0015	SITI AMNIDA BT ABU BAKAR	ICP LAB	26/9/12	
15	M7004	Shahrizan Shafie	Process	26/9/12	
16	M6006	YEAP SU SEN	Process + Technical	26/9/12	
17	M6005	Alexander Rockliff	Op. Manag.	26/9/12	
18					
19					
20					

Verify By :

Figure 2.6: Sample of HSE Training Attendance list

CHAPTER 3

METHODOLOGY

3.1 Preliminary Investigation

For this research, the qualitative assessment is chosen for research methodology. Interviews are done with the HSE department of Universiti Teknologi PETRONAS who will be the future user of the system makes it easier in problem identification and system planning as the communication and input can be directly obtained. Face-to-face interviews is the best way to collect high quality data. Face-to-face interviewing offers a greater degree of flexibility if compared to other type of interviews. A skilled interviewer can explain the purpose of the interview and encourage potential respondents to co-operate; clarify questions, correct misunderstandings, offer prompts, probe responses and follow up on new ideas in a way that is just not possible with other methods (Mathers, Fox and Hunn, 1998).

3.2 Software Development Life Cycle (SDLC)

A system development life cycle is a series of clearly defined and distinct work phases that are used by systems engineers and systems developers to plan for, design, build, test, and deliver information systems. In each phase of SDLC, deliverables required by the next phase in the life cycle are produced. Requirements are translated into design. Code is produced according to the design which is called development phase. After coding and development the testing verifies the deliverable of the implementation phase against requirements.

Hence, the methodology decided to be used in this research is divided into two big phases as shown in Figure 3.1

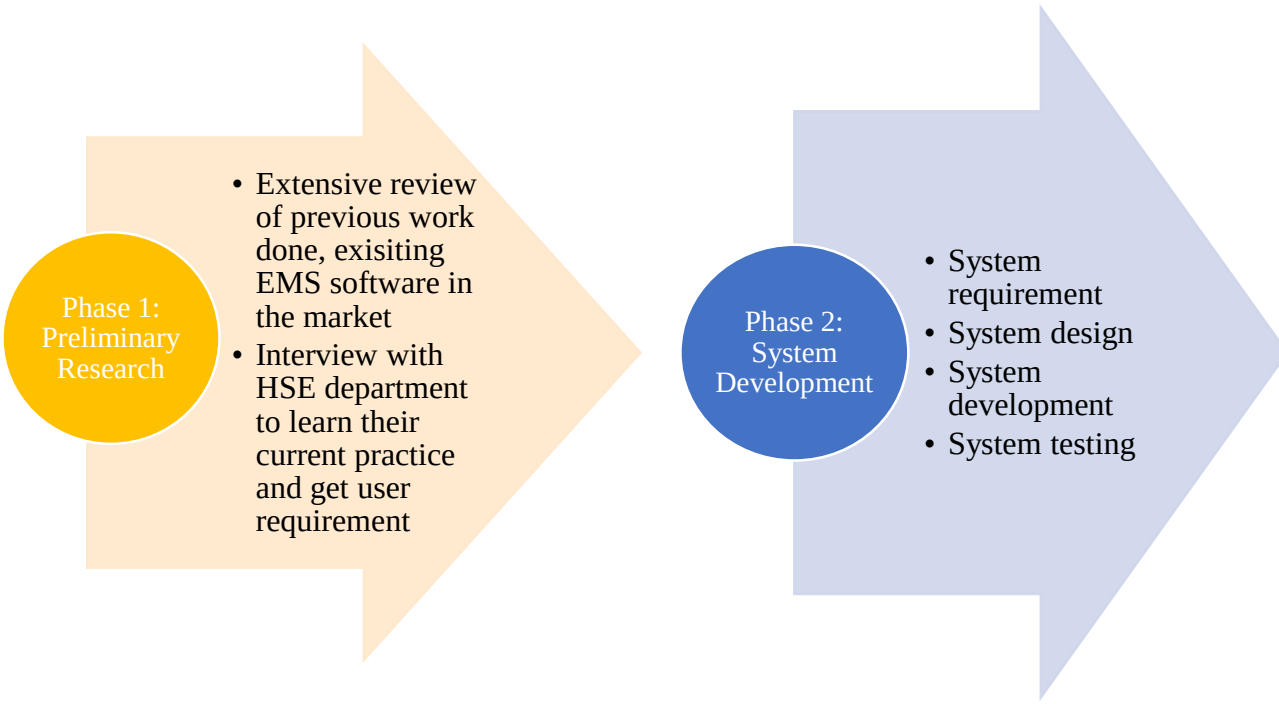


Figure 3.1: 2-Phases Methodology

Phase 1: Preliminary Research

For the first phase which is preliminary research, the activities done are towards building a solid project foundation. An extensive research of how organisations values the importance of having an Environmental Management System is done. Literature reviews on the effort of different organisations in and outside Malaysia to promote sustainability have been studied to be taken as guideline for this project. Besides that, a research on existing EMS software in the market are also done to know the important features that an EMS should adopt to increase organisation's operational efficiency. The criteria of the system are then outlined and compared in this research as a way to first plan the system functionality. Qualitative assessment has been chosen for this research as this research is more focused to a group of users which is the HSE department of the university. From the interview, some issues have been highlighted by Mr Suhaidi that he believes can be solved by using IT. In the second

interview, the first draft of design for the system was done. Pn Zamzuria demonstrated her current practice that she found to be very tedious. Overall, the first phase of this research represents the Planning and Requirement Analysis in the software development life cycle.

In the second phase, the system development cycles take place. In this phase, system design, coding and implementation and system testing will occur. From the requirement analysis obtained in the first phase, system design is produced. System Design aids in identifying hardware and system requirements and also assists in defining the whole system architecture. The system design specifications will be the input for the next phase of the software development. The table below describes the design feature for the system.

Criteria	How the system for UTP will embed the criteria
Document repository	An online central repository to store HSE documents.
Expiration date tracking	Automatic notifications in the form of popup.

Table 2: Design features for UTP's EMMS

The two criteria listed above have significant importance for this project. The absence of a system that embed the mentioned criteria has significantly affected the performance of the HSE department. It is very crucial for the time being for the department to have a document repository where those who requires HSE related documents can easily obtain these documents. A big university has a lot of compliance measures in order to have a safe environment and minimizing the risks of accidents. A university's name and reputation are at stake if it is found to be not abiding to the legal safety regulations. Therefore it is of utmost importance for the university to comply and ensure that all the employees under the university adopt the same culture. By having a document repository, employees can further understand what are needed in operating a chemical lab and also know the permits and certifications that the university has.

Phase 2: System Development

a) System requirement

From the requirement analysis obtained in phase 1, system requirement has been successfully designed to define the system architecture. The results of system requirement are as follows:

i. Use case representing the boundary/scope of the system

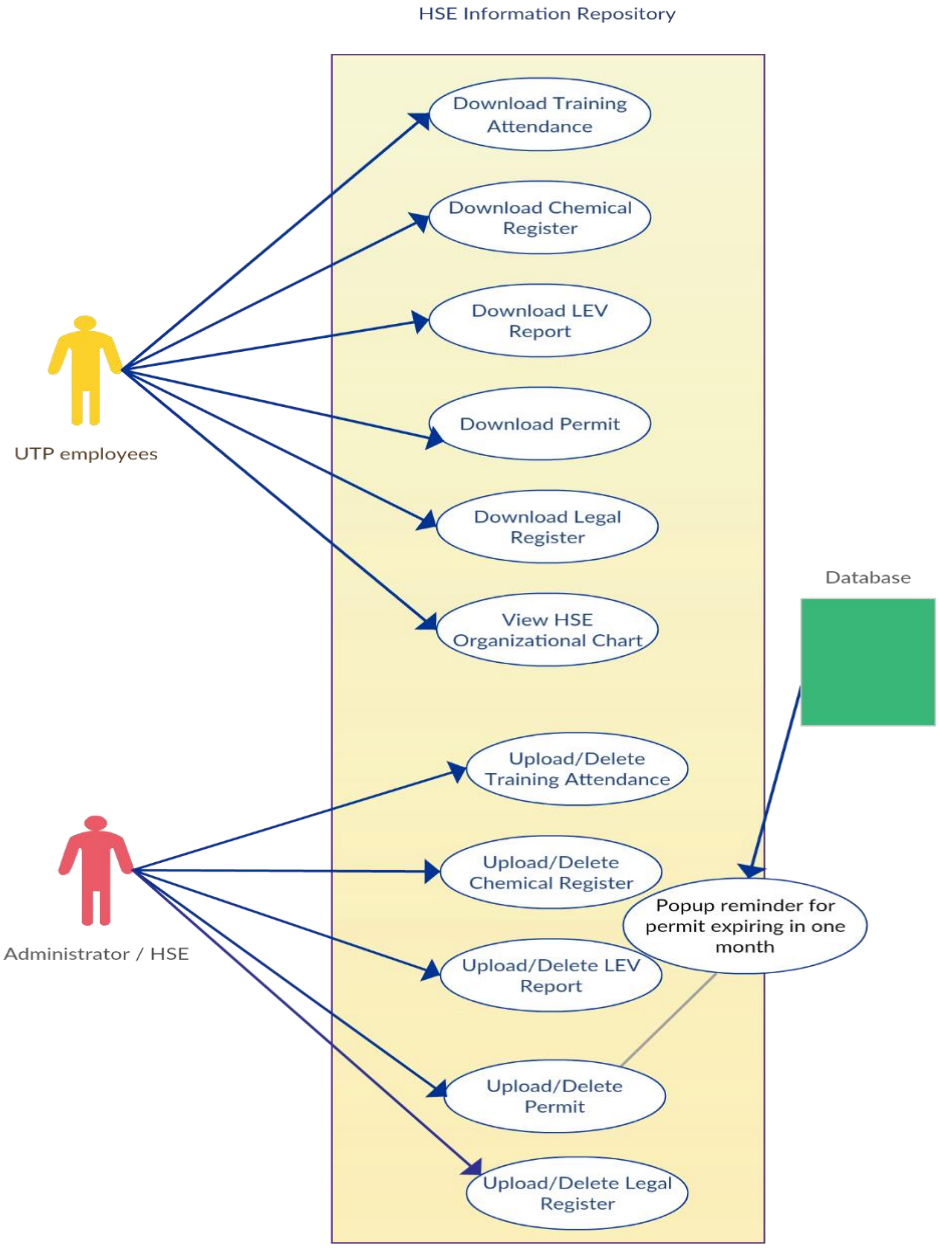


Figure 3.2 Use Case Diagram

ii. Security and level of accessibility

- System is designed to only be accessible for UTP staff.
- There are mainly two types of users who will be able to access the system which are administrators and guests.
- Multilevel security mode where the administrator of the system will be HSE staff and they have the authority to add / remove documents.
- For guests who are UTP staff, they can go to the portal to view documents, HSE training information and download reports or certifications.

b) System Design

i. Data Flow Diagram

A Data Flow Diagram (DFD) is a representation of the flow of data through an information system. A DFD is normally used as a preliminary step to create an overview of the system. A DFD shows what kind of information will be input to and output from the system, where the data will come from and go to, and where the data will be stored. Figure 4.3 shows the data flow diagram for this research.

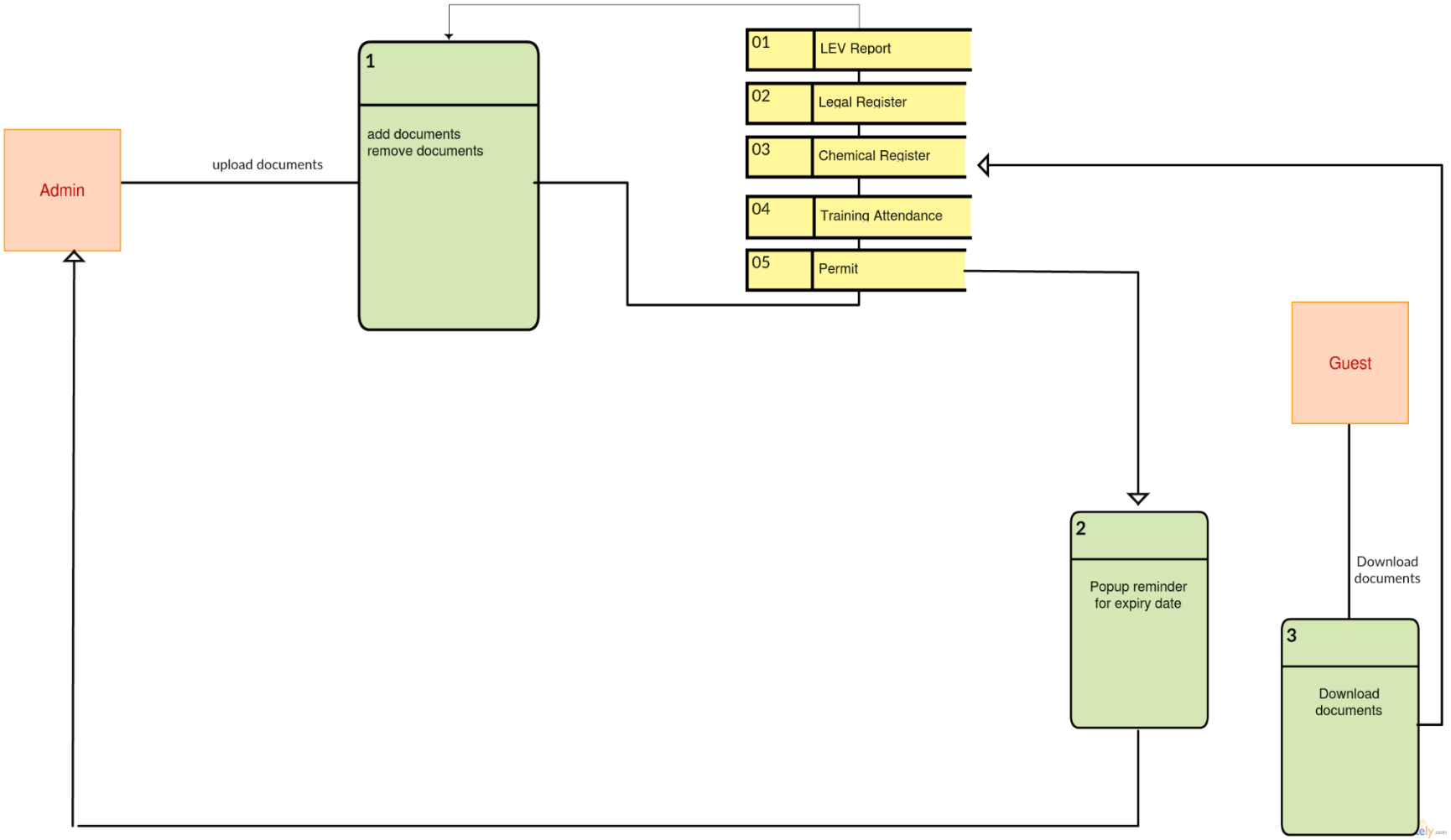


Figure 3.3 DFD Diagram

c) System Development

i. Functionality

Figure 3.4 shows the system's homepage where list of all available documents uploaded. The login section is for the administrator to login where he/she then will be able to upload or delete documents. The different tabs can be clicked to make it easier for employees to search for the specific documents. Documents have been filtered into respective categories such as Training, Legal, Chemical and Permit.

Figure 3.5 shows the popup notification that will be on screen once the administrator logged into the system. From the popup window, user can know in how many days the document will be expiring.

Figure 3.6 shows the document upload module. When the administrator wants to upload a document, he/she needs to fill all details of the document. The details will then be displayed in the table of available documents.

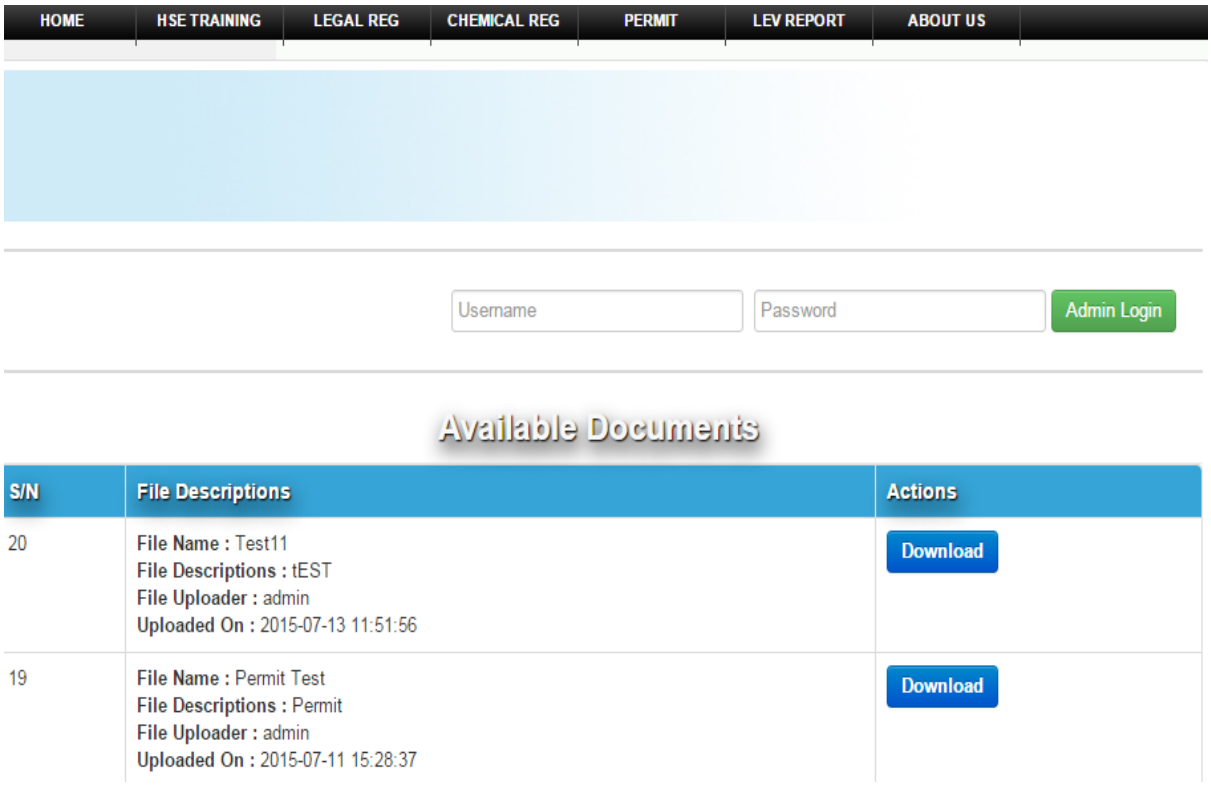


Figure 3.4: System's homepage

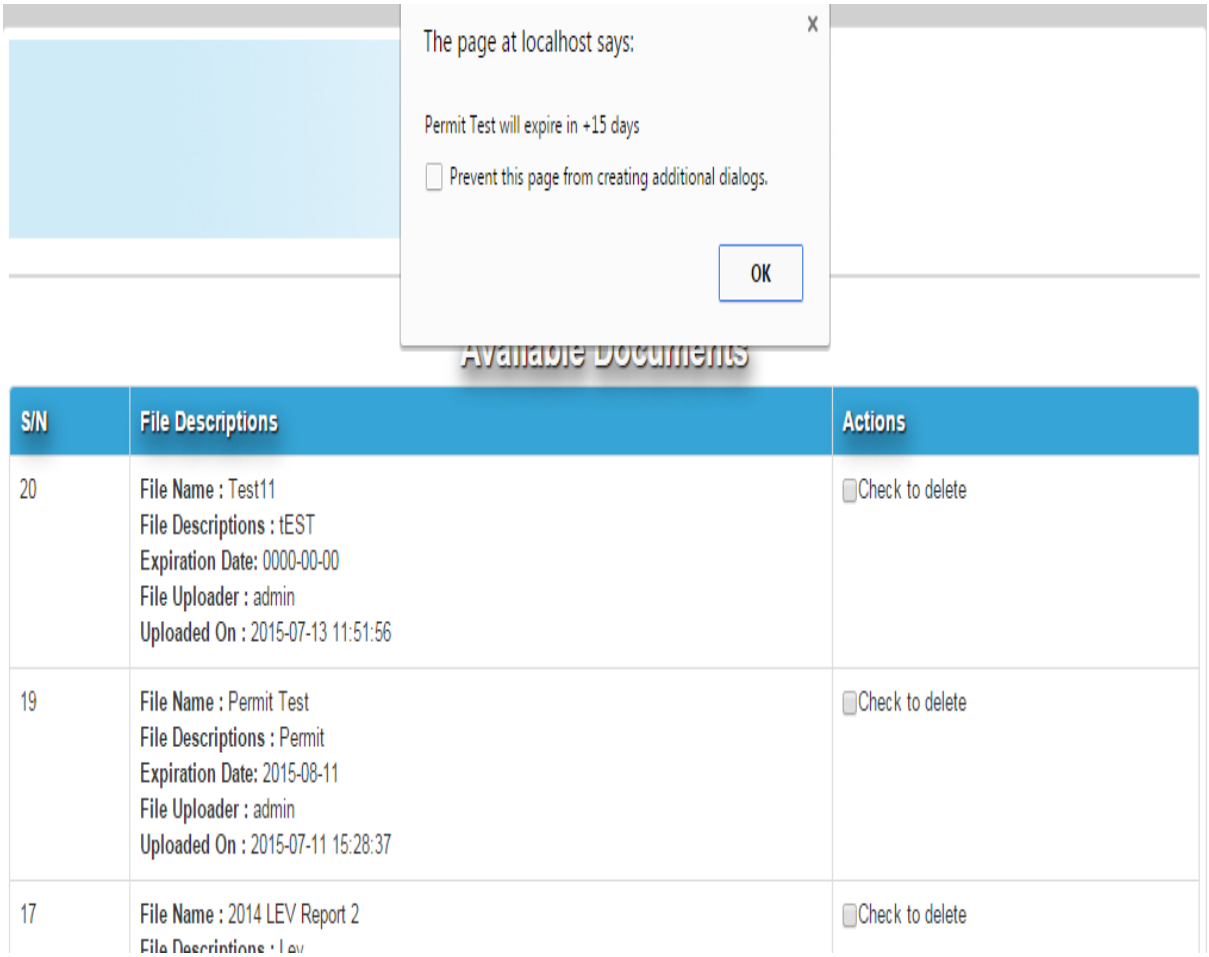


Figure 3.5: Popup notification

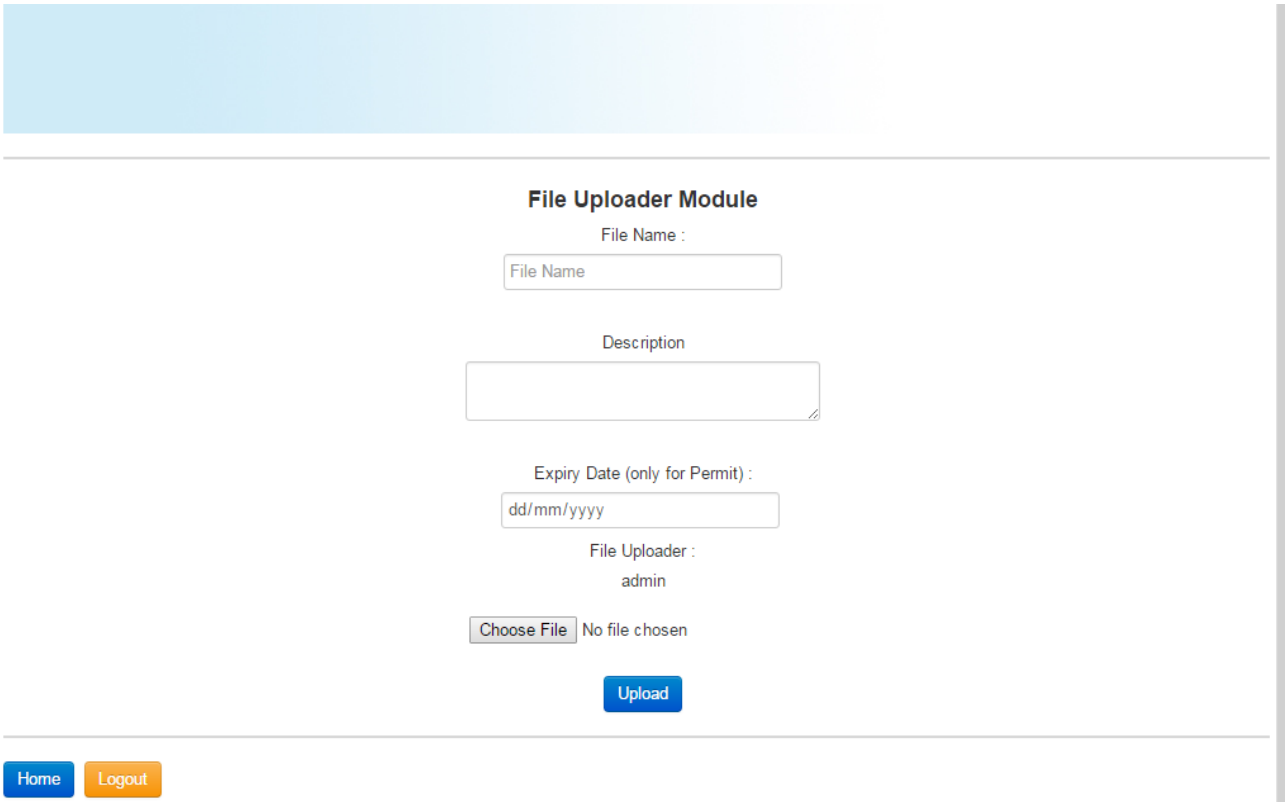


Figure 3.6: Document upload

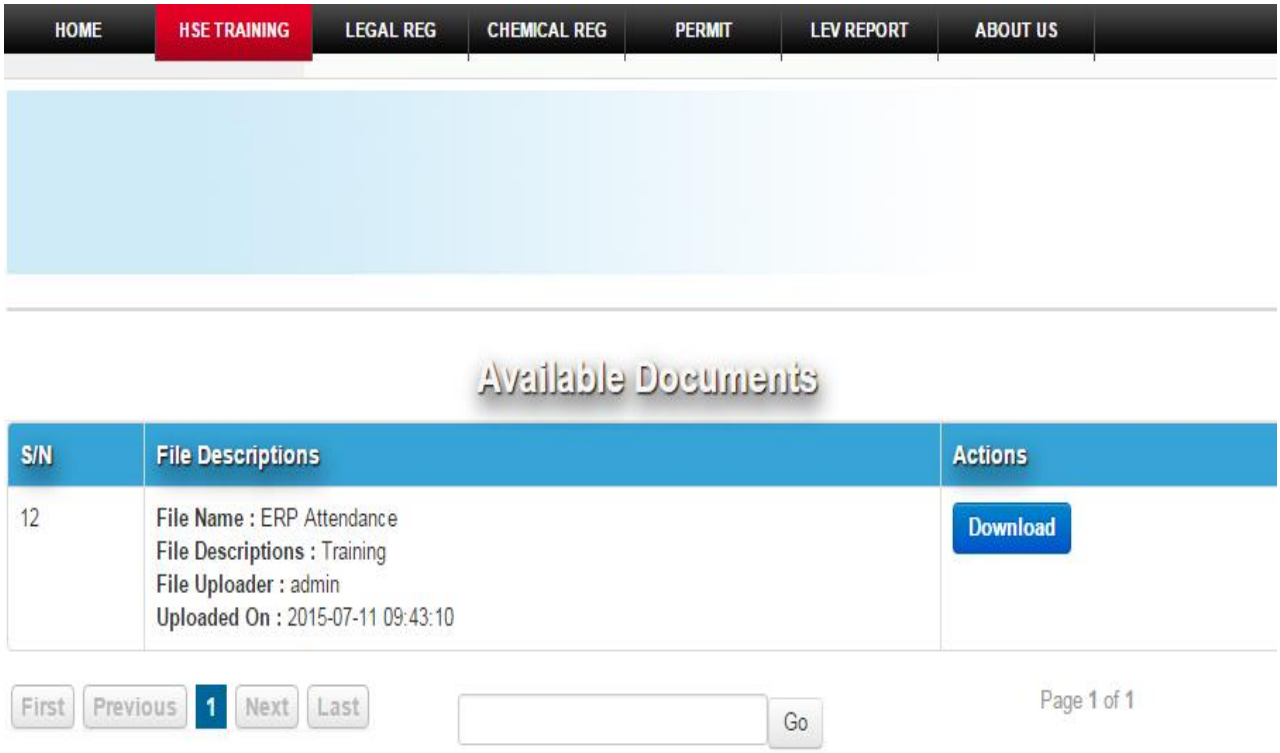


Figure 3.7 Filtered documents

Figure 3.8 shows the content of the ‘About Us’ tab. In this section, organizational chart of the HSE department is available where contact details such as name, email address and telephone numbers of HSE personnel are stated.

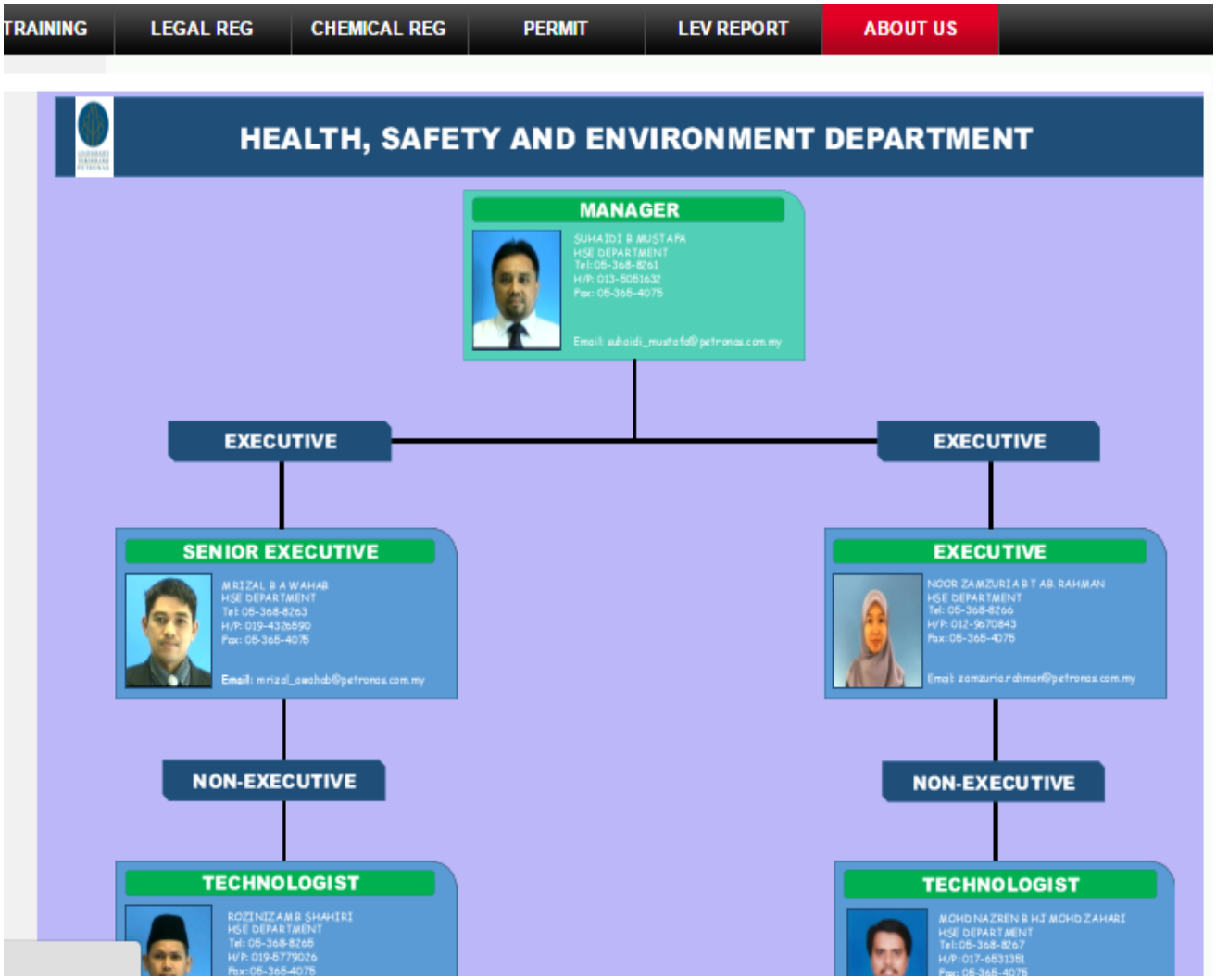


Figure 3.8: HSE Department’s Organizational Chart

ii. Part of the development algorithm

```
<?php
include ('connect.php');
@session_start();
@$upass=$_POST['upass'];
@$_SESSION['uname']=mysql_real_escape_string($_POST['uname']);
@$uname=$_SESSION['uname'];
@$upass=md5($upass);

@$selectqry="SELECT * FROM users WHERE uname='$uname'";
@$results=mysql_query($selectqry);

if (isset($_POST['uname']) && (isset($_POST['upass']))){
while($details=mysql_fetch_array($results)) {
        @$dbuname=      $details['uname'];
        @$dbupass=      $details['upass'];   }

if (@$dbuname==$uname && @$dbupass==$upass ) {

                @mysql_query($hdslog);
                Header( "Location: admin/" );
                exit();}

else if(@$dbuname!=$uname || @$dbupass!=$upass){
echo "<script>
alert('Wrong username or password. Please try again.');
window.open('index.php','_self');
 </script>";}}
?>
```

Figure 3.9: Login.php

```
$query_pag_data = "SELECT * FROM up_files WHERE fdesc LIKE '%chemical%' ORDER BY ID DESC
LIMIT $start, $per_page";

$result_pag_data = mysql_query($query_pag_data);

$msg = "";

while ($details = mysql_fetch_array($result_pag_data)) {

   $msg .= "<tbody>
```

Figure 3.10: Select statement to filter documents according to description

```
<?php
if($_POST['page'])
{
$page = $_POST['page'];
$cur_page = $page;
$page -= 1;
$per_page = 5;
$previous_btn = true;
$next_btn = true;
$first_btn = true;
$last_btn = true;
$start = $page * $per_page;
include ('../connect.php');

$query_pag_data = "SELECT * FROM up_files ORDER BY ID DESC LIMIT $start, $per_page";
$result_pag_data = mysql_query($query_pag_data);
$msg = "";
while ($details = mysql_fetch_array($result_pag_data)) {

$datetime2 = new DateTime($details['expirydate']);
$datetime1 = new DateTime(date("Y/m/d"));
$interval = $datetime1->diff($datetime2);
$timeDiff = $interval->format('%R%a days');
$name = $details['fname'];

if($timeDiff < 30)
{
        echo "<script type='text/javascript'>alert('$name' + ' will expire in ' +'$timeDiff');</script>";

}
```

Figure 3.11: Popup reminder

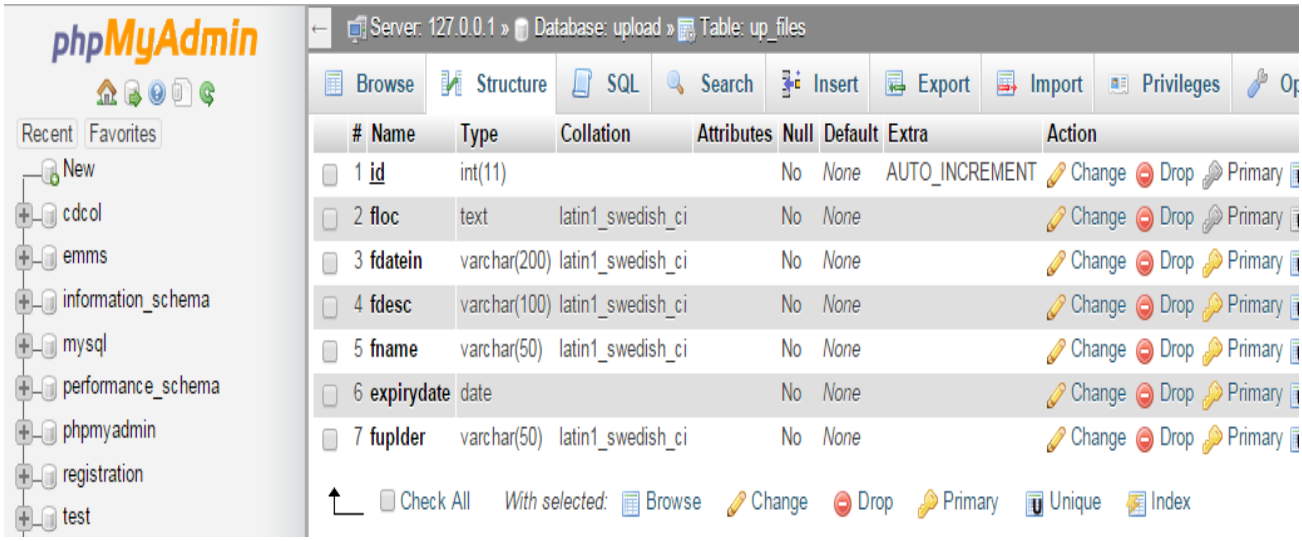


Figure 3.12: Database table in phpMyAdmin

d) System Testing

Face-to-face qualitative research was chosen for this project. This method involves individual, in-depth interviews, with a moderator sitting next to and observing the participant. The reason for this method is because the target users are small in numbers. An in-depth feedback can be obtained by requesting the participant to fill in the user experience survey after following closely the user guide. Firstly, the administrator need to login. After successfully logging into the system, the popup reminder for any expiring permit in 30 days will be shown and the administrator will be directed to a page where the documents available are shown. Delete checkbox will be shown in each column of the documents and to proceed deleting, the administrator need to check the checkbox. To upload new documents, administrator needs to click the 'Upload' button where he/she will then be directed to file uploader module.

For Guest, all the available documents will be displayed in the homepage. However, to ease their viewing, guests can select any tabs to see the filtered documents respectively. To download documents, they need to click the button 'Download'. Once clicking the button, the download will appear in their internet platform's download tab. Both users were then given user experience surveys after the testing.

3.3 GANTT Chart

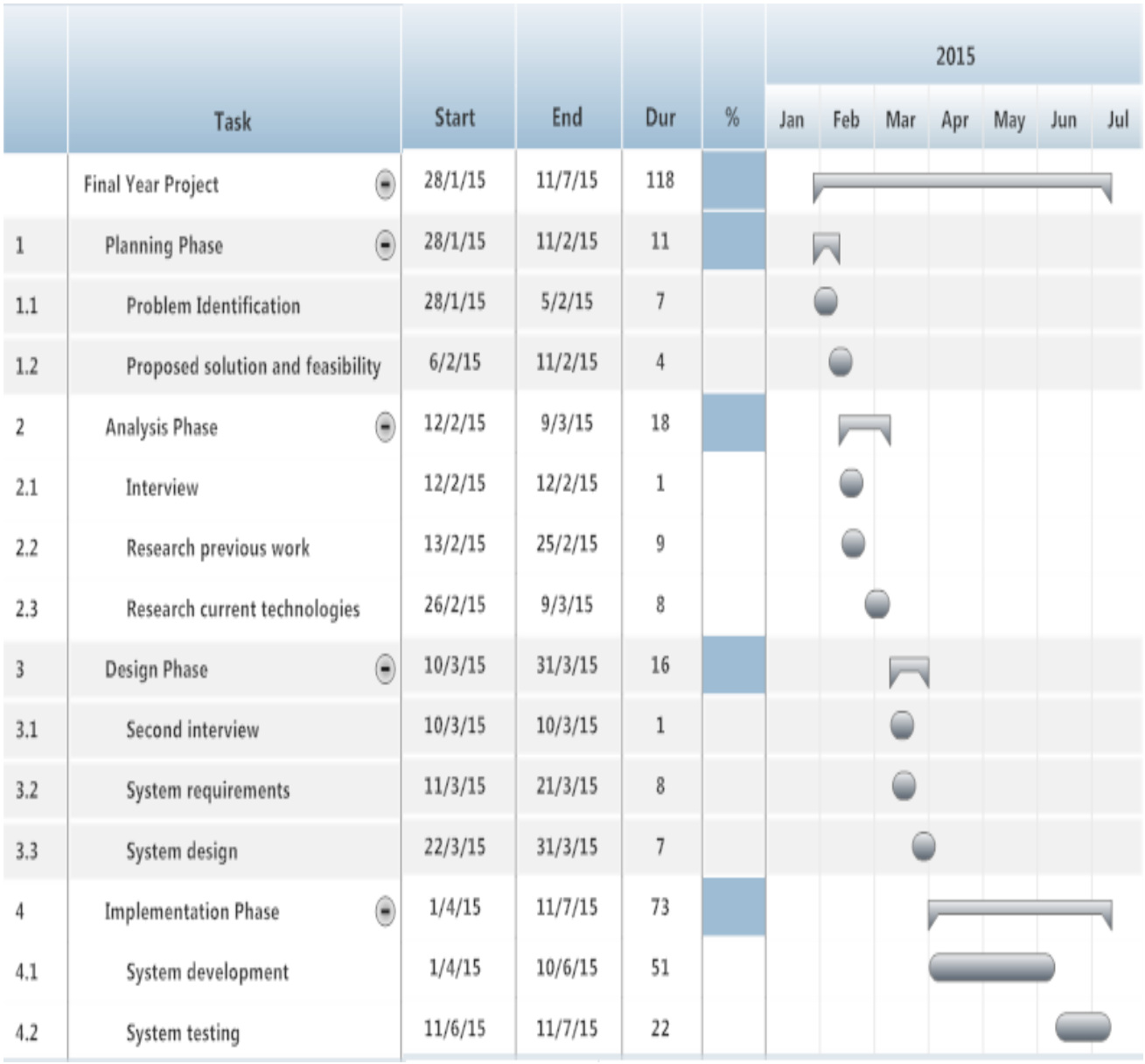


Figure 3.13: Gantt chart with timeline

3.4 Tools

The tools required for the system development are as follows:

a) Hardware
   i. Personal computer

b) Software
   i. HTML5
   ii. PHP5
   iii. MySQL
   iv. XAMPP

CHAPTER 4

RESULTS AND DISCUSSION

This chapter covers the interview and findings from the system testing.

4.1 Interview

Needs analysis / user requirement interviews with the HSE department were conducted. The interviews were done with Mr Suhaidi Mustafa who is the Manager of the Health, Safety & Environment in UTP and Ms Noor Zamzuria A. Rahman, an executive attached to the Health, Safety & Environment Department . The main objective for the first interview is to learn the current practice of HSE department or in other words serves as the pre-development requirement analysis. Questions on the implementation of EMS in UTP, the department's responsibilities in environmental management and ideas to create UTP's own EMS were discussed. The questions posed are as listed below:

i. What type of environmental documents that HSE are dealing with?
ii. How does HSE currently monitor/track, measure and report it?
iii. What are the weaknesses in current practice?

Table 3: Findings from Interview

Interview Question	Findings
What type of environmental documents that HSE are dealing with?	UTP's permits, chemical, hazard and legal register list, training attendance list and waste generation records.

How does HSE currently monitor/track the documents?	Documents are stored in a server accessible only to the HSE department. Tracking of expiration of permits or certification is manually done by checking each related documents.
What are the weaknesses in current practice?	Storage of documents in the server are not organized as some documents are not available. It took time for HSE to entertain each request by UTP staff to manually search for the documents required and emailing them back the reply.

4.2 System Testing

The user experience survey is designed and distributed to the HSE executives and ten UTP employees. For the HSE executive, the survey focused on whether the system meets the requirement. The survey comprises of open-ended questions where the user will be able to comment elaborately and give recommendations for improvement. For the UTP employees, the survey comprised of close-ended questions. It was more into getting the user experience satisfaction.

There are altogether 11 respondents for the surveys; 1 from the HSE department and 10 UTP employees. The analysis of the results of the surveys will be shown below.

Table 4: Findings from survey with HSE executive

Questions	Findings
1. What is your first impression on the website?	"The homepage is very simple. Fonts are big enough. Good choices of colours."

2. Does the system meets your requirements?	"Overall, the system meets the requirements. People can now download documents through this website. I can also know which permits are nearing expiration now without needing to check them one by one."
3. How easy was it for you to follow the user guide provided and complete your task?	"As the complexity of this system is not that high, every tasks can be done quickly. The user guide was very direct so I find it very easy and user-friendly."
4. Did you experienced any problem while using the system?	"So far, no."
5. Do you have any recommendation for the system?	"I think this website can grow more in the future. This can be the future HSE portal where our department can post announcements and HSE future training plans."

From the above findings, it is concluded that this system has meet the requirements from the user. The simple interface of the system makes it easier for the user to successfully use the system. There are no problem faced by the user during the testing and every function is well-functioning.

The findings of the close-ended surveys for UTP employees will be presented in the form of charts.

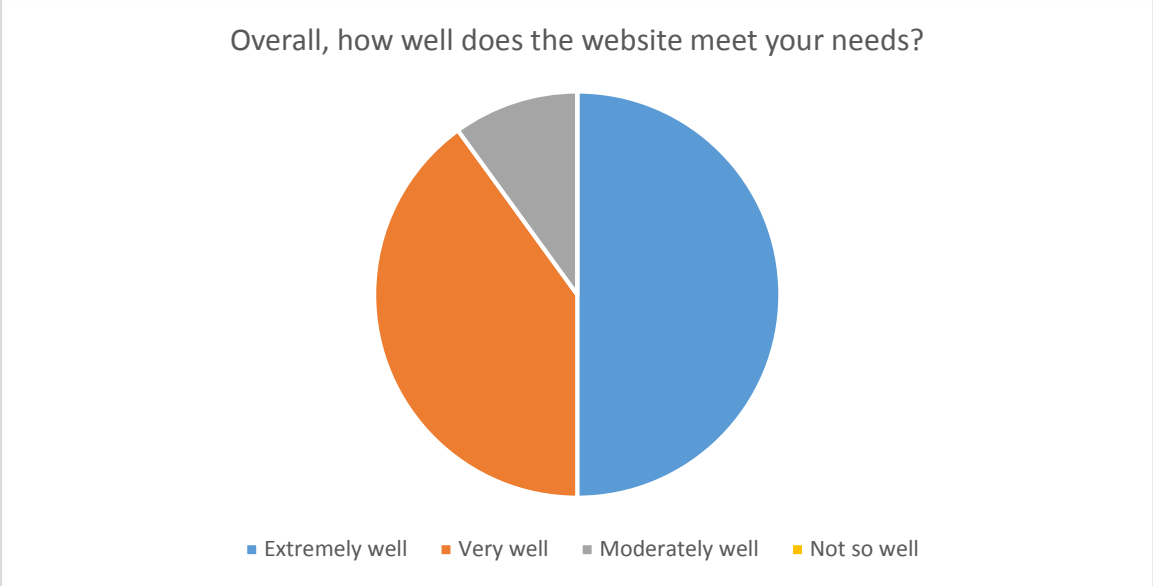


Figure 4.1: Question 1

Out of all the 10 respondents, 50% responded extremely well, 40% responded very well and only 10% responded moderately well. This shows that this system is well received by most users.

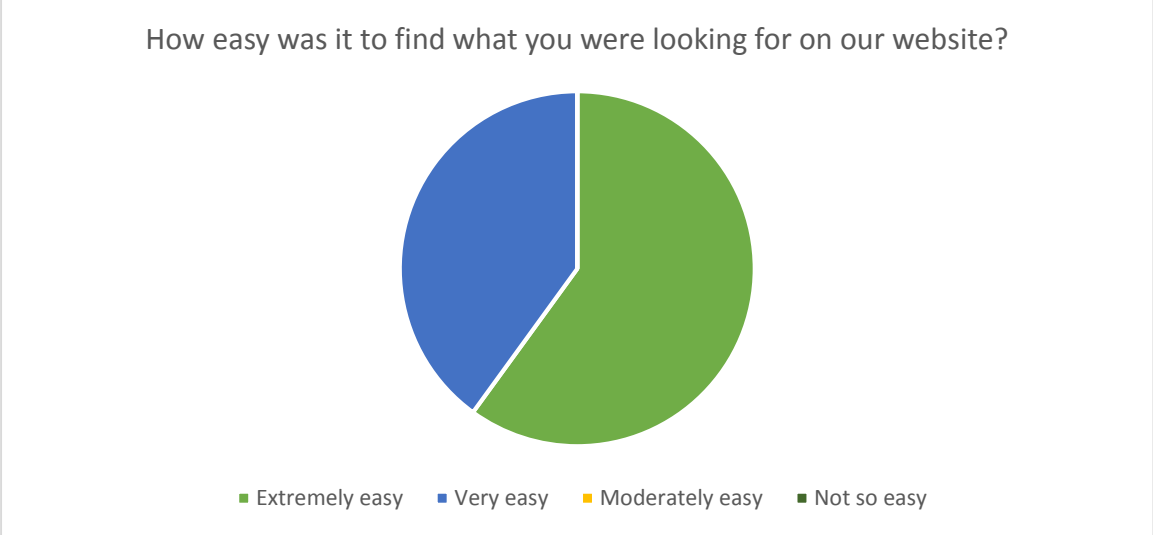


Figure 4.2: Question 2

60% of the respondents answered that it is extremely easy to find what they are looking for in the website and the rest answered very easy. Overall, this system usability is very high.

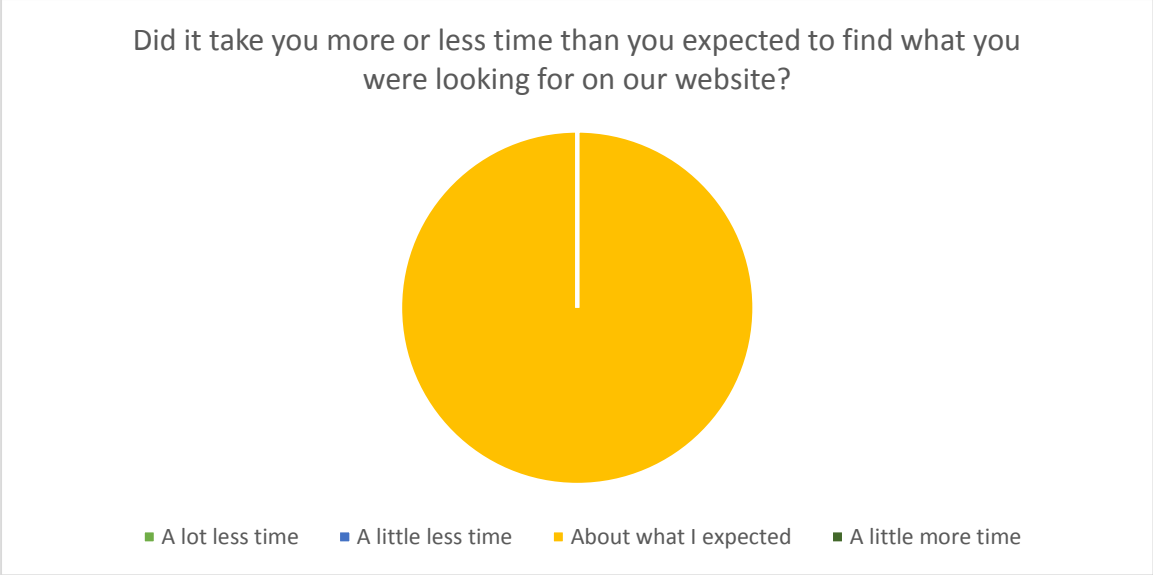


Figure 4.3: Question 3

All respondents said that the time taken to find what they were looking for on the website is about their expectations.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

From this research, it can be concluded that the solution to the problem encountered by the HSE department of Universiti Teknologi PETRONAS has been obtained. In order to increase an organisation's efficiency, a systematic approach need to be taken and implemented. This research can be the first step for the university to adopt as an effort to achieve ISO 14001 in terms of Environmental Management System. With the implementation of the university's own web-based HSE Document Repository, it is hoped that the current practice of the department can be improved in aspects of effort and time reduction.

Throughout the research, all objectives have been achieved successfully. The graphical user interface and functionality of the system has been developed which is shown in Chapter 3: Methodology. Interviews and feedback surveys were done and discussed in Chapter 4: Results and Discussions. Findings from the system testing suggest that the most users found it to be effective in replacing the problematic practice previously.

As this system provides interface for both HSE department and UTP employees, it is hoped that the information transfer between these two parties can be simplified. Having a portal makes it easier for the staff to know about the HSE regulations and certifications compliance that the university need to abide with. With this kind of knowledge, it can results in more awareness in handling laboratories and also related to working safety practices. Hence, by using this system, good practices among the staff can be nurtured and unwanted workplace catastrophes can be avoided.

5.2 Recommendation

For recommendations, it is suggested that this system to add more functions so that it can be the official portal for the HSE department. In the future, this system can be fully developed into a very dynamic website where announcements, training plan and schedules can be posted. Besides that, for future enhancement of the research, the system may want to add a function where guest can submit their documents to HSE department to be evaluated and approved. Currently, for the first launch of the system, only administrator of the system have the access to edit, remove, and update the documents. Guest can only view the portal and download documents that they require.

Besides that, this system can also be the platform for employees to report HSE related incidents where feedbacks or work status can be monitored by both parties. This will lead to a bigger improvement in the effort to acquire Environmental Management System accreditation.

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APPENDIX A

SURVEY QUESTIONS FOR UTP EMPLOYEES

HSE Information Repository
Usability Test Questionnaires

Researcher: Nur Hidayah Binti Mahiyuddin
Supervisors: Dr Emy Elyanee and Dr Subarna Sivapalan

The objective of this questionnaire is to determine the fulfilment of functional requirements of the system application prototype. It is aimed for user evaluation to better provide further enhancement on the system.

1. Overall, how well does the website meet your needs?

- Extremely well
- Very well
- Moderately well
- Not so well
- Not at all well

2. How easy was it to find what you were looking for on our website?

- Extremely easy
- Very easy
- Moderately easy
- Not so easy
- Not at all easy

3. Did it take you more or less time than you expected to find what you were looking for on our website?

- A lot less time
- A little less time
- About what I expected
- A little more time
- A lot more time

4. Do you have any other comments about how we can improve our website?

_____

_____